BRUCE L. GARDNER

American Agriculture in the Twentieth Century

HOW IT FLOURISHED AND WHAT IT COST

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To David B. Gardner

1944–2001

Contents

Preface

This book is the product of a long-term inquiry into the economic development of U.S. agriculture. The knowledge available on this subject has two main sources: quantitative data on agriculture that have been gradually developed over the last eighty years, and the perceptions and explanations of many observers and scholars. I am deeply in debt to the individuals who have worked on each of these fronts—creating quantitative indicators of economic conditions and sharpening up hypotheses to explain the evolution of those conditions. Although I criticize some statistics and ideas that have been put forward, their authors have provided both the factual information and the speculation constructed upon that information from which I have built my own edifice of explanation.

A difficulty in the presentation of this material is how to be intelligible to the widest possible readership while still not burdening the narrower professional audience, which I take to be agricultural economists and economic historians, with lengthy explanations of what they already know. I have sought to avoid technical terms and jargon, but some nonetheless remain. I hope not to have fallen hopelessly between the two stools of the professional audience and the wider group who might benefit from this book.

In the course of this investigation, much of the material in Chapters 8 to 10 was presented in lectures and at seminars, including ones in 1998–2000 at the University of California, Davis; UC Berkeley; Iowa State University; Ohio State University; Washington State University; Michigan State University; Louisiana State University; the Higher School of Economics (Moscow); and at the annual meetings of the American Agricultural Economics Association and the Australian Society of Agricultural Economists. I want to acknowledge helpful comments received at those occasions and also from colleagues at the University of Maryland, which has provided a near-ideal environment in which to carry out this work. Special thanks are due to graduate students Fabrizio Bresciani, Carla della Maggiora, Sumeet Gulati, and Brian Roe, who helped mobilize the sizable time series of national-, state-, and county-level data used; and to Liesl Koch, who brought irreplaceable skills of organization and exceptional care to the preparation of the manuscript; and to my wife Mary, for her eminently sensible comments and for being mostly patient with the demands this project imposed. I learned much about farming at ground level over many years from my brother, David Gardner, a lifelong dairy farmer of Solon Mills, Illinois. He died at work on his farm September 6, 2001. This book is dedicated to him.

American Agriculture in the Twentieth Century

1

Introduction

In American agriculture at the beginning of the twentieth century, optimism prevailed. A long period of low prices and low farm incomes had ended in 1897, and the subsequent income improvements had been sustained. In its economic review of 1899 the *New York Times* reported: "The farmer, the miller, the stockman, and all classes engaged in like industries are reaping the benefits that flow from bounteous harvests and good prices" (January 1, 1900, p. 2). The secretary of the National Live Stock (it was two words then) Association expressed an ebullient confidence seldom heard from farmers before or since: "The live stock industry of the United States was never in a more prosperous condition than it is at the present time. The live stock men of the country can ask for no greater blessing than a continuation of these conditions. That they will do so for a number of years there seems to be little or no doubt" (ibid., p. 13).

And the optimists were right. Eight years later, in the 1908 *Annual Report* of the U.S. Department of Agriculture (USDA), Agriculture Secretary James Wilson said in his twelve-year review, "This period has developed an amazing and unexampled prosperity for the farmer . . . With better houses filled with modern conveniences, the family life has developed in strength and in enjoyable living . . . the farmer's labor is rapidly becoming less in physical stress, and the burdens are becoming lighter . . . The farmers of the mortgage-ridden state of Kansas of former days have stuffed the banks of that State full of money" (USDA 1908, pp. 151–152).

Broad credence in this rosy view is evident in marketplace indicators: rising farmland prices and increasing farm numbers. Economic conditions improved still further after 1910, with the period 1910–1914 being labeled the "golden age of agriculture" and cited for the following half century as an economic ideal to be sought after through government policies.

Yet after World War I farm prosperity evaporated with remarkable speed and stunning persistence, culminating in 1929–1931. The farm economy has had profitable periods since, but has never regained the sustained optimistic tone of the first fifth of the century. Nor has farming ever fully regained the significance it had at that time in the national economy. Since 1920 the United States has lost two-thirds of its farms and, in the course of that decline, helped to populate many urban neighborhoods with its refugees. Nonetheless, the farms that remained in 2000 had attained a level of income and wealth far beyond any seen in the "golden age," both absolutely and relative to the nonfarm population.

One purpose of this book is to assess the good news and the bad news in the story of the U.S. agricultural economy. The two sides of the story are connected, in that the decline of farm numbers reflects an astounding increase in farmers' productivity. With one-third the labor force committed to agricultural production as was the case in 1900, America now produces seven times the farm output. Crop yields per acre have increased phenomenally, as have milk yield per cow and other indicators of animal productivity. The real prices that consumers have to pay for farm products have fallen by half. As late as 1950, food consumed at home accounted for 22 percent of the average U.S. household's disposable income. By 1998 that percentage had been reduced to 7.[1] During this same period, the average farm family's income had risen from below to above that of nonfarm families.

One may nonetheless reasonably question the conclusion of twentieth-century American agricultural success. We cannot forget the economic losers, the millions who have had to live in grinding rural poverty and those who left farming because of economic pressure, often extending to bankruptcy. The biggest decline was among African American farmers in the South, where almost a million such farms prior to the Depression have been reduced to about 20,000 today. Many of the more isolated rural communities have seen their population base severely depleted and have become economic backwaters, with small towns virtually abandoned. Moreover, U.S. agriculture as a whole has had to weather general economic instability and sustained periods of economic crisis in the 1920s, 1930s, 1950s, and 1980s. Those who remain in commercial agriculture are under market-driven pressures that make some of the traditional attractions of farming as a vocation economically unfeasible. This after the expenditure of hundreds of billions of federal taxpayer dollars in support of agriculture. To top it off we have consumers who believe today's manufactured food products are pale imitations of genuine articles of the past, while today's commercial

1. The data cited and used throughout this book are primarily those of the U.S. Departments of Agriculture and Commerce. The data on 1950 expenditure shares are from *Historical Statistics of the United States,* published by the Bureau of the Census (1975); for 1998 they are from Clauson (1999).

farms are thought by many to present greater threats to the environment than the smaller farms of earlier decades.

Despite these and other problems, the development of U.S. agriculture in the twentieth century is on balance a great success story. A detailed consideration of the evidence for and against this conclusion is one purpose of this book. But more basic is the question of how and why American agriculture evolved as it did after 1900. An attempt to answer that question is my second and more complicated purpose.

Some readers may question the twentieth-century focus of the book. Perhaps the features of U.S. agriculture that make it a marvel of technological progress and productivity were already in place in 1900. Isn't the real question how we got to that stage? Unfortunately, pushing back our analytical starting point to 1840, say, when we first have somewhat reliable detailed data to work with on a national scale, would not solve the problem. U.S. agriculture may well owe much to its favorable position going back to colonial days and the early Republic; but no one book could hope to cover all of the relevant history in sufficient detail even if the data were less sketchy than they are. More directly pertinent, there was an acceleration of U.S. agricultural development during the twentieth century that appears unlikely to owe much to nineteenth-century foundations. Analysis of that acceleration is an important aim of Chapter 2.

Moreover, the twentieth century is different from what went on before in that 1900 roughly marks the end of the period of geographical expansion of U.S. agriculture. Frederick Jackson Turner placed the "closing of the American frontier" at 1890, but for agriculture this is too early. U.S. agriculture was growing rapidly at its extensive margins all through the 1890s. U.S. land in farms increased by more than 200 million acres (25 percent) in this decade, the largest increase in any decade of our history. The growth of land in farms was slower after 1900, with the exception of the West (Figure 1.1). The shift away from land-based growth of agriculture as new territory opened up is apparent in the slower growth rates of U.S. farm output after 1900, as shown in Figure 1.2.

Figures 1.1 and 1.2 introduce technical data problems that recur throughout the book. First, in order to compare growth rates over long periods of time, logarithmic scaling of the data is preferable to plotting the data themselves. Second, consistently defined statistical measures are typically available for stretches of several decades at best, not the whole century. Long-term comparisons have to be patched together by linking data from several sources. Third, "farm output" is not a straightforward concept; it combines disparate products (indeed it is a paradigm case of adding apples and oranges), some of which have changed in nature over time. We will revisit and assess these problem areas in the next chapter.

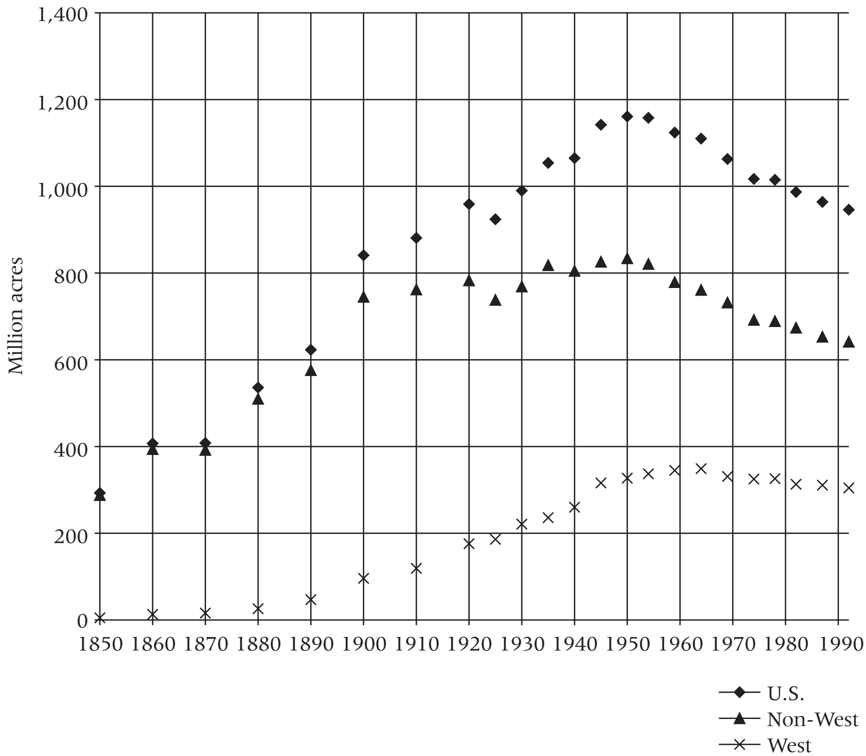

Figure 1.1 U.S. land in farms. Data from U.S. Department of Commerce, *Census of Agriculture.*

A striking turning point in U.S. agriculture is illustrated in Figure 1.3, which shows U.S. real agricultural gross domestic product (GDP) per person in farming (farmers and hired farmworkers) for the hundred-year period 1880 to 1980.[2] Agricultural GDP per person is analogous to the per capita measures that are the standard indicator of economic growth. For the sixty years between 1880 and 1940, excluding the Depression of the 1930s, the trend rate of growth is 1.0 percent per year. This is a respectable growth rate

2. The expression "real" denotes an attempt to make comparisons of dollar values between two points in time meaningfully comparable by adjusting for changes in the purchasing power of the dollar. The adjustment consists of deflating by a general price index. Criticisms have been made of all such indexes, and price-level measurement before the twentieth century is especially problematic. Throughout this book I obtain "real" dollars by using the GDP deflator. Historical data for this index go back to 1900, as reported in U.S. Department of Commerce (1975) Series F-5. For the twentieth century as a whole, this deflator implies that a dollar in 1900 was the equivalent of $20.22 in 2000, implying an annual rate of decline in the value of the dollar of 3.0 percent over the century.

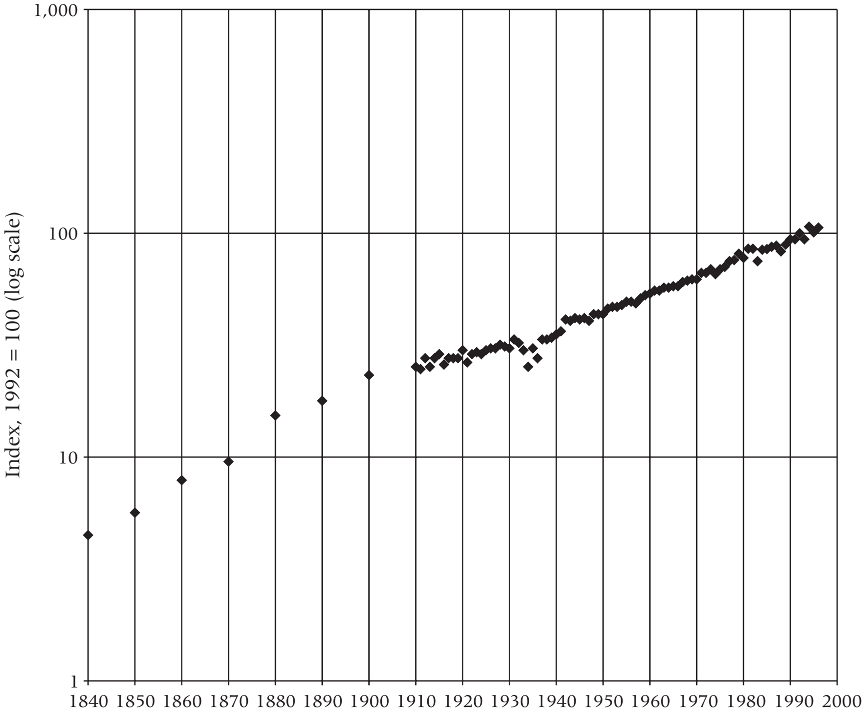

Figure 1.2 U.S. farm output, 1840–1996. Data from U.S. Department of Commerce (1975); extended to 1996 using U.S. Department of Agriculture, *Agricultural Statistics.*

and generates a doubling of real incomes in seventy years. (The sketchy data available indicate essentially the same rate of growth from 1840 to 1880; see Towne and Rasmussen 1960.) After 1940, excluding the years of World War II, the trend rate of growth is 2.8 percent annually.

What accounts for this tripling in what had been a fairly stable if unexciting long-term trend? Before attempting to address this question, which is at the analytical core of this book, we need to be clear about the facts of twentieth-century agricultural history in as precise a way as possible. Has the advance of productivity been a steady climb or are there specific episodes of growth, and if so can they be attributed to specific causes? How good are our measurements of output and input growth, and of the sources of this growth? How large were the costs of achieving it? What has been the economic fate of those who left agriculture and those who remained behind? How can we properly measure the economic and social status of households in today's rural communities as compared with those of former days?

In addition, there are questions about who reaped the rewards from

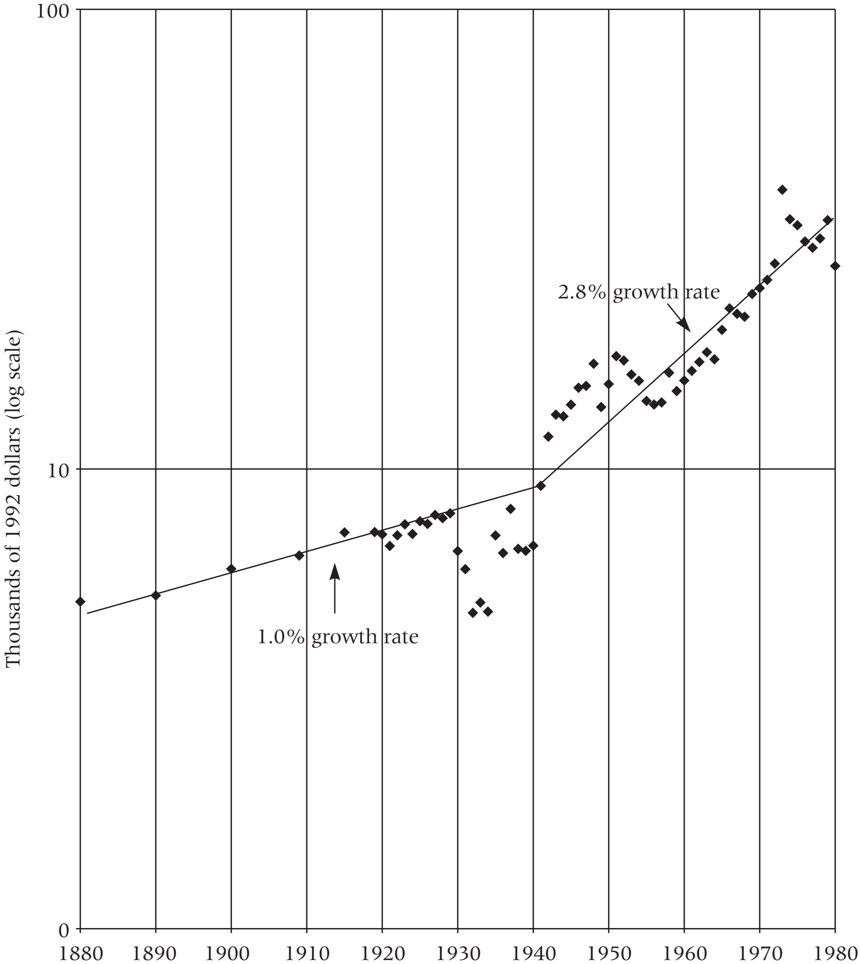

Figure 1.3 One hundred years of U.S. real farm GDP per person in agriculture. Data from U.S. Department of Agriculture, *Agricultural Outlook,* various issues, and U.S. Department of Commerce, *Survey of Current Business,* various issues, for data since 1929; Towne and Rasmussen (1960) for data before 1929.

productivity growth in U.S. agriculture: farmers or agribusinesses who sell inputs to farmers and buy their products? Large- or small-scale farmers? Landowners or farmworkers? To what extent have food consumers shared in the gains? Have we sacrificed too much in soil erosion, wildlife habitat, bucolic landscape, water-quality degradation from chemicals?

Many of these questions point in the direction of political action. Proposals for public policy remedies have pervaded discussion of problems of U.S. agriculture. Here too, it is important to look first at facts and history. What have been the consequences of our agricultural and rural policies, especially the over sixty-five years of intense experimentation with farm programs initiated with the New Deal of the 1930s? In considering how U.S. policies might have been better directed, and how they might best be formulated for the future, it is important to understand how the market/policy nexus has developed. Who have been the gainers and losers from these policies?

Although answering these questions is important for understanding our country's history and prospects, it is perhaps even more important to have an accurate assessment of lessons learned because many nations of the world now face situations in which agricultural productivity growth and farm-sector economic adjustment remain to be achieved. The U.S. experience may provide lessons useful in the policy debate in these countries.

My approach in this book is to begin with a detailed analysis of the facts and data available on changes in agricultural technology (Chapter 2), the economic situation of farm enterprises and of the farm population (Chapter 3), out-migration from agriculture, rural poverty, and rural communities (Chapter 4), the functioning of agricultural commodity and input markets (Chapter 5), and governmental action influencing agriculture (Chapters 6 and 7). I then turn to explanations in Chapter 8. This discussion leads to further examination of data that reinforce the belief, already evident in the earlier chapters, that U.S. aggregate data are insufficient to resolve many of the key questions. In order to place a greater range of historical data in our purview, Chapter 9 takes up a systematic exploratory econometric investigation of state-to-state differences in the economic development of agriculture. The hypotheses that appear most likely to be illuminating after this work are then tested on still less aggregated data, for a sample of 315 U.S. counties, in Chapter 10. In Chapter 11, I pull together what has been learned and examine the implications.

2

Technology

American agriculture has been transformed in the past hundred years by changes in the technology of farming. Farms as economic enterprises have also changed, along with the roles of farm owners and workers. Farms are generally larger and more specialized, and for some commodities the traditional farm is on the verge of disappearing. These changes are closely related to changes in technology.

Technology can be defined in an abstract sense as the set of possible outputs that can be obtained from given inputs of land, labor, and capital. Technology in a concrete sense is what the inputs do or have done to them in order to generate output. Agricultural outputs are harvested crops, livestock products, and fattened animals. The quantities of inputs committed to production constrain the amount of output that can be produced. Changes in technology have made it possible to obtain more output from given inputs. Some such changes involve details of an existing production process—for example, adding protein-rich supplements to the diet of cows in order to improve milk yield. Other changes are improvements in inputs to make them more durable or effective, such as replacing iron wheels by rubber tires on farm machinery, or replacing open-pollinated seeds with hybrid varieties. More immediately striking is the invention of altogether new inputs, such as the milking machine, the mechanical cotton picker, or antibiotics for curing animal diseases. Twentieth-century agriculture even saw the introduction of new farm outputs, such as canola (a form of rapeseed containing improved vegetable oil) and major qualitative changes in traditional products (including the broiler chicken, lean hogs, high-lysine corn).

In 1940, USDA published a list of innovations it considered the most important of the century to date (see Table 2.1). Of these, two were singled out as most significant: the farm tractor and hybrid corn. Developments surrounding both of them are worth reviewing in some detail. We begin with

Table 2.1 Notable technical innovations, 1900–1940

Machinery	
All-purpose tractor	Fertilizer spreader
Pneumatic tires	Power sprayer
Diesel tractor	Automatic drainage pump
Corn picker	Spray irrigation equipment
Power mower	Electric fence
Silage and hay chopper	Electric poultry equipment
Pickup baler	Hay dryer
Beet lifter and topper	Crusher-mower
Cane harvester	Duck-foot cultivator
Multirow planter	Seed placement plates
Animal innovations	
Artificial insemination	Improved control of diseases:
Controlled feeding	Tuberculosis
Sanitation improvements in dairy	Bang's Disease
Cross-breeding cattle, hogs, and poultry	Cattle Tick Fever
Improved balanced rations	Poultry diseases
Improved control of insects and internal parasites	
Progeny testing	
Improved feed quality control	
Plant innovations	
Hybrid corn	Disease-resistance:
Rust-resistant wheat and oats	sugar cane
Longer-staple cotton	barley
Early maturing sorghums	Wilt-resistant alfalfa
Cold-tolerant sugar cane	Scale-resistant potatoes
Improved lespedeza strains	Improved insect control:
New sweet potato varieties	quarantine methods
Plant hormones	poisons and traps
	tillage and rotations
Land-use improvements	
Terracing and contour plowing	Range improvement
Strip cropping	Higher-analysis fertilizers
New crop rotations	Minor plant food elements
Green manure and cover crops	Legumes for nitrogen fixation
Phosphate fertilization of pastures	Increased lime applications

Source: U.S. Department of Agriculture (1940), pp. 6–7.

the tractor, as an introduction to the larger topic of the mechanization of U.S. agriculture.

Mechanization

The U.S. Census of Agriculture in 1900 counted 20 million horses and mules on the nation's farms—an average of almost 4 per farm. These animals were the main source of farm power for the energy-intensive tasks of tillage, crop production, and transportation. Oxen were still used in U.S. agriculture in 1900 but were marginal power sources. The Agriculture Census last counted oxen in 1890, finding about 500,000. (For an assessment of the advantages of horses over oxen, see Carver 1911, pp. 258–260.) On the broader issue of animal versus mechanical power, Thomas Nixon Carver noted that many farm operations "demand animal rather than mechanical power, and so far as we are yet able to see into the future, will continue to demand it" (pp. 256–257). This vision held for about fifteen years. In 1900 the market value of draft animals was equal to almost a tenth of the value of the farms on which they lived ($1.5 billion for horses, and $20 billion for land and buildings). Steam-powered engines and early attempts at gasoline-fueled tractors existed in 1900, but together provided only about 15 percent of the power of draft animals (Wik 1953, p. 89).

Figure 2.1 shows the trends in horses and mules from 1900 to 1952, when USDA ceased separate annual estimates of their numbers. The num-

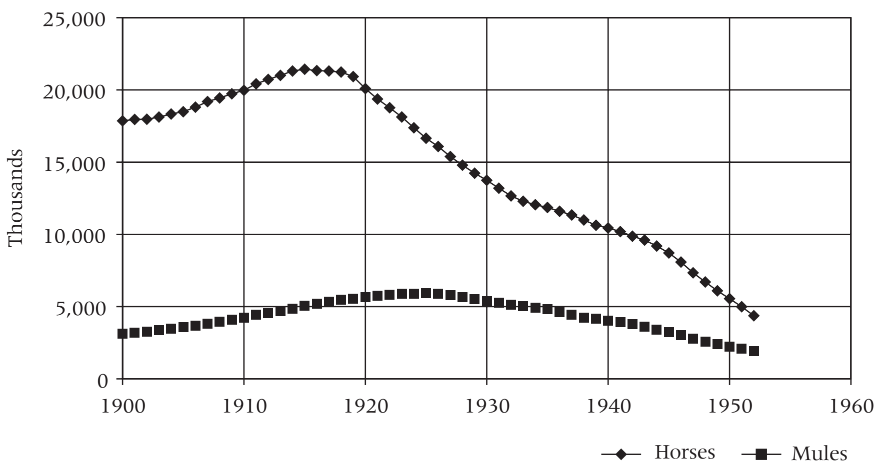

Figure 2.1 Horses and mules on farms. Data from U.S. Department of Commerce, *Census of Agriculture,* various years.

ber of horses grew to a peak of over 21 million in 1915, as land in farms continued to increase gradually and horse-drawn implements used in crop production continued to be improved. The population of mules did not reach its maximum until 1925, and declined only gradually after that date. The use of mules was concentrated in the mid-latitude border states, from Virginia to Arkansas, where the adoption of mechanical tractor power was slower. But despite a reputation for hard-working reliability going back to George Washington—himself a noted mule breeder—mules as well as horses eventually proved unable to compete with the gasoline tractor as its versatility, reliability, and affordability were impressively improved between 1900 and 1930.

It is salutary to recall, however, that not all mechanical innovations swept the alternatives out of the way as the tractor did. A colorful if transitory source of power for U.S. agriculture at the turn of the century was the steam engine. Best adapted as a stationary source of power for threshing machines and similar tasks, these magnificent machines still draw crowds of admirers to demonstrations of them in action (which continue draining the pockets of their aficionados). However, for the purposes of mobile traction power, the main and increasing use of mechanization after 1900, the steam tractor was no match for the rapidly improving gasoline or kerosene models. Steam tractors ran on cheap fuel—water and wood—but took a relatively long time to get a head of steam, and were so heavy that they used too much of the energy they produced just to move themselves. They also tended to sink in wet soils, causing damaging soil compaction as well as inconvenience, and with a high center of gravity they could not be confidently used on side hills.

The future of traction power lay with the internal combustion engine. The first operational gasoline tractor was put together in 1892, and the first commercial tractor business was that of Hart and Parr of Iowa City, Iowa, who built their first model in 1901. The *Farm Implement News* estimated the cost of running a gasoline tractor at less than half that of a comparably powered steam engine; it listed among the gasoline engine's superior features that "there is no danger of fire or explosion, no leaky flues, no boiler repairs, no water team," and that as compared with a steam engine it "runs with less than half the care and attention, entirely free from danger to life" (*Farm Implement News,* December 8, 1892). Large gasoline- and kerosene-powered tractors made some inroads in the market before World War I, but the main commercial breakthrough was the development of small, reliable, multipurpose tractors during World War I and in the 1920s. Important steps in innovation were the introduction of the tricycle arrangement of the wheels in 1924, which made cultivation of growing row crops more feasible, and rubber tires in 1932. The number of tractors manufactured in the United States increased from 20,000 in 1915 to 200,000 in 1920 (Williams 1987, p. 68). USDA estimated that total farm power provided by internal combustion tractors surpassed the output of steam engines by 1915 and all sources of animal power by 1930 (Wik 1953, p. 84). By 1950, 86 percent of commercial farms reported having tractors.[1] In the 1950s and 1960s, diesel engines and four-wheel drive led to substantially increased economy of operation and pulling power.

A statistical difficulty is measuring an appropriately quality-adjusted stock of tractors and corresponding flow of tractor services. The number of tractors on farms reported in the 1959 Census of Agriculture was 4.7 million. In the 1997 census this number had been reduced to 3.9 million. Yet it is virtually certain that the aggregate pulling power of the U.S. tractor herd was larger in 1997, and tractors were more reliable and more user friendly in 1997. Unfortunately it is impossible to quantify these gains with precision. The 1997 census asked about not only the number of "wheel tractors" on the farm but also whether they fell into the category of less than 40, 40 to 99, or 100+ horsepower. But in 1950 the question covered only the number of tractors.

Data on specifications of tractors can be used to get an idea of the qualities of new tractors sold each year, but information on which tractors survive, and for how long, is conjectural. Also, if one is going to combine disaggregated tractor information into an overall index of tractor services, one must quantify how much better it is to have, for example, an 80-horsepower rather than a 40-horsepower engine. It is doubtful that a simple horsepower measure is good—that is, that two 40-horse tractors equal one 80-horse tractor. Moreover, how does one score improved transmissions, easier-starting diesel engines, better hitching mechanisms, and so on? USDA has worked on these and other measurement problems and currently estimates 1997 tractor services to be 23 percent less than the 1959 level, compared with a 17 percent reduction according to the census tractor numbers for the two years. USDA's estimate is doubtful as a final answer. The measurement problems are similar for other capital inputs.

Horses run on oats, roughly speaking, and so the replacement of animal power by mechanical power changed land use. An estimated 93 million acres of U.S. cropland (27 percent of total harvested acres) were used to grow feed for horses and mules in 1915. By 1960 this acreage had dropped to 4 million, thus freeing up about a fourth of the country's cropped area for

1. Census of Agriculture data; to avoid tedious repetition, sources for numerical estimates will be cited henceforth only when *not* from the Census of Agriculture.

other uses. (One could equivalently say that a fourth of U.S. cropland lost its job, and this way of looking at the issue comes to have special resonance in the context of later developments in farm labor.)

Beyond its land-saving aspect, the replacement of animal by mechanized traction power furthered the process of making farming less self-sufficient and more market dependent. The cost of off-farm purchased inputs, repair services, chemicals, and other equipment increased from 5 percent of total production costs in 1910 to 12 percent in 1992, and tractorization is a significant cause of this trend. The overall evolution of the sources of farm traction power and related inputs is shown in Figure 2.2. In the forty-five-year period from 1915 to 1960 the transition from animal to mechanical power was completed.

The innovation of the power take-off for transmitting tractor engine power to attached machinery in the field, introduced in 1918, led to ad-

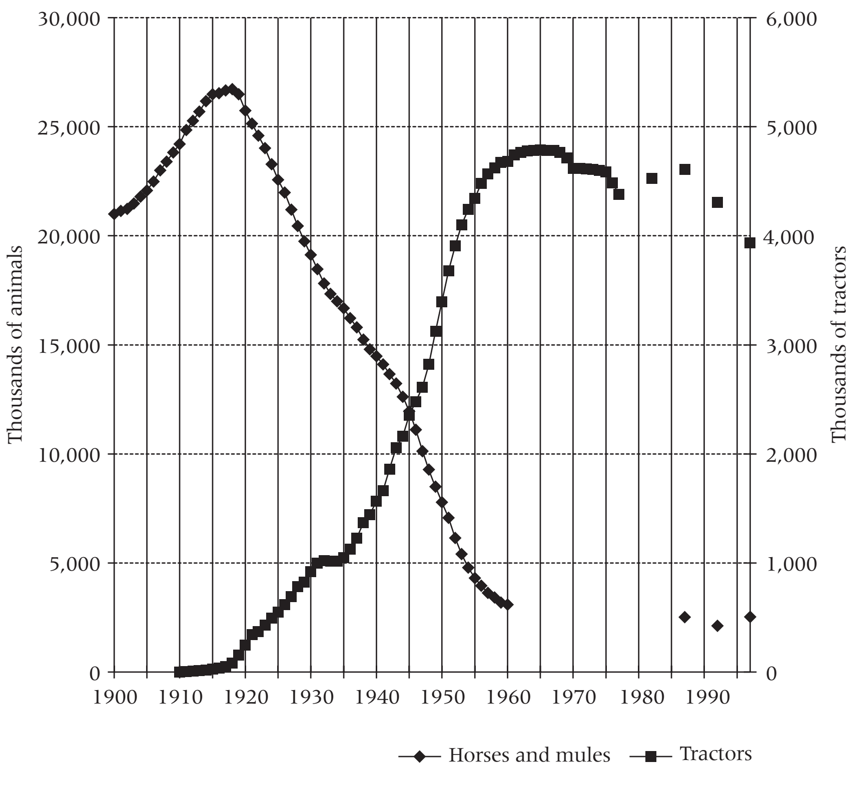

Figure 2.2 Animal and tractor power. Data from U.S. Department of Commerce, *Census of Agriculture,* various years.

vances in both the size and the complexity of cropping equipment. In the mid-1920s the use of grain combines and corn pickers began to accelerate. After World War II, forage harvesting machinery, such as hay balers and choppers, and the cotton picker came into their own (Table 2.2). By 1960 these machines were standard equipment on farms—it would be odd to do without them. In the 1930s a comprehensive effort was undertaken by USDA and the California Agricultural Experiment Station to develop machinery for harvesting, planting, and other operations in sugar beets. The task was largely accomplished by the end of World War II. By 1964 the labor required to produce a ton of sugar beets was estimated at 2.7 hours, compared with 11.2 hours in 1915–1920. The mechanization of tobacco and some vegetable harvesting occurred only in the 1960s and 1970s; and hand harvesting remained the norm to the end of the century for some fruits and vegetables, especially for high-valued or organic products sold fresh.

Although the tractor is primarily a mechanical substitute for animal power, a major thrust of mechanization in all its forms is the replacement of human labor. The development of cereal-grain harvesting machinery, notably the reaper and the threshing machine, was a highlight of the nineteenth century. Mechanization was seen as the prime source of the U.S. advantage in wheat production. Abroad, it was seen as such a threat that English farm laborers in 1900 carried out a riotous destruction of imported American reapers (Crichton 1998, p. 202). In the twentieth century mechanization was applied to every substantial farm chore. The most sweeping developments occurred in mid-century—roughly from 1925 to 1970.

The key to many labor-saving devices was the supply of electricity to farms from central generating stations. The cost of electric power transmis-

Table 2.2 Machinery on farms (thousands of units)

	Combines	Corn pickers	Farms with milking machines	Pickup balers	Forage harvesters
1910	1		12		
1920	4	10	55		
1930	61	50	100		
1940	190	110	175		
1945	375	168	365	42	20
1950	714	456	636	196	81
1954	980	688	712	448	202
1959	1042	792	666	680	281
1964	910	690	500	751	316

Source: U.S. Department of Commerce (1975).

sion to rural areas, however, delayed the widespread farm use of electricity. In contrast to the overwhelmingly private-sector origin and diffusion of tractors, federal subsidies played a key role in expanding electricity provision to farms, principally through the Rural Electrification Administration. The REA was established by executive order in May 1935 as part of President Franklin D. Roosevelt's New Deal program. In 1935, 11 percent of farms were wired for electricity. By 1960, 97 percent were (Rixse 1960, p. 71).

The earliest uses of electricity were in lighting, which was especially valuable in livestock farming in winter. It is estimated that the time needed to accomplish typical daily winter chores was reduced by one hour per worker using electricity as opposed to lanterns. Through mid-century the largest single usage of electricity was for irrigation pumps—begun as early as 1898 in California (Hienten and Schaenzer 1960, pp. 75, 79). Electric motors proved ideal for small-scale power generation in confined spaces, and many ingenious applications to agricultural tasks immediately followed the availability of motors. These innovations have been especially notable in dairying and livestock feeding, with the following major steps in mechanization between 1920 and 1960:

- Vacuum-driven milking machines
- Fans for ventilation and hay drying
- Refrigerated bulk tanks for milk storage
- Barn cleaners for manure removal
- Pipeline milkers and milking parlors
- Silo unloaders
- Augers, grinders, and other feed-handling equipment
- Electric fencing, making light-duty temporary pasture management feasible.

These devices alleviated much back-wrenching labor, but because they were costly it was not immediately clear that they would add much to a farmer's returns, in the sense of getting more output from a dollar's expenditure. Physical output per hour undoubtedly rose dramatically. In 1910, USDA estimated that 3.8 hours of labor were used to produce 100 pounds of milk on average in the United States. By 1935–1939, the labor required had been reduced only slightly, to 3.4 hours; but by the 1980s the labor had been reduced phenomenally, to 0.2 hours per 100 pounds of milk.

Mechanization increased productivity not only by allowing one person to do more work in a given farming situation, but in addition by making it feasible to enlarge and restructure farm enterprises. Automation of milking and feeding led to the replacement of the traditional stanchion dairy barn, where cows remain in individual stalls when not out to pasture, by a milking parlor with associated loafing barns, where cows spend their time untethered between milkings. The milking-parlor structure permits large dairy herds without the expense of huge stanchion barns that large-scale production would otherwise entail—an instance of capital-saving innovation.

Many changes in technology worked to foster specialization in farming, as their adoption required large fixed investments that generated the least costs when used to produce large quantities of output. But some innovations made farms more self-sufficient and worked against specialization. The development of affordable electric arc welders enabled farmers to make many repairs and creative adaptations of machinery that would otherwise have to be provided by off-farm service providers. Electric shop tools of all sorts performed a similar function.

Figures 2.3a and 2.3b show the reduction in estimated labor requirements

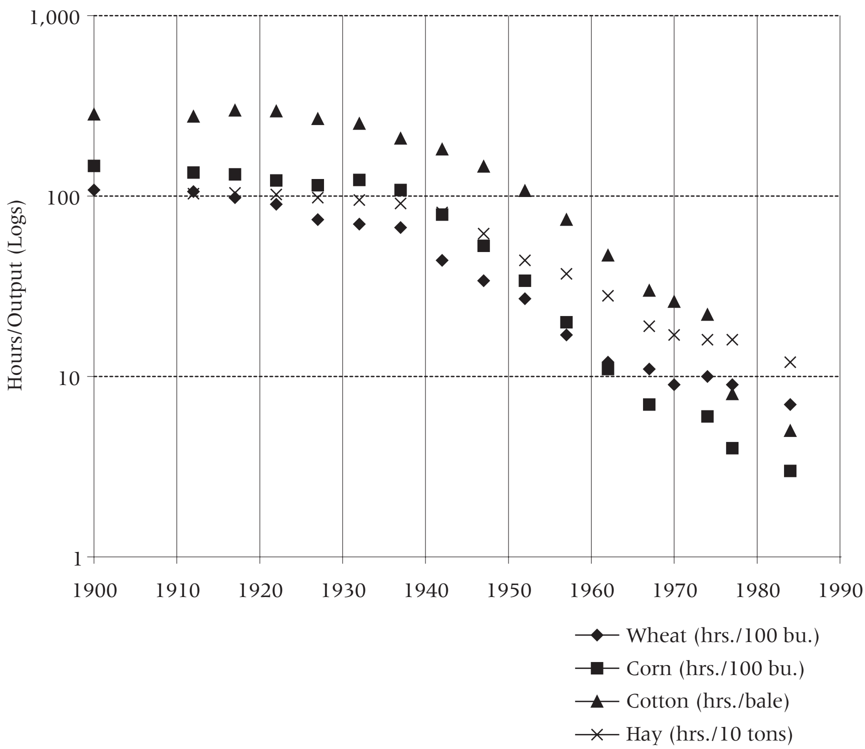

Figure 2.3a Labor hours per unit output of crops. Data from U.S. Department of Commerce (1975) and U.S. Department of Agriculture, *Agricultural Statistics*, various years.

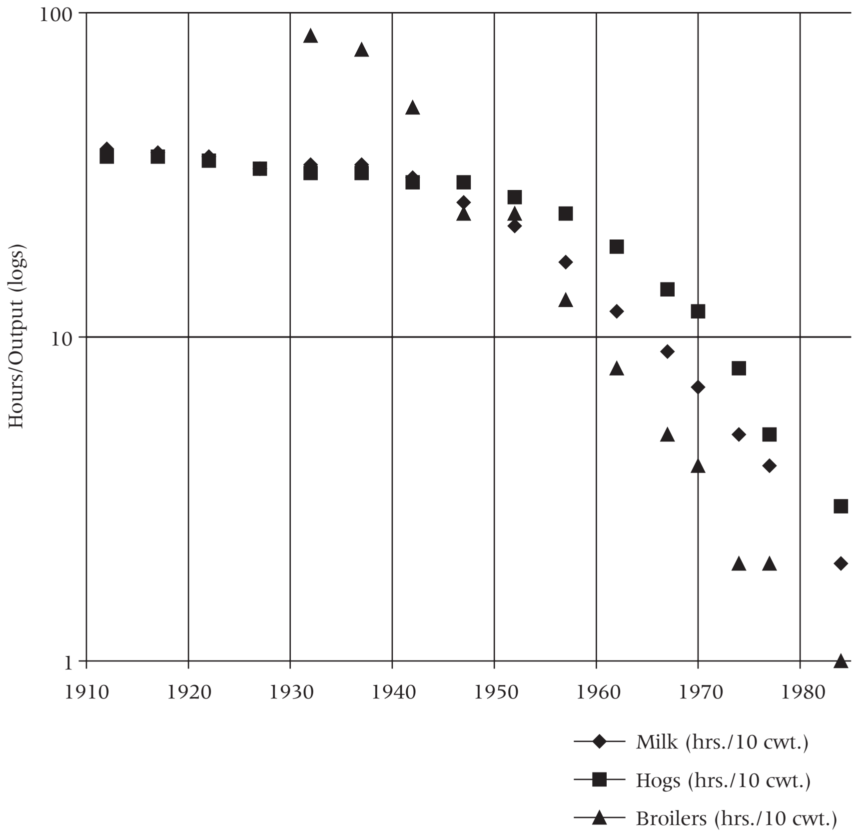

Figure 2.3b Labor hours per unit livestock output. Cwt. = 100 lbs.; data from U.S. Department of Commerce (1975) and U.S. Department of Agriculture, *Agricultural Statistics*, various years.

for some of the major crops and livestock. For the four crops shown, large reductions in labor requirements did not occur until the late 1930s. The early part of these reductions, roughly 1935 to 1955, corresponds to the rapid adoption of new farm machinery, but labor requirements continued to decline almost as rapidly after the main period of mechanization had been completed. In part these later gains are the result of continued improvement in the reliability and size of machinery, as two-row planters, cultivators, and harvesters were replaced by four-row, eight-row, twelve-row, and for some jobs even larger equipment. Labor requirements in dairy and hogs did not begin their period of rapid decrease until after World War II.

The causes and consequences of these changes will be discussed in detail later. The point at present is simply to note the remarkable scope of change that occurred. In 1900, an estimated average of 147 hours were used to produce each 100 bushels of corn. By the mid-1980s this had been reduced to 3 hours—roughly a fiftyfold increase in labor productivity. In cotton, an exceptionally labor-intensive field crop, 284 hours were used for each 500-pound bale in 1900. By the 1980s, U.S. growers obtained a bale of cotton with 5 hours of labor—again about a fiftyfold increase in labor productivity.

The gains in dairy reported earlier are impressive but less spectacular than those for corn and cotton. Nonetheless, animal agriculture provides the most striking example of increasing farm labor productivity, in broiler chickens. At the time of the first broiler statistics, in 1929, 85 hours were used per 1,000 pounds of broilers. By the mid-1980s, according to USDA's estimates, this had been reduced to 1 hour.

Richard Day (1967) carried out a detailed study of mechanization of cotton in the 1940s and 1950s that emphasized the speed of the adoption of new technology and its disruptive consequences. He estimated a decline of labor input per bale of cotton from 160 hours in 1940 to 24 hours in 1960 in the Mississippi Delta, which together with other factors reduced the annual demand for farm labor from 17 million to 1.6 million worker hours. This is an average annual rate of decline of 14 percent, and meant essentially the layoff of 90 percent of the 1940 work force. In another single-commodity study, Andrew Schmitz and David Seckler (1970) estimated that the adoption of the tomato harvester in California reduced worker hours by 50 percent, from 48.5 million to 29.0 million, between 1965 and 1973.

The consequences of mechanization for farmworkers—both those who lose their jobs and those who remain—depend on the underlying causes and events that are concurrent with mechanization. Day concluded that in 1940–1949 labor was predominantly pulled out of agriculture by demand in the nonfarm sector, largely connected with economic activity stimulated by World War II. The resulting scarcity of labor set the stage for farmers to adopt the mechanical cotton picker. Then in 1950–1957 labor was pushed out by the new technology as it became more and more widely used in cotton farming. This interpretation is an example of the theory that observed innovations are "induced" by economic incentives rather than being the autonomous result of the advance of science and technology.

This theory is not just of academic interest. Mark Krikorian (2001) argues against allowing foreign guest workers in U.S. agriculture, citing the results of prior lawsuit-induced foreign labor shortages in sugar cane. "Today, virtually all Florida sugar cane is harvested by machine, resulting in dramatic increases in productivity, higher wages and more civilized working conditions for the remaining workers. In short, cutting off the stream of foreign labor promoted dramatic steps toward modernization." The generality of induced-innovation explanations remains in question. For a skeptical historical discussion, see Olmstead and Rhode (1996).

New Crops and Genetic Improvements

Technical and economic changes have led farmers to change the allocation of their cropland considerably, within a remarkably steady total acreage. The Census of Agriculture found 325 million acres of crops harvested in 1910, and 309 million acres in 1997. But, for example, the acreage of oats declined from 37 million in 1910 to 4 million in 1992 (a result of the phaseout of draft horses), the acreage of rye declined from 2.3 to 0.3 million, of flaxseed from 2.2 to 0.2 million, and of buckwheat from 840,000 to 65,000 acres. At the same time soybeans, with acreage too insignificant to survey before 1919, expanded to 58 million acres in 1992 (equal to the entire combined surface area of Illinois and Indiana). Grain sorghum underwent a similar expansion, from unrecorded before 1919 to almost 10 million acres in the 1990s. A final twist is provided by highly touted new crops that turned out to be flops, like triticale and jerusalem artichokes, or even menaces like johnson grass and kudzu, introduced in the South in the nineteenth century and in the 1930s, respectively, for forage and erosion control, but now troublesome weeds. (On the case of the jerusalem artichoke, see Amato 1993. Comparable investment disasters have occurred with emu, ostriches, fur-bearing animals, and exotic breeds of the standard farm species.)

One of the most important sources of productivity growth in U.S. agriculture has been genetic innovations in both crops and livestock. Selective breeding of domestic animals goes back to the dawn of human history. Recently improved understanding of the genetic basis for selective breeding, and better methods for applying genetic knowledge, have led to big improvements in the yield of traditional crops. The greatest success story was the huge yield increases resulting from the development of hybrid corn. The Great Depression notwithstanding, Iowa farmers went from negligible acreage devoted to hybrid corn in 1930 to 90 percent of corn acreage in 1940. Other states lagged behind, but adoption of hybrid corn was virtually complete nationwide by 1960 (see Huffman and Evenson 1993, chap. 6).

Even commodities where hybridization has not been a mechanism of genetic improvement have seen continued yield increases through traditional selective breeding. New varieties of oats, for example, have generated higher yields without benefit of hybridization. In livestock, selective breeding has been made more efficient by the use of artificial insemination, which allows males with desirable traits to become sires of many more and

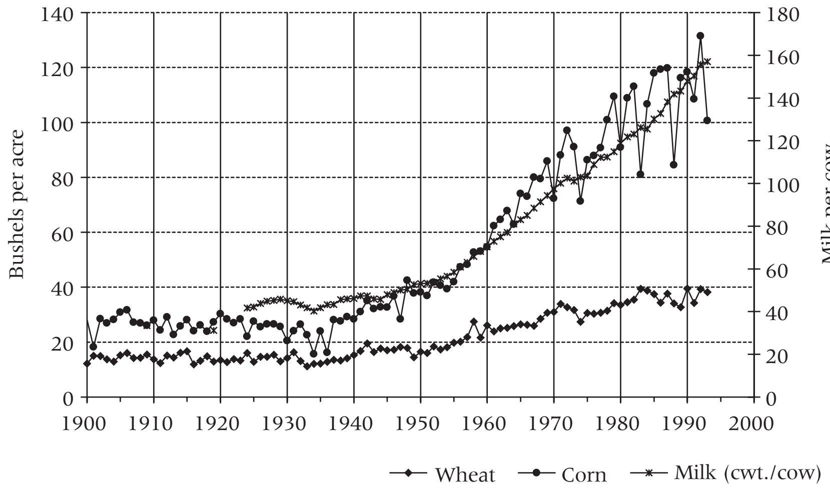

Figure 2.4a Yields of crops and of milk. Cwt. = 100 lbs.; data from U.S. Department of Commerce (1975) and U.S. Department of Agriculture, *Agricultural Statistics,* various years.

widely dispersed offspring than would otherwise have been the case. Recent developments, notably embryo transplants, cloning, and genetic engineering, did not generate measurable productivity gains in the twentieth century, but point toward a continuation of similar productivity gains in the twenty-first.

The results of these technological advances appear in increased labor productivity to some extent, but the gains are most apparent in yield data—output per acre, milk per cow, meat per pound of feed. Figure 2.4 shows the story of twentieth-century technical progress in U.S. agriculture using such yield data for selected products. The data are graphed in two ways, bushels per acre in Figure 2.4a and as the log of bushels per acre in Figure 2.4b. Figure 2.4a shows much larger yield gains in later years, suggesting an acceleration of productivity growth. For example, annual milk yield rose by 2,900 pounds per cow during the 1980s, but by only 1,700 pounds per cow during the 1950s. Yet the percentage gain is 28 percent in the 1950s and 22 percent in the 1980s.[2] So in *rate* of growth the 1950s performed better.

Similarly, Figure 2.4a shows the biggest increases for milk and the small-

2. A problem with percentage changes is that they can be strongly affected by choice of the beginning or ending value as a base (so a rise from 30 to 60 can be a gain of either 50 percent or 100 percent). In this book percentage changes are calculated so as to avoid this ambiguity. This is done by using changes in the natural logarithms of the beginning and ending values, which is equal to the difference between the beginning and ending value divided

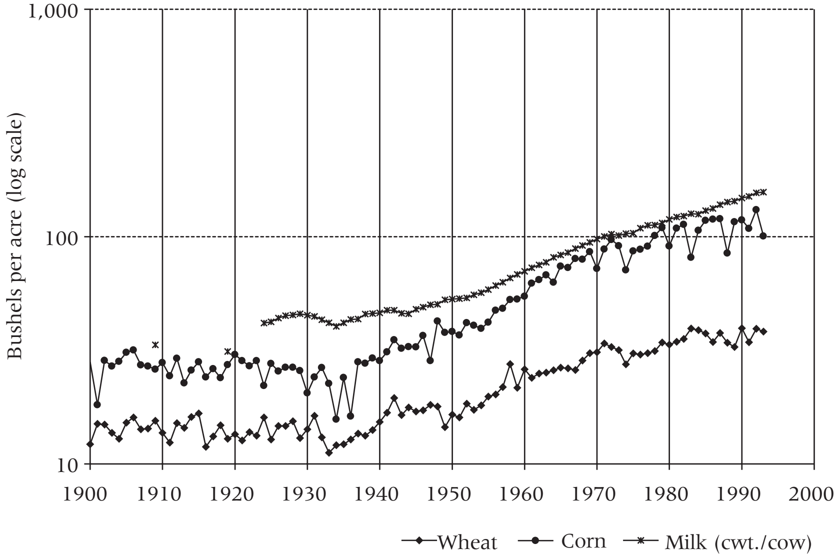

Figure 2.4b Natural logs of yields of crops and of milk. Cwt. = 100 lbs.; data from U.S. Department of Commerce (1975) and U.S. Department of Agriculture, *Agricultural Statistics*, various years.

est for wheat and soybean yields. Milk per cow rose from 12,000 pounds annually in 1980–81 to 14,900 pounds in 1990–91, while wheat yields rose from 33 bushels per acre in 1980 to 39 bushels in 1990. But even though the numerical gain is much larger for milk, in percentage terms the rate of gain is quite similar, 24 percent for milk and 18 percent for wheat.

To obtain an indicator of whether the crops selected are representative, Figure 2.5 shows USDA's index of aggregate output of all crops divided by all U.S. cropland harvested (excluding orchard acreage). This graph, as many of those that follow in this book, begins at 1910 rather than 1900 as might be thought more natural in a book about twentieth-century agriculture. The reason, for data that require aggregate crop acreage, is that the 1900 census acreage data are suspect. USDA surveyed acreage annually then as it does today, and when the 1900 census found 19 percent more wheat acreage than USDA had found, it became clear that the scope for error was substantial. That the problem is at least partly the fault of the census is indicated by

by the geometric mean of the two values. This measure has the advantage of being uninfluenced by the choice of beginning or ending value of the base, and has other desirable features as discussed by Tornqvist, Vartia, and Vartia (1985). Note also that logarithmic rescaling of yields in Figure 2.4b causes equal percentage changes to show up as equal slopes of the yield graph, making it easy to judge by inspection which yields, in which periods, are growing fastest simply by noting the steepness of the graph's slope.

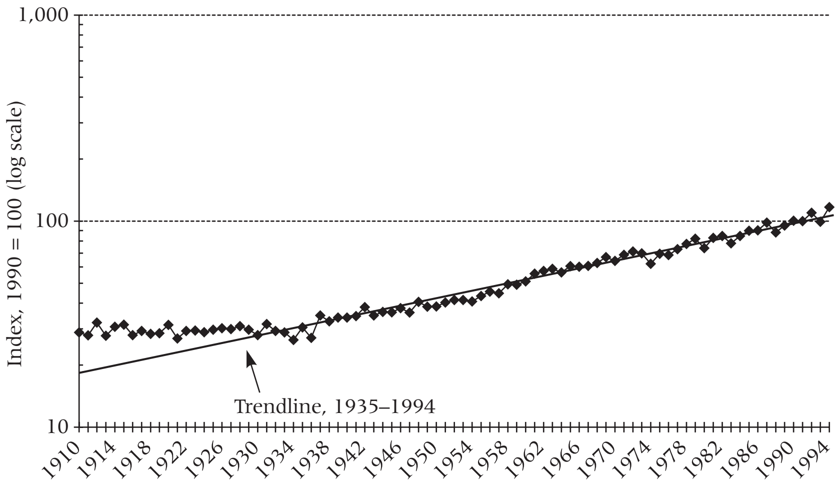

Figure 2.5 U.S. crop output per acre. Data from U.S. Department of Commerce (1975) and U.S. Department of Agriculture, *Agricultural Statistics*, various years.

the fact that "more than 100 counties were credited with farm acreages materially in excess of the land area of the counties" (Murray 1939, p. 707). In any case, Figure 2.5 confirms the story that yields fluctuate around an unchanging mean until about 1935; then yields fluctuate around an increasing trend, at a trend rate of growth of 2.1 percent per year, for the rest of the century.

Chemicals and Biotechnology

Commercial fertilizer has been used in agriculture throughout the twentieth century. One of President Woodrow Wilson's remarkably activist initiatives to boost agricultural output during World War I was a plan to subsidize the importation of Chilean nitrates. As Figure 2.6a shows, a steady increase in the use of commercial fertilizer on farms occurred from 1900 until the onset of the Depression. Usage in 1930 averaged about 2 tons per farm.

During and after World War II fertilizer use took off, sustained at a rate of 4½ percent annually for the forty years between 1940 and 1980. One reason is that improved seeds and irrigation made crops more responsive to larger doses of nutrients. Another is the decline over time in the real price of fertilizer caused by innovations in manufacturing inorganic fertilizers. Especially notable is the growth of nitrogen application. U.S. nitrogen use increased from 2.7 million tons in 1960 to 11.4 million tons in 1980 (Figure 2.6b).

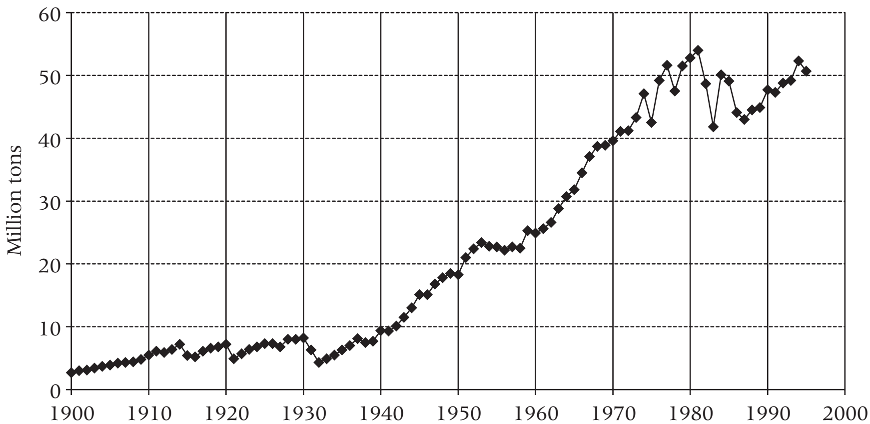

Figure 2.6a Commercial fertilizer used on farms. Data from USDA (1997d).

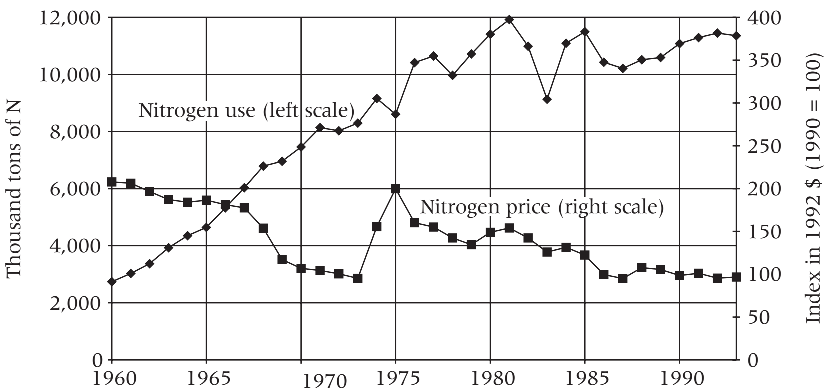

Figure 2.6b Inorganic nitrogen fertilizer use and real nitrogen price. Data from USDA (1997d).

During this period the price of nitrogen declined by 28 percent in real terms (despite a price run-up during the energy crisis of the 1970s).

Rapid expansion in the use of inorganic nitrogen fertilizer in the 1950s and 1960s was not so much a matter of a new, improved input as a large reduction in the cost of manufacturing an old one. The development of economical processes for making NH_4 (ammonia) from natural gas caused the price of anhydrous ammonia fertilizer to fall by about one-half in nominal terms between 1960 and 1970, and fertilizer prices generally declined in real terms throughout the post–World War II period until the energy crisis of the mid-1970s. (Similarly, progress in the manufacture of tractors led to a continual decline in the real cost of horsepower even as tractors and their implements increased in reliability and ease of use.)

The other major class of agricultural chemicals is pesticides. Although various poisons have been used to combat weeds, insects, and other agricultural pests for centuries, U.S. farm use of chemical pesticides only became massive after World War II. The insecticides DDT and later malathion and the broad-leaf herbicide 2,4-D, a synthetic organic herbicide developed in the 1940s (and ancestor of the Agent Orange used by the U.S. armed forces as a defoliant in Vietnam) became popular in the 1950s. Pesticide use increased tenfold between 1945 and 1972 (Figure 2.7). In 1952, 11 percent of corn and 5 percent of cotton acres were treated with herbicides; by 1982 these percentages had risen to 95 and 93 percent, respectively (Osteen 1993, p. 314).

Analysis of immediate postwar data indicated that an additional dollar spent on fertilizer or pesticides generated increased output worth \$3 to \$5 on average (Griliches 1964a; Headley 1968). That high a return per addi-

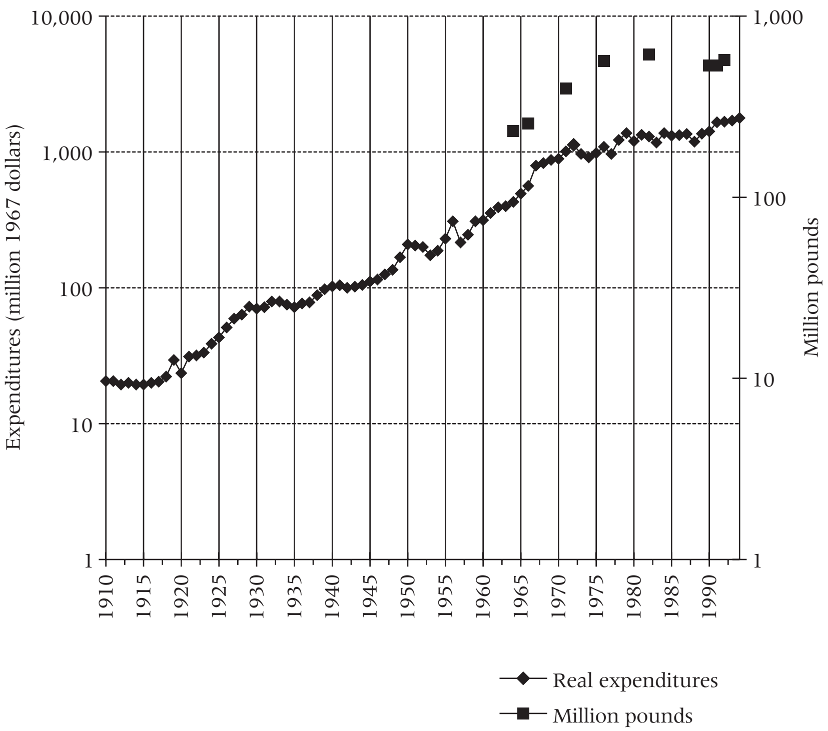

Figure 2.7 Indicators of pesticide use. Data from USDA (1997d).

tional dollar spent implies that profit-seeking farmers should have increased their use of fertilizers and pesticides in the 1960s, as indeed they did. USDA's aggregate chemical-input use index increased sixfold between 1950 and 1980, a growth rate of 6 percent annually. There is some evidence that the returns to additional pesticide use have declined in recent years, which would explain why the rate of use has slowed down and even reversed for some crops. But it remains the case that spending $1 on pesticides generates more than $1 worth of additional output, according to the preponderance of evidence (see the review of studies in Fernandez-Cornejo, Jans, and Smith 1998).

Pesticides are controversial in ways that other technological changes are not—although all the main twentieth-century innovations have drawn criticism. All pesticides are poisonous to some forms of life, and there is always the worry that unintended targets, including humans, will be harmed when pesticides are applied. Incidents such as the feared contamination of cranberries in 1958, which led to much of the crop's being condemned for human consumption at the Thanksgiving season, made headline news.

Of greater long-term policy significance was the concern about pesticide effects on wildlife publicized by Rachel Carson's *Silent Spring* (1962), aimed particularly at DDT. DDT was soon banned in the United States (but is still used abroad, especially in attempts to control mosquitoes that transmit malaria). Chlordane and other poisons that last a long time in the soil have also been phased out. The human health effects of pesticides, as used in the 1990s, on food consumers have not been established, although suspicions that remain have fostered expansion of "organic" foods certified to have been grown without use of pesticides or other chemicals. Such concerns, coupled with the capability of pests to evolve resistance to the most effective and cheapest pesticides, contributed to the leveling off of pesticide use after 1980 that is shown in Figure 2.7. Cotton was the most intensively treated major crop, with 10 pounds of active ingredient per treated acre in 1966–1976; but through more careful management and improved chemicals the dosage had been reduced to an average of less than 2 pounds per acre by the end of the 1980s (Osteen 1993, p. 92). Application rates for the other main pesticide-using crops—corn, soybeans, and grain sorghum—have also declined since 1979.

Data on pesticide quantities are particularly difficult to compare over time because the nature of the chemicals used has changed so much. Figure 2.7 shows two alternative measures, both from USDA. The longer, more continuous series constructs a quantity index by dividing farmers' pesticide expenditures by a price index of pesticides. The more recent series, not available for every year, is a weighted average of quantities of active ingredients used in pesticides. Note that for the period since 1980 one index increases and the other decreases, illustrating the difficulty of identifying such trends with statistical precision.

In the 1980s the thrust of innovation turned decisively to biotechnology. Medicines have had a long history of use for animals as for humans, but post–World War II innovations in antibiotics, vaccines, and synthetic hormones made pharmaceutical products significant factors of production in agriculture on a more massive scale. Antibiotics were routinely added to manufactured feeds, and growth hormones, first used in cattle in the 1960s, were widely adopted. In the 1980s, scientists mastered the ability to manipulate and produce large quantities of synthetic hormones and genetically altered plants and animals. A genetically engineered enzyme entered the marketplace in cheese production in 1990. The first farm-level uses approved by the Food and Drug Administration—which by law had to certify their safety to humans—occurred in 1994, for a tomato variety with better properties of staying fresh after being picked and for synthetic bovine growth hormone (BST), to increase milk production. In the late 1990s the major innovations were seeds genetically engineered to have desirable properties for pest control. The main ones are corn that is resistant to corn rootworms, cotton resistant to bollworms (both corn and cotton plants engineered to produce the pest-killing bacterium bT), and soybeans that are resistant to the widely used herbicide glyphosulfate (Roundup), enabling that chemical to be used to kill weeds in the beans.

Those innovations are being adopted by farmers at an impressive pace, with about half of U.S. soybean acreage and a fourth of corn acreage devoted to genetically modified seeds in 2000. This record indicates that the additional costs of the engineered seeds are more than offset by savings from the reduction in the use of (or in the case of soybeans, increased effectiveness of) chemical pesticides. Genetically engineered seeds have not yet generated observable results in productivity statistics, but like the innovations in animal genetic manipulation mentioned earlier, they indicate prospects for continued technological change in the twenty-first century. Biotechnology has also created new problems, however, two of the most notable being consumer resistance to the products (without apparent foundation, but nonetheless the consumer must be obeyed—or the producer loses a market) and the enforcement of property rights in the products (if farmers reproduce the seeds rather than buying them anew each year, the seed producer loses a market). A feasible technological solution to this latter problem exists and has been implemented for some seeds, namely a “killer gene” that makes the seeds of genetically engineered crops sterile. (Policy issues in agricultural technology are addressed later, in Chapter 6.)

Information and Marketing Innovations

Innovations in information technology have not only facilitated the adoption of new production methods by farmers but have had great economic and social impact on rural life. Most important in the first half of the century were radio and the telephone. Radio provided a way of getting timely weather reports, market news, and other information to isolated rural communities and individual farmers. Its cultural impact was perhaps as important as the economic information it brought. Radio provided farm people access to entertainment and educational programs on essentially the same basis as urban dwellers, eliminating at a stroke an important advantage of urban living. A survey in the 1940s found the most highly valued uses of radio to farm families to be, starting with the most valuable, news, religious programs, serial stories, market reports, and "old-time music" (Loomis and Beegle 1957, p. 425). The Census of Agriculture found that 4 percent of farms had radio sets in 1925, and 73 percent in 1945. By 1954 radios had expanded to nearly universal use, and 35 percent of farm dwellings had television.

The economic value of radio and television depends of course on what is broadcast. Several local stations began broadcasting weather forecasts and commodity market reports in 1921, and the first full-time farm reporter went on the air in 1923. A notable step was taken with the inauguration by Sears, Roebuck and Company of station WLS (World's Largest Store) in Chicago in 1924. The station was aimed at rural customers, and its success led to further development of farm-oriented broadcasters (Baker 1981; Weil 1977, pp. 229–230). Lindstrom (1948) reports average daily listening time of almost five hours for farm families.

The telephone was perhaps an even more important economic innovation, enabling farmers to take initiatives in business dealings and information gathering with speed and timeliness never before feasible. Immediately upon the expiration of Alexander Graham Bell's patents in the mid-1890s, many new enterprises entered the telephone business. By 1900 there were 9,000 independent telephone systems established in towns, villages, and rural areas, and by 1920 an estimated 39 percent of farms had telephone service (Weitzell 1960, p. 87). However, in one of the few instances of technological reversals, in 1935 this figure had declined to 21 percent. Telephone business failures and the deterioration of facilities without financing for new investment caused many telephone systems to fold or confine themselves to towns. As late as 1950 only 38 percent of farms had telephones, while at the same time about 85 percent were electrified. The financial means for more widespread rural telephone systems became available in

1949, when Congress amended the Rural Electrification Act to provide a subsidized rural telephone loan program. Even then the percentage of farms with telephones rose only to 76 percent by 1964, compared with almost universal coverage for electricity by that date.

There were significant regional differences in the percentage of farms wired for electricity and telephone service. As was the case with hybrid corn adoption, the South was slow to obtain these services, with only 64 percent having telephones by 1964 (the last year the Agriculture Census asked whether farms had telephones). But by the end of the century, electricity, telephone service, and television had become practically universal on commercial farms throughout the country. Many farmers, especially younger ones, use the Internet, but its overall impact remains small. Even when farmers become fully wired, the improvement in information availability will be less spectacular than what radio and telephone made possible. The real information revolution for rural people occurred earlier in the century.

In product marketing, technological progress has generated lower costs of transportation for material inputs going to the farm and for products marketed from the farm. These effectively reduce the costs of farm inputs, increase the receipts from output, and increase the comparative advantage of more remote farming areas. Reduced transportation costs have also influenced on-farm technology and the scope of production activities carried out on farms. The cream separator was standard equipment on commercial-sized dairy farms in the early twentieth century, and farms sold primarily cream or butter, with skim products being used on the farm. But as transportation and preservation technology improved, it paid to market whole milk. The separator was on the way out in the 1930s and had essentially disappeared by the 1950s (Barger and Landsberg 1942, p. 221).

In addition, innovations in processing created new markets for farm products. For example, the development of lower-cost methods of conversion of corn to fuel ethanol and to high-fructose corn syrup (albeit boosted by industrial subsidies and the sugar price support program, respectively) increased the farm-level demand for corn significantly in the 1970s and 1980s. Recurrent energy crises since the 1970s have boosted the search for biofuels, such as specially processed soybean oil as a substitute for diesel fuel and high-fiber crops grown on marginal lands as fuel for electricity generation. The key to success or failure will be the improved efficiency of processing technology.

Productivity Growth

To pull these technological changes together analytically, we need an overall indicator of productivity growth. Most practical discussion of productivity uses relatively straightforward concepts such as crop yield (output per acre), labor productivity (output per worker), or other ratios that divide a measure of output by a measure of input (milk per cow, corn production per ton of fertilizer or fuel). Some of these ratios are also called measures of efficiency, particularly in energy use where improvement in output per unit of heat energy used in grain drying, for example, is called an indicator of energy efficiency. Economists commonly make a distinction between productivity and efficiency—that efficiency refers to the output achieved from inputs *for a given technology,* while productivity also encompasses the results of changes in technology. But for the present I will treat the terms as synonyms and will usually refer to productivity even for indicators such as output per unit of energy used.

LAND PRODUCTIVITY

The economic significance of technological change lies in its capacity to make possible additional farm output per unit input, which is what growth in productivity measures. The economic benefit lies in the lower costs of producing agricultural output and the possibility of achieving a larger national income with given resources. Technological change also has social costs, which have caused some to question its overall benefit, both to farmers and to society generally. Probably what swings the argument largely in its favor (expressed as public willingness to support and subsidize the development and dissemination of agricultural technology) is the belief that a growing population will, in the absence of technological progress, soon place intolerable pressure on the world's farmland resources. This belief has prompted a focus on land productivity as an indicator of technological success in agriculture.

Figure 2.4 shows output per acre for particular crops, and Figure 2.5 aggregates all crops and divides by all acreage harvested. Looking at a single crop's yield, for example wheat, can be misleading, because that crop may not be representative of crop production more broadly. It can also be misleading because of double cropping. An acre growing winter wheat can produce more when it is used to plant a second crop, often soybeans, after the wheat is harvested. Double-cropping is a long-standing practice in fertile areas of the South, where growing seasons are long. The practice became more widely attractive to farmers with the development of low-tillage methods and herbicidal weed-control methods that let soybeans be grown expeditiously after winter wheat or another early-harvested crop. USDA estimates that between 1969 and 1982, acres double-cropped increased from 3.1 to 12.5 million, with 11 million of the 12.5 million acres involving soybeans as one of the crops (Hexem and Boxley 1986).

Double-cropping increases land's productivity by obtaining more output from a given acre. But in the wheat-soybean example, this increase is not captured by looking at *wheat* output per acre. Indeed, double-cropping often reduces the yield of each of the two crops separately. Therefore, an area in which double-cropping is increasing in importance, as it did in the United States in the 1960s and 1970s, can experience an increase in land productivity while individual crop yields show no increase, or possibly even a decrease.

Appropriate aggregation can solve this problem: take the output of wheat and soybeans together and divide by the acreage planted to both crops, counting an acre only once if it is double-cropped. Aggregation, however, creates the problem of how to add up the crops. It is misleading to add tons of wheat and tons of soybeans, because the two crops differ in economic value. A solution is to add the values of wheat and soybeans produced, that is, output multiplied by the price of each. But a new problem presents itself. Economic conditions change, as when the demand for soybeans, and therefore its price, has risen relative to wheat. This creates a further difficulty in aggregating soybeans and wheat to obtain a crop-output index.

Consider the facts about wheat and soybean output in 1940 and 1970. The U.S. production figures are as follows:[3]

	Million bushels		
Year	Wheat	Soybeans	Total
1940	800	100	900
1970	1,400	1,100	2,500
% change			94

Consider just adding the bushels of wheat and soybeans. A consequence of our nation's spirited resistance to the metric system is that one must first take care to determine what a bushel is. Fortunately the wheat and soybean bushels are both 60 pounds (but corn, barley, and oats each have different bushels). The meaning of the sum is nonetheless questionable for economic reasons—would you add bushels of oats and caviar? So, for economically meaningful aggregation, we use prices to weight the goods. The relevant prices for wheat and soybeans are:

3. To avoid end-point bias in calculating percentage changes, the calculations use the convention of dividing the change by the average of the two end-points, for example, $(2500 - 900) \div (2500 + 900)/2 = 0.94$. This avoids the bias caused by using either the first or last value as a base: $(2500 - 900)/900 = 1.78$ or $(2500 - 900)/2500 = 0.64$. Note that the log-difference approach used earlier gives $\ln(2500) - \ln(900) = 1.02$, not quite the same as the 0.94 from the crossed-weight calculation. When calculating large changes in relative terms, there is no single best way. I generally use the log difference, as mentioned earlier.

	$/bushel	
Year	Wheat	Soybeans
1940	0.70	0.90
1970	1.30	2.80

Now we can calculate the value of wheat and soybeans together:

	Million dollars		
Year	Wheat	Soybeans	Total
1940	560	90	650
1970	1,820	3,080	4,900

The problem now is that our figures change over time because prices change, whereas we are only interested in output changes. The solution is to use "base-period" prices to aggregate both years' quantities. But should we use 1940 or 1970? Does it matter? Suppose we aggregate using 1940 prices:

	Million dollars at 1940 prices		
Year	Wheat	Soybeans	Total
1940	560	90	650
1970	980	990	1,970
% change			101

Now use 1970 prices:

	Million dollars at 1970 prices		
Year	Wheat	Soybeans	Total
1940	1,040	280	1,320
1970	1,820	3,080	4,900
% change			115

Has output gone up 101 percent as the 1940 price weights indicate or 115 percent as the 1970 price weights indicate? Before addressing this question, we have to face a more fundamental economic difficulty with yield as a measure of productivity. A focus on crop yield per acre lends itself to assessments like the following:

> Our use of land is profligate. It stands in direct contrast to the pattern that has developed in Japan where the productivity per acre is approximately 10 times that of the United States. (Goldschmidt 1978, p. xxxii)
>
> It appears that there is something seriously wrong with the American agricultural system. Since 1910, United States agricultural efficiency, as measured in energy, has decreased 10-fold. At the turn of the century, according to University of Wisconsin researchers, the American farmer

used less than one calorie to extract one calorie of food energy from the soil. Their research indicates that farmers now spend close to 10 calories of energy for every one obtained in food. (Lerza 1975, p. 48)

The calculations in these quotations are all ratios of output quantity to the quantity of a particular input. Such ratios are *partial* productivity indicators. In constructing them, we relate agricultural output to the quantity of the input that appears most constraining. This approach would be meaningful if there were only one scarce input. But the constraints upon output are multiple, and change over time. Analysts of productivity up to medieval times in western Europe focused on seed that was planted (rather than eaten) as the key scarce resource in food production, and often measured yield as the ratio of grain harvested to grain planted as seed (see van Bath 1963).

Measurement of productivity in manufacturing has focused on labor productivity as measured by output per worker (or output divided by hours of work). This is the reciprocal of the labor requirement data discussed above with reference to agricultural mechanization and plotted in Figure 2.3. Figure 2.8 shows output per labor hour for U.S. agriculture as a whole, which is an indicator of labor productivity. For purposes of comparison the U.S. Department of Commerce index of labor productivity for nonfarm business is also shown. Since 1950 the nonfarm labor productivity index has increased 2.5 times, from 40 to 100. This is an impressive performance, and serves to highlight the extraordinary performance of productivity in U.S. agriculture, which grew by 7 times since 1950. Note also that while the graph clearly shows the slowdown in nonfarm productivity growth that began in 1970s, there is much less of a slowdown in agriculture. It does appear that the rate of growth in farm labor productivity has slowed since 1985, with the observations since then all lying below the 1940–1996 trendline.

The trend of farm labor productivity growth is similar to that of land (Figure 2.5), with an acceleration of both indicators after 1935. However, the rate of growth of labor productivity is more than twice as high as land productivity growth during the 1935–1985 period, 2.1 percent annually for land and 5.0 percent for labor productivity. (Both indexes are set equal to 100 in 1982, so comparisons cannot be made of levels, but only of rates of growth.)

Attempting to pull all the partial productivity measures together results in a confusing story. Labor productivity indicates remarkable progress in U.S. agriculture. Energy productivity indicates remarkable regress. Land productivity (yield per acre) indicates progress, but suggests that U.S. agriculture remains much less productive than countries such as Japan. A comparable indicator in livestock, milk yield per cow, is about twice as high in the

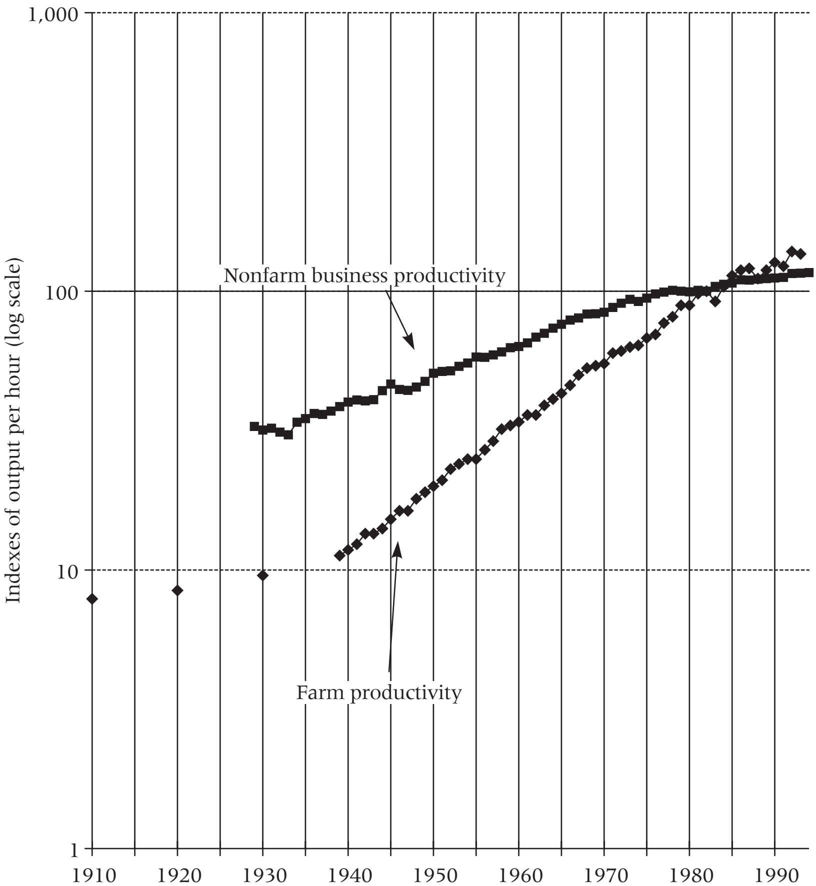

Figure 2.8 Labor productivity. Data from Council of Economic Advisers (2000) and U.S. Department of Commerce (1975).

United States as in New Zealand. Yet Japan is a high-cost importer of U.S. grain and New Zealand is a low-cost exporter of dairy products. Something is going wrong analytically. Which indicator is the right one?

The answer is that all partial productivity measures are wrong and are liable to mislead. The reason is easiest to see in the case of labor productivity. The U.S. agricultural labor productivity index is plagued by a fundamental problem: it rose not only because of technical progress but also because of an increase in the quantity of other inputs per worker. Thus U.S. farm labor productivity would rise even if technology were stagnant, because the declining farm labor force and increasing use of purchased inputs meant the average worker had more land and other inputs to work with.

MULTIFACTOR PRODUCTIVITY MEASURES

Multifactor productivity (MFP) indexes have been developed to measure changes in output relative to the whole package of inputs used. USDA pioneered in estimating MFP indexes. Its early work, culminating in Loomis and Barton (1961), aggregates all crop and livestock products into an overall agricultural output index, and aggregates input indexes for labor, land, capital, and purchased inputs into an overall input index. The ratio of output/input indexes is the multifactor productivity index.

Although the approach appears straightforward, there are many difficulties in constructing the output index, the input index, and in the economic meaning of the ratio. It is unclear what an aggregate input index means, not only for comparisons over time but also at any given point in time, because of the heterogeneity of farms. At any point in time, the many thousands of farms producing a crop will be using many different production methods, with differing effectiveness. Economists have analyzed the circumstances under which, for example, a multifactor productivity index aggregated over farms accurately measures technological change. Unfortunately, the circumstances are stringent and not plausibly met. For example, if some farmers are inefficient in not minimizing the cost of producing their output using the available technology and then produce more output, we will not be able to tell whether a measured rise in productivity is caused by technological change or improved efficiency with unchanged technology. Similarly, if some farmers have unexploited economies of size, we will not be able to distinguish between technological change and increased realization of such economies.

Even when it is not possible to tie measured productivity change precisely to a change in technology, MFP growth can still be meaningful in a broader sense. It is an answer to the question, Given the inputs of land, labor, and capital committed to agricultural production at two points in time, does a given quantity of inputs generate more output at the later date, and if so how much more in percentage terms?

Input quality. Because the quality of outputs and inputs changes, using available data to compare dates far apart in time becomes problematic. Researchers have attempted to provide quality-adjusted input quantities, but this is a difficult task. Consider farm labor. Labor quality has improved because farmworkers today get more schooling than in the past, so more of them can read, calculate, and have machine-shop or other mechanical skills. But by what percentage does today's average farmworker provide more productive services per hour than yesterday's? We cannot use real wage rates as an indicator because real wages change over time, even for workers of a given quality. USDA's approach in its farm labor input measure is to adjust labor quality based on a standard premium paid to workers at different ages, levels of schooling, and other characteristics (Ball et al. 1997). So if the average farmworker now has four more years of schooling than was the case forty years ago, and four years of schooling generates a 10 percent wage premium, then we will say that a given number of hours of farmwork time amounts to 10 percent more labor input now than was the case forty years ago.

Measuring the appropriate premia is itself a difficult undertaking. It is not just a matter of observation, because most farm operators' family labor is not paid a market wage. It is assumed that the premia are the same for self-employed workers as for hired workers. But there are differences between hired and self-employed workers that may be directly related to the premia that the self-employed workers would receive if they were in the hired labor force. More schooling or additional years of experience may be more or less valuable to a farm operator than to a hired farmworker.

The difference between the rate of change over time in USDA's quality-adjusted farm labor input measure and a measure that just counts estimated labor hours without quality adjustment is not large, but it does make a difference. Between 1948 and 1982 the labor index that USDA formerly used, before quality adjustment, fell 4.0 percent per year. The new USDA index fell 3.0 percent per year over this period. With labor accounting for about 30 percent of all inputs by value on average, the substitution of the new USDA index for the old one by itself reduces average MFP growth over this period by about 0.3 percent, that is, instead of 1.7 percent productivity growth, the rate would have been 2.0 percent if the old labor input measure were still used.

Input quantities. Even aside from the quality-change problem, the index-number problem discussed earlier in aggregating wheat and soybeans remains. Now, however, we have to aggregate hundreds of commodity and input quantities. The main aggregation tool is still price weighting, and the problem remains that *all* observed prices are misleading weights when relative prices change over time. In practice, the problem is likely to be no worse with fifty commodities produced than with two, and is generally not a huge problem because the prices of most commodities have not changed a great deal relative to one another over time. The big problem is with inputs, where relative prices and quantities have changed much more over time.

If all input quantities were changing at about the same rate, it would not make much difference how we aggregated them to calculate total input growth, but trends in input use are completely different for farm labor, land, and capital. Labor decreases dramatically, land remains about constant, and capital inputs increase rapidly. With trends so disparate, the weight placed on each input makes a big difference. So it matters a great deal which year's prices we use to aggregate input quantities.

Consider purchased farm inputs compared with farm labor. USDA's estimate of the hired farm labor used decreased from 22.5 billion worker-hours in 1910 to 6.5 billion in 1970, while purchased inputs increased from $1.6 billion in 1910 to $7.6 billion (in 1910 prices) in 1970. By what percentage did aggregate inputs increase? Using 1910 prices, $.11 per hour for farm wages, and an index calibrated at 1910 levels of $1 for purchased inputs, we have the ratio of 1970 to 1910 inputs as: $(6.5 \cdot 0.11 + 7.6 \cdot 1)/(22.5 \cdot 0.11 + 1.6 \cdot 1) = 2.04$. Thus aggregate input use has doubled between 1910 and 1970. Now consider 1970 price weights. The ratio of farm wage rates to purchased input prices in 1970 is almost three times what it was in 1910 (1.29/3.24 in 1970 instead of 0.11/1.0 in 1910). The ratio of 1970 to 1910 aggregate inputs using 1970 prices is: $(6.5 \cdot 1.29 + 7.6 \cdot 3.24)/(22.5 \cdot 1.29 + 1.6 \cdot 3.24) = 0.96$. That is, instead of doubling we now estimate that aggregate input use has slightly declined. The only difference is the higher wage rate relative to purchased input prices in 1970. The 1970 prices give more weight to the decline in labor input.

Incorporating land and capital equipment inputs in a multifactor input index makes the calculations more complicated but does not change the basic result: if we use factor-price weights from early in the century, we get a much higher rate of growth of aggregate farm inputs than if we use factor-price weights from recent years. Acquaye, Alston, and Pardey (2000, p. 8) compare initial-period (Laspeyres) and end-period (Paasche) MFP indexes for 1991 using their best input and output data. From a base of 100 in 1949, the estimate of MFP is 161 using Laspeyres weights and 280 using Paasche weights—the latter giving almost twice the rate of productivity growth as the former.

This problem can be broken into smaller pieces in annual data by changing price weights more often and looking at shorter time periods, but this doesn't remove the difficulty of comparing more recent dates with dates a century or so earlier. The vast literature on the index number problem, which arises in many areas of applied economics, has suggested a number of ways to estimate the "true" percentage rate of increase of an aggregate. The most attractive appears to be the "ideal" index developed by Irving Fisher, which replaces the end-point price weights by the mean of the two. This is equivalent to the geometric mean of the Laspeyres and Paasche indexes, that is, the square root of 280×161, or 212. But there is no guarantee this estimate is accurate. We can be confident that the "true" aggregate growth rate lies between the bounds of the 280 and 161 estimates, but bounds this wide are disconcerting.

Moreover, the validity of using price weights to aggregate agricultural inputs turns out to depend not just on observable quantities but also on economic assumptions. Zvi Griliches (1963) carried out a study of measured technological change during the period of its strongest acceleration, 1940–1960, in which he showed that economic assumptions matter a great deal in how multifactor productivity measurement is carried out. He estimated that labor added less to the value of output than the market value (measured by the farm wage) of labor used. This implies that farmers in aggregate were not profit maximizing—their net income would have been increased if they hired less labor or reallocated some of their household's own time to nonfarm uses. Moreover, he found that additional output generated by capital in agriculture exceeded the cost of capital. In both of these findings he confirmed observations of Theodore Schultz (1947) that disequilibrium in labor and capital use on farms existed in the sense that there was too much labor and too little capital given the technological changes that had occurred.

As a result, Griliches used a weight of .33 on labor and .26 on power and machinery in aggregating inputs, while USDA's index used weights of .40 and .14, respectively. Because the farm labor force was rapidly declining in 1940–1960, while capital was increasing (which is what the disequilibrium argument would predict), this difference in weights made a difference in the measured growth of aggregate inputs. Griliches estimated that aggregate inputs in agriculture grew by 14 percent over the twenty-year period, while the USDA input measure grew by 5 percent. Moreover, he found substantial economies of scale: he estimated that increasing all inputs by 10 percent generated an increase in output of 13.6 percent. This is also an indicator of disequilibrium: the technological changes that accompany the release of excess labor and investment in new capital result in larger and lower-cost farms.

Griliches's estimates imply that disequilibrium and economies of scale account for 1.5 percent of the 2.0 percent annual productivity growth indicated by the USDA statistics for 1940–1960. This is not to say that the USDA measure is wrong, but just that MFP measurement is sensitive to economic assumptions as well as to statistical data problems, and that what is measured is not only changes in technology.

Griliches's estimates depend on an ingenious idea for avoiding the index-number problem that has been refined over many years—to represent the technology by estimating a production function for agricultural output. If we knew enough about the mathematical structure of production, we could avoid the index-number problem, and if that mathematical structure were simple enough, we could even measure the extent of technical change by a single parameter or just a few of them.

Most disappointingly, despite decades of investigation by agricultural economists, no widely accepted specific mathematical representation of U.S. agricultural technology has been found. Richard Just and Rulon Pope (2001) argue that data compromises that have been made in even the most sophisticated work in agricultural production economics cannot be expected to provide accurate information on the structure of technology. Consequently, efforts to measure productivity empirically have remained focused on index numbers. Considerable progress has been made in the theory of index numbers, in particular in finding calculating formulae that are consistent with a reasonably general mathematical specification of the production technology. But serious measurement problems remain.

A problem in measuring farm output is that some of the outputs are also inputs. Most notably, feed crops are an output but they are fed to animals rather than consumed directly by humans. It is therefore double-counting to use the sum of feed output and meat output as aggregate agricultural output. This double-counting can be avoided by constructing separate crop and livestock output measures, as is done, for example, in the work of Wallace Huffman and Robert Evenson (1993). The problem of allocating the farmer's inputs between these two outputs then arises. This allocation is straightforward for some inputs, such as fertilizer, seeds, or veterinary services, because they are used only for crops or for livestock. But for some inputs, notably the farmer's labor or purchased inputs such as electricity, it is not possible to carry out accurately an allocation between crops and livestock. This problem is especially serious for data earlier in the twentieth century, when farms were less specialized.

The approach USDA takes is to construct a measure of aggregate agricultural output that excludes feed fed on farms. This means, for example, that more than half of the corn produced does not go into the aggregate output measure. Neither is pasture consumed by livestock counted as agricultural output—for pasturing activity the output is meat, or other livestock products, and the input is the services (rental value) of pasture land and other inputs such as fencing.

The exclusion of feed from the output measure probably reduces the quality of the annual farm production data. Annual crops lend themselves well to surveys that identify how much was produced in a given year. For livestock, especially dairy and beef cattle with a lifespan of several years, obtaining annual production estimates is not so straightforward. We have data on inventories of cattle on farms and on the slaughter of cattle, but neither gives a direct estimate of production. Cattle sold actually produced much of their beef value in earlier years. In the years before 1910, the approach used by analysts was to multiply an assumed rate of weight gain to the beginning inventory of cattle. This means the estimated changes from year to year in livestock output did not incorporate production variations resulting from changes in the grass available in pastures or in the feeding rate for a particular year. And changes in productivity that took the form of an increase in the rate of conversion of feed to meat were incorporated only by changing the assumed rate of weight gain.

A further measurement problem arises for capital goods. Capital includes all produced means of production that are not used up in a year's production process. Most important among capital goods are the machinery and equipment used on farms. Changes in the characteristics of capital goods over time create serious measurement problems, as in the case of tractors. But even when the nature of a capital good remains essentially the same over time, it is difficult to quantify capital inputs accurately.

Consider the wheelbarrow. Many of those found on farms today are quite similar to those of one hundred years ago. So it would in principle be straightforward to develop a time series of wheelbarrows on farms, and to say by what percentage today's wheelbarrow stock differs from that of 1900. But we cannot do this for aggregate capital, because there are hundreds of capital goods as important as wheelbarrows, and neither in 1900 nor in 2000 were data on their numbers collected. Instead, surveys ask about broad categories of expenditures on items used in production. To get a quantity index, USDA divides expenditures (which is PQ, price times quantity) by an index of prices of production items (P) to obtain an index of aggregate input quantity (PQ/P = Q). Even for a simple input like a wheelbarrow, this approach is not straightforward. The Sears, Roebuck catalogue (1902) lists wheelbarrows suitable for farm use ranging in price from $1.25 to $4.00. In 2000 one could buy roughly comparable wheelbarrows (judging from what is currently available at Home Depot) for $30 to $80. Home Depot is used for comparison because Sears in 1902 advertised itself as the "cheapest supply house on earth," a market niche that today Home Depot more closely approximates than does Sears. For the Sears as well as Home Depot price ranges, prices exclude shipping and assembly. Note also that since the overall price level increased just over twenty times between 1902 and 2000 (using historical CPI or GDP deflator series), the real price of wheelbarrows was approximately constant over this ninety-eight-year span.

Using the midpoints of the wheelbarrow price ranges in 1902 and 2000, the price of wheelbarrows in 2000 was twenty-one times that of the price of wheelbarrows in 1902. So after dividing farmers' spending on wheelbarrows in 2000 by 21, the percentage change between 1902 and 2000 in deflated spending gives us a measure of the change in wheelbarrow quantities bought for farm use. Such an estimate leaves ample room for error, even if we have good data on expenditures for both 1902 and 2000 (which we do not). It could be, for example, that the cheaper wheelbarrow of 1902 was really more comparable to the average one of 2000, so the appropriate price increase is 55/1.25 = 44 rather than 21. This would make a big difference in our estimate of wheelbarrow Q. Or it could be that the more expensive one of 1902 was more comparable to the average one of 2000, and the appropriate price increase is 55/4 = 14. In fact, wheelbarrows have changed. None of the 1902 models had rubber tires and some had wooden trays; but the 1902 models made of steel (the $4 ones) may have been more durable than today's. (It is also true that wheelbarrows are used quite differently on farms in 2000 than in 1902. At one time they were big labor savers in cleaning barns and generally in moving heavy items from one place to another; today they are used for only a few tasks. However, this is not really a measurement problem. To the extent that farm wheelbarrows today spend most of their time in idleness, this just means that each one generates less in productive services, so that having them is properly measured as an input that creates less output, that is, as a drain on farm productivity in 2000 as compared with 1902.)

Lacking data on individual items of capital equipment, USDA and other investigators resort to estimates of aggregate expenditures on equipment. Beyond the index-number problems discussed earlier, changes in the relative prices of different inputs complicate the aggregation of input expenditures, because different items vary in years of service expected. If a farmer spends $50,000 on a tractor and $50,000 on gasoline, it would be wrong to say that they have an equal share in the cost of this year's crop. At the end of the year the farmer still has a valuable tractor, but the gasoline is gone. One approach to measuring the cost of capital inputs is to estimate the opportunity cost of funds tied up plus the amount of the lifetime service of, say, a tractor that is used up in one year; that is, we count only the interest cost plus depreciation in the value of the tractor as the capital input (fuel, repairs, and other associated costs are another input). USDA's estimates cited earlier use this approach, but it is impossible to be accurate about the depreciation that occurs for different capital goods at different times and places, and USDA has been criticized for arbitrariness in the rates of depreciation used (see AAEA 1980 and Penson, Hughes, and Nelson 1977). For example, tractors and other complicated machinery have become more durable as their manufacture has been perfected. And there is a problem in aggregating over the nation at a point in time, because the same equipment will last longer in some climates than in others. Moreover, an increased rate of innovation has in some cases caused more rapid depreciation of the existing capital stock, as older equipment has sooner become obsolete and sometimes has been left to rust, unused. And some innovations that make equipment cheaper also use less durable materials.

Given these complications, the preferred approach to measuring the input services of capital goods is to estimate the rental value of durable equipment. The same rental value approach can be used for land as well. This places the accounting for input use of land and capital goods on the same footing as labor, where the wage rate can be viewed as the rental value of a worker's services. Problems also arise, however, in obtaining data on the rental value of capital goods. More fundamentally, the wage rate is the price of labor input, and we have separate data on the quantity of labor services (for example, hours worked). For capital, the rental price is the basic indicator for both price and quantity. How can we measure the physical thing that constitutes the quantity of capital inputs? A measure of depreciation by itself is not an appropriate answer. Consider two new tractors that are identical except that one is more durable than the other (but they are equally productive in their first year). Their contribution to current output is the same. But using depreciation in calculating the service flow would give a smaller measure for the durable tractor, because depreciation is less. Yet it would be wrong to say that the durable tractor provides less services in production. It would be more appropriate to say that the services of the durable tractor come at a lower price (which is what rental value measures directly).

The appropriate accounting would score the more durable tractor as higher quality. If it provided twice the services for the same cost, it would be equivalent to two less-durable tractors. One way to make adjustments is by means of prices. But prices of two tractors may differ for reasons other than quality. Given the lack of rental price data for most capital goods, and the lack of a standardized, quality-adjusted quantity measure of the stock of complicated machines, the best feasible approach is to define standard quantities as well as possible, for example by horsepower categories of tractors, and then estimate depreciation of each category as indicated by used equipment prices. The decline in price (adjusted for inflation) is an indicator of capital used up, and this plus the cost of funds tied up in the equipment constitutes the relevant economic content of the rental price of capital.

The practical problem—obtaining appropriate depreciation measures from used equipment markets—remains. The most carefully and fully developed information available at present is that made available by Timothy Cross and Gregory Perry (1995) for tractors, plows, certain planters, combines, balers, and other harvesting and cultivating equipment. Unfortunately for the task of historical comparison, the necessary data are generally unavailable before 1980, and Cross and Perry's work makes plain that the pattern of depreciation varies widely across types and manufacturer of equipment, so any depreciation schedule, even the general form of a schedule (for example, geometric decay versus "one-hoss shay" equipment that loses value only slowly until it one day collapses), that is developed for recent years is unlikely to be correct for earlier decades.

The approach of dividing deflated values by an input price index places a great deal of weight on having an appropriate input price index. The most insistent critic of the way USDA has used prices in its input accounting is Zvi Griliches (1960).[4] He estimated that USDA's prices of tractors and other complex machinery as of 1958 were overstated by about 20 percent as compared with their prices of ten years earlier. This meant that USDA's estimate of the growth of real services of these items over the period was underestimated by about 20 percent, and this in turn meant that the USDA estimate of agricultural productivity growth would be overstated by 20 percent times the share of inputs accounted for by these machinery items. If the share is 15 percent, then MFP growth is overstated by 3 percent over the decade or 0.3 percent annually. Since the annual rate of productivity growth at this time was estimated at about 1.6 percent annually, the error was not trivial. The rate of growth of new inputs whose rate of quality change is even faster may be measured even more poorly.

Biases can easily be substantial, but there are two possible silver linings in the cloud. First, if the biases remain similar at all times, we may hope at least to detect accurately changes in the trend rate of MFP growth. But the periods of such structural changes are likely to occur at times when quality-measurement biases are also changing. Second, the problem with input-quality measurement is not that we will find productivity growth where none occurred, but rather that we will misplace the source of growth. Even with no adjustment for tractor quality, we would correctly measure changes in output produced from inputs used in agriculture and in tractor production. It is just that we would attribute to agricultural productivity what is more properly attributed to productivity gains in the tractor industry. If we are willing to view productivity measurement in a broader sense, the problems are reduced. But then to be consistent we should make *no* adjustments for input quality. We should not, for example, adjust for the schooling of farmworkers. Then we would count improvements in the education of farmworkers as part of agricultural productivity growth.

4. See also Griliches (1964b) and ensuing discussion to get the flavor of the obstacles Griliches faced.

Measuring cropland services as an input involves additional problems. Land varies in natural fertility, but we do not attempt to adjust for this in measuring productivity, just as we do not attempt to adjust for workers' strength or natural abilities. If land becomes more productive or labor more productive, without investment, we count that unproblematically as an increase in MFP. But some changes in land management over time are problematic. One is the summer fallowing of land—holding cropland idle during a growing season, typically in order to conserve moisture. In the western states, 17 percent of cropland was counted as being in summer fallow in 1969, but this percentage had dropped to 8 percent by 1997 (Smith and Young 2000). The main reason for this change appears to have been the growth of minimum-tillage practices, which leave more moisture-retaining residue on fields and reduce the value of fallowing. The point for productivity measurement is that if you include only planted acreage in the land base, you will create a bias toward understating productivity growth over the period. In fact, the USDA land input series incorporates all land in farms, including fallow land, so the shift to less summer fallow did not change the measured land input. Note that this approach also counts land idled under government programs (up to 20 percent of cropland in some years) as part of the land input.

After years of work, USDA in the mid-1990s published new and improved input, output, and productivity measures (see Ball et al. 1997). They undertake to make all quality adjustments that the data permit in purchased inputs, labor, and land. The previous USDA index uses data going back to 1910. The new index has additional data requirements: for example, because it attempts to adjust for age and educational attainment of the farm labor force, it covers only the period after 1948. However, for the period they both cover, the old and new estimates of productivity growth are very similar. The average annual rate of growth between 1949 and 1980 was 1.56 percent according to the old index and 1.60 percent under the new index. Figure 2.9 shows a multifactor productivity index for the whole period 1910–1996, constructed by joining the old and new indexes at 1949.

Other agricultural economists have also attempted to construct input, output, and productivity measures that overcome the various criticisms that have been made. Notable studies include Kendrick (1961), Capalbo and Vo (1988), Huffman and Evenson (1993), and Alston and Pardey (1996). Alston and Pardey believe that they improve upon USDA, because they do more with disaggregation by states and therefore have indexes in which inputs and outputs are more uniform in quality, which they then aggregate to obtain a national index. For a common 1949–1985 estimating period, they obtain an annual MFP growth rate of 1.6 percent (1996, p. 153); Ball et al. (1997, p. 1062) obtain 2.0 percent. While various authors make estimates of

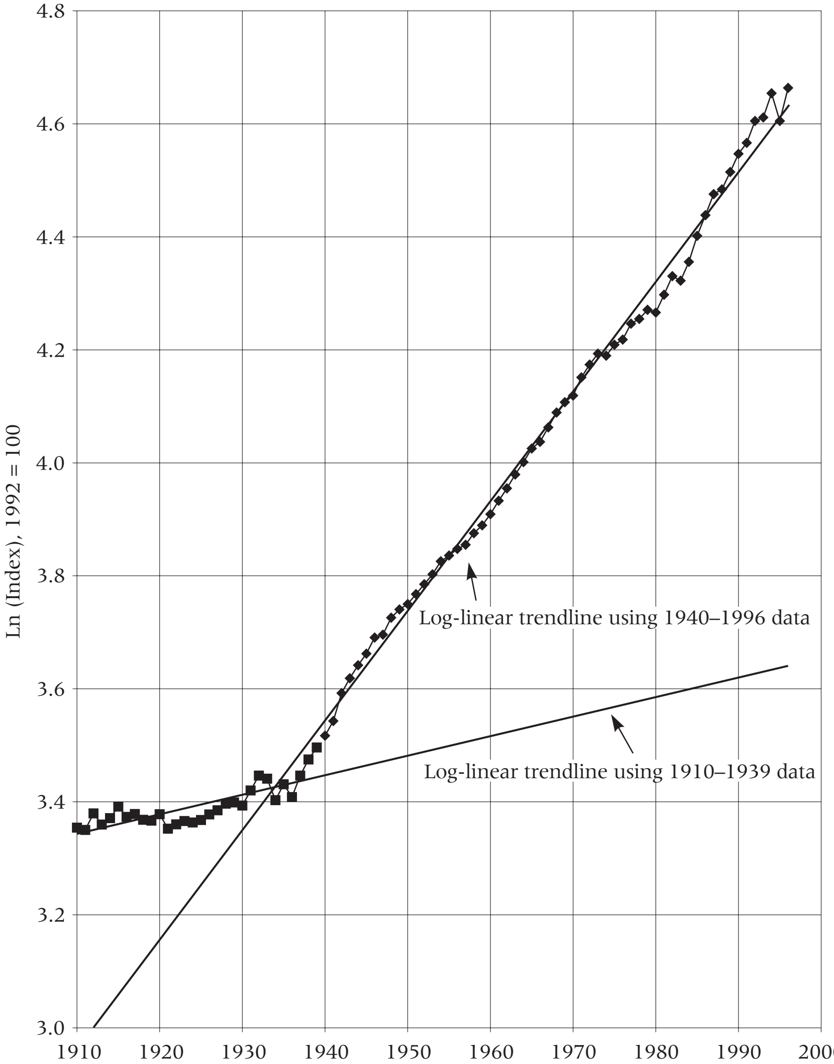

Figure 2.9 U.S. farm multifactor productivity index (smoothed). Data from Ball et al. (1997) and U.S. Department of Commerce (1975).

MFP growth that vary a good deal in specific subperiods, what is most notable is that their longer-term estimates are quite similar. For periods between 1947–1950 and 1983–1985, the annual rates of MFP growth obtained range from 1.3 percent in Capalbo and Vo to 1.8 percent in Huffman and Evenson, and up to 2 percent for USDA, with the others close to 1.6 percent.

The general story told by the multifactor productivity indexes that extend back to 1910 is similar to what the land and labor productivity indicators suggest. Productivity growth was slow before the 1930s—two-tenths of 1 percent annually in 1910–1939. Since 1940 productivity growth has been rapid and has been sustained. Indeed, one difference between Figure 2.9 and some of the earlier yield and labor productivity graphs is that Figure 2.9 shows no sign of a productivity slowdown in the 1980s and 1990s.

However, the apparent acceleration of MFP growth after 1985 is debatable on grounds of the appropriateness of the capital input data. USDA measures a substantial decline in capital inputs since 1980. The evidence indicates that farmers bought much less new equipment starting at about that time (the time of the farm crisis of the 1980s). It is likely that USDA is overstating the rate of depreciation of capital, as the work of Cross and Perry (1995) suggests they may be. The main reason is that USDA assumes that farm tractors and machinery have no productive value after nine and fifteen years of service, respectively. Yet much older equipment remains on farms, according to Census of Agriculture data. The 1997 census reports 3.9 million tractors on farms; yet USDA data indicate only about 1 million had been bought by farmers in the preceding fifteen years. Therefore, about 3 million tractors on farms are not counted in USDA's capital input measurement. Many of these may well be seldom used or rusting behind a farmer's barn. But farmers report them, and observation confirms many such tractors still in use. A similar problem exists for other farm equipment. Therefore, more real capital was left in the 1990s than USDA measures (and correspondingly there was less being used up in the 1980s). Correcting for this would mean more inputs in the 1990s and less in the 1980s, hence higher productivity in the 1980s and lower productivity in the 1990s, thus placing the MFP chart in Figure 2.9 more nearly along the long-term trend line.

The apparent change in rate of growth after 1940 could possibly be just a random event, with no economic meaning. Investigating the data statistically, which means taking seriously the existence of random errors in the data (caused, for example, by weather fluctuations), can help answer the first and most elementary question of whether acceleration really occurred. Figure 2.9 smoothes out year-to-year fluctuations in measured productivity by means of a Kalman filter, and shows least-squares trend lines for the periods before and after 1940 (see Harvey 1989, chap. 4). The trend slope is significantly different in the two periods, where "significance" means the residuals from the trend line restricted to have the same slope through the whole 1910–1996 period are larger than those from the separate trend lines shown in Figure 2.9, and according to the appropriate *F* test would be larger by chance with probability less than 1 percent under the null hypothesis that the slope is the same for the whole period. The estimated rate of productivity growth is 0.4 percent in 1910–1939 per year and 2.0 percent in 1940–1996. But because of the large yield variations in the Dust Bowl years of the 1930s, even smoothed productivity growth is highly variable, and this makes it impossible to pinpoint the year in which MFP growth accelerated.

What Does It All Mean?

Facts about farm technology are observations of machines used, crops grown, workers at their jobs. We know these things are different today than they were fifty or a hundred years ago, and we can describe many of the differences in detail. What we can't see directly is the nationwide aggregate picture that the individual observations add up to. To tackle this objective we need quantified data, aggregations of facts into measured indicators. Our problems begin with the realization of how difficult it is to get data and indicators we can rely on.

The data we have that are closest to observable facts are crop yields estimated by USDA. USDA's enumerators have measured plots in fields and counted ears of corn in much the same way for decades. The resulting estimate of changes in a county's corn yield at two different points in time gives us something fairly solid to work with. For almost all our other data, for example the *value* of a farmer's corn crop, we rely on an interviewee's response to a question. Sometimes the interviewee has only a vague idea of the answer or sees reasons for shading an answer. A large reported value of the wheat crop might lead to a supposition that a farmer is richer, or more taxable, than he wants to be known as being; a small reported value of the crop might lead to a supposition that the farmer is a fool, or unlucky, and this too might influence the answer given.

Fortunately, there are ways, which USDA exploits, to obtain independent information with which to check farm survey data at the aggregate level. Buyers of wheat are fewer, and they can be asked about the prices they pay; there are also publicly available price quotations on organized markets. Millers can be surveyed about the quantities of wheat they use, and exporters file papers about the quantities they export. The various bits of data should add up. Often they do not. The aggregate value of crops reported in USDA's annual economic survey of farmers tends to be substantially less than the value that aggregate data from other sources indicates. USDA relies on its experience and judgment to provide its estimate of the value of crops, and similarly of gross farm revenue, farmers' costs, and net farm income. The estimates so derived have an unfortunately (because unverifiable) subjective component, but they may well be right, or at least only slightly wrong, or consistently wrong in such a way that changes in the estimates over time are meaningful.

When it comes to complex economic concepts like productivity, still more problems arise, as we have seen. Nonetheless, the data available pertaining to productivity appear to be sufficiently fact based, and fit together well enough, to tell a story in which one can be at least provisionally confident. The main result is summarized in the several approaches to measuring technological change and productivity growth in U.S. agriculture that have been reviewed. They all have problems, but the predominant tale told by all of them is the same: at some point between 1935 and 1940, U.S. agriculture became able to increase its output of crops and livestock per unit of inputs at a substantially faster sustained rate than had been seen before in our history (and at a faster rate than in the U.S. nonfarm economy). This accelerated rate of growth was maintained throughout the last half of the twentieth century.

At several times in recent decades the growth story has been seen to be weakening, as yields or some other indicators stagnated for a short period. A not atypical alarm was rung by Jay Staten: "The great upward surge in crop yields per acre that started in 1935 came to an end in the 1970s, and no one knew for sure what had happened" (1987, p. 20). Such alarms have so far proved uniformly false.

In the end it is hard to avoid concluding that productivity growth in U.S. agriculture has indeed occurred at a rapid and long-sustained rate in the post–World War II period. It is also hard to resist believing that this is good news. Productivity growth provides the potential for higher farm incomes and lower consumer food costs. It improves the global competitiveness of the U.S. economy. It indicates investment and action as opposed to torpor and decline. But the good news is not unalloyed, and we have not yet considered the extent to which the potential gains to producers and consumers have been realized, nor have we addressed the costs to workers and other suppliers of goods and services tied to technologies that were replaced. The next chapter begins the task of placing agricultural technology in its social and economic context.

3

Farms

Agriculture has been organized in many ways: as a community activity of a village or clan; as large-scale industrialized collective farms under communism; as plantation-style farming, where most labor is supplied by wage earners or crop-sharing workers or, earlier, by slaves resident on the estate. In contrast, the typical U.S. farm is largely owned and operated by a single household or small partnership. Such operations are limited in size by the capacity of the households' financial and managerial resources, including their borrowing capacity. The existence of family farms as the primary economic unit, alongside the evident technological and economic success of U.S. agriculture, has led to the hypothesis that the family farm as a means of economic organization is a causal factor in that success, perhaps the chief causal factor.

Economists have provided correctives to a too-easy endorsement of the inherent superiority of family farming. Schultz (1964) emphasized the efficiency of traditional agriculture in even the poorest countries, and Robert Fogel and Stanley Engerman (1974) developed evidence of the economic efficiency of plantations in the antebellum U.S. South. Moreover, the economic characteristics of U.S. farms have evolved over the past fifty years, especially in livestock production, in ways that appear ever further from the traditional family farm. Today's broiler grower has lost many of the features thought to be central to family farming, with no evident loss of efficiency or technological dynamism—indeed gains are more apparent. At the same time, others have emphasized the cultural and social problems aggravated by increasing farm size and changing economic organization of farming (for example, Berry 1977 and Hanson 1996).

This chapter presents facts about the economic organization of U.S. agriculture and takes the first steps toward an analysis of structural changes in twentieth-century farming.

Counting Farms

The Census of Agriculture defines the farm as a *place* of agricultural production, and associates with each such place an *operator* of the farm. The census says the following about the farm operator:

> The term "operator" designates a person who operates a farm, either doing the work or making day-to-day decisions about such things as planting, harvesting, feeding, and marketing. The operator may be the owner, a member of the owner's household, a hired manager, a tenant, a renter, or a sharecropper. If a person rents land to others or has land worked on shares by others, he/she is considered the operator only of the land which is retained for his/her own operation. For partnerships, only one partner is counted as the operator. If it is not clear which partner is in charge, then the senior or oldest active partner is considered the operator. For census purposes, the number of operators is the same as the number of farms. (U.S. Dept. of Commerce, Bureau of the Census 1994, p. A-9)

In practice, counting farms and their associated operators is tricky. Several working members of a family may participate in operating the same farm, and some individual operators farm at several locations. Some farms have both an owner and a tenant, and it may not be obvious which one is the operator. Some tenants rent land from many owners, and some landowners rent to many tenants. If a nonfarm resident owns two farms and rents each to a different resident tenant operator, there are two farms for census purposes. But if the same two farms were occupied by farmworkers who were paid wages and had no management responsibilities, there would only be one farm. Yet again, if the workers were resident salaried managers, there would be two farms.

The Census of Agriculture is the primary source of information about farms and farm operators used in this book. It is a useful source because the census was conducted in roughly comparable ways throughout the twentieth century. Censuses of Agriculture were carried out in 1900, 1910, 1920, 1925, 1930, 1935, 1940, 1945, 1950, 1954, 1959, 1964, 1969, 1974, 1982, 1987, 1992, and 1997. Complications arise because the number and types of questions asked have varied considerably from census to census. Before 1920 very little economic information was collected.

A complication in tracking farm numbers is that two different U.S. government counts of farms are published. The census count is published periodically, as just noted. USDA's official farm number estimate, however, is published annually, based on modification of census counts using two sample surveys. One samples a list of farms that the National Agricultural Statistics Service (NASS) maintains, to see if farms on the list remain or have been sold, subdivided, or otherwise changed in operation (for example, the operator retired and rented out the farm's land). The second NASS survey consists of visits to all land segments in areas selected by aerial photography to identify every operating farm within the segment's boundaries.

Although one might expect the census count, which in principle identifies every farm, not just a sample, to be more accurate, the greater attention to finding every farm in a particular area that the NASS procedures follow has demonstrated that the census in fact misses some farms. USDA's estimate of farm numbers for 1997, which is 2,190,500, exceeds the 1,970,000 of the census by 11 percent. The issue is similar to the overall population undercount, which the Census Bureau proposed to correct by means of post-census sampling in the Population Census of 2000 (but was rebuffed by Congress). As with the Population Census, the Agriculture Census has been politically contentious. States want to find large numbers of farms within their borders not only for purposes of statistical pride but also because federal funds for some agricultural programs are distributed to states in proportion to the number of farms in each state.

THE DECLINE OF FARM NUMBERS

Agriculture census data quantify common knowledge that farms have been disappearing (Figure 3.1). The United States began the twentieth century with 5.7 million farms. By 1920 this number had risen to 6.5 million. The 31.4 million residents on the farms of 1920, estimated separately in the decennial Census of Population, accounted for 30 percent of the country's population. In 1997 farm residents made up less than 2 percent of the population. The 1997 percentage is an extrapolation, made necessary because the Bureau of the Census ceased publishing estimates of the farm-resident population after 1991. This decision reflects both the decreased importance of the farm population and the decreasing economic and social significance of residence on a farm, as more people who live on farms are not farmers and more farm households do not live on the farm they operate. The last Census Bureau estimate, for 1991, posited a farm population of 4,632,000, or 1.9 percent of the total U.S. population.

Farm numbers have not declined steadily. Their number rose during 1900–1920, when optimism about farming as a business opportunity prevailed; indeed, farm numbers continued to increase gradually until the mid-1930s. That increase even accelerated a little during the Depression when,

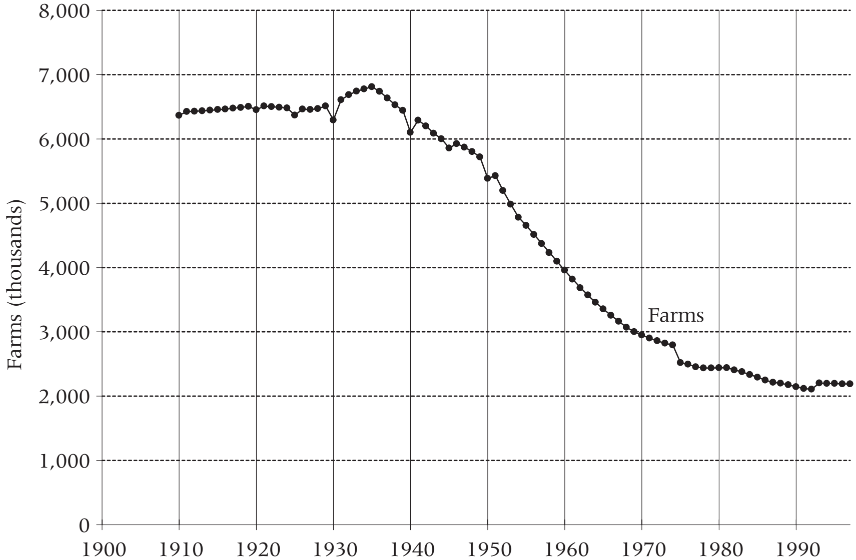

Figure 3.1 Number of farms. Data from U.S. Department of Commerce (1975); for data after 1970, U.S. Department of Agriculture, *Agricultural Statistics,* various years.

bad as the agricultural economic situation was, it was even worse for many of those unemployed in the nonfarm sector. The big decline in farm numbers got started in the late 1930s and accelerated after 1950. In the two decades between 1950 and 1970, the United States lost almost half its farms. After 1970 the rate of decline moderated, but farm numbers continued to fall until the 1990s. During the 1990s the number of farms stopped declining and, according to USDA's estimates, increased slightly over the decade. Surprisingly, in view of the attention given to the industrialization of agriculture, this increase in farm numbers can be attributed to a rise in the number of small farms, as average farm acreage fell from 460 acres in 1990 to 434 acres in 2000 (USDA 2001b).

A complication is that the definition of a farm has changed over time. The Agriculture Census of 1900 defined a farm as an agricultural operation requiring the continuous services of at least one person. In 1910 the criteria were made more precise: an agricultural operation utilizing three or more acres, or normally producing agricultural product worth at least $250 (for sale or home use). In 1945 and 1950 the $250 requirement was reduced to $150. In 1959 the three-acre requirement was increased to ten acres plus at least $50 in production for sale; or if the farm had less than ten acres, $250 in products for sale. The biggest change in definition occurred in 1974, when the acreage criterion was dropped and a farm was defined as any place from which $1,000 in agricultural products were produced and sold, or normally would have been sold. Reference to sales means that agricultural operations that yield production only for the household's own use or for noncommercial distribution are not farms. This change defined about 300,000 small farms out of existence and reduced the farm population by 21 percent. We can estimate the reduction with some precision because the 1974 Agriculture Census and the 1980 Population Census counted farms under both definitions.

The $1,000 sales criterion persisted to the end of the century. As of 1997, USDA's post-census sampling increased the count of U.S. farms from 1.97 to 2.06 million; and a further increase to 2.19 million resulted from a change in farm definition in 1999 that was retroactively applied to 1993–1998 data. The change involved adding some small farms, notably those that had five or more horses but did not meet the requirement of $1,000 or more in sale of farm products, and adding farms producing maple syrup and short-rotation woody crops (see USDA 2001b). A difficulty with such revisions is that they create artificial jumps in the data over time. The official data show an increase of 94,000 farms between 1992 and 1993; keeping the farm definition the same in the two years, however, would have shown a decline of about 25,000 farms. But in Figure 3.1, the 1974 and 1993 changes are the only observable events attributable to change in the farm definition. Note that the $1,000 criterion permits more farms to be counted in 1997 than were counted under the $250 criterion in 1910, since the average price of farm products in 1997 was about six times the level of 1910 while the minimum sales criterion increased only four times.

The economic causes and consequences of the decline in farm numbers have long been debated, and the issues are not fully resolved. A key question is whether farmers were induced to leave agriculture by the invisible hand of opportunity elsewhere or were pushed out of agriculture by the invisible foot of technical redundancy or economic adversity in farming. The process of cotton mechanization, as we saw in the last chapter, combined both. A detailed analysis of this crucial issue will come later.

FARMLAND

Although farm people now account for less than 2 percent of the U.S. population, land in farms is over half of the total area of the contiguous forty-eight states. And in contrast to the huge decline in farm numbers, the amount of land devoted to agriculture has increased in the last hundred years. Land in farms in 2000 was larger than in 1900 by 110 million acres, an increase of 13 percent. But land in farms has declined by almost 25 percent from its peak of over 1.2 billion acres in 1950. Figure 3.2 pieces together statistics that, like farm numbers, were produced by two different government agencies, the Bureau of the Census in the Commerce Department and the Economic Research Service (ERS) of USDA. Until 1950 the estimates are Census of Agriculture counts for 1900, 1910, 1920, 1925, 1930, 1935, 1940, 1945, and 1950, with USDA's linear interpolation between these years from 1910 to 1950. After 1950, the data between census years are USDA estimates that attempt to adjust for farms missed in the census count. But in the census years, the lower census estimates are used. Thus the apparent sharp drops in farmland in 1954, 1959, 1964, and 1969 are just artifacts of data publication choices. After 1970, the data use USDA's own estimates even in census years.

Although the decline in farmland over the last five decades is modest compared with what transpired in farm labor, the loss of land for agricultural purposes has been sufficient to raise calls of alarm. Perhaps the most intense discussion of this issue was dubbed the "vanishing farmland crises" in the early 1980s (see Baden 1984). The factual background for this out-

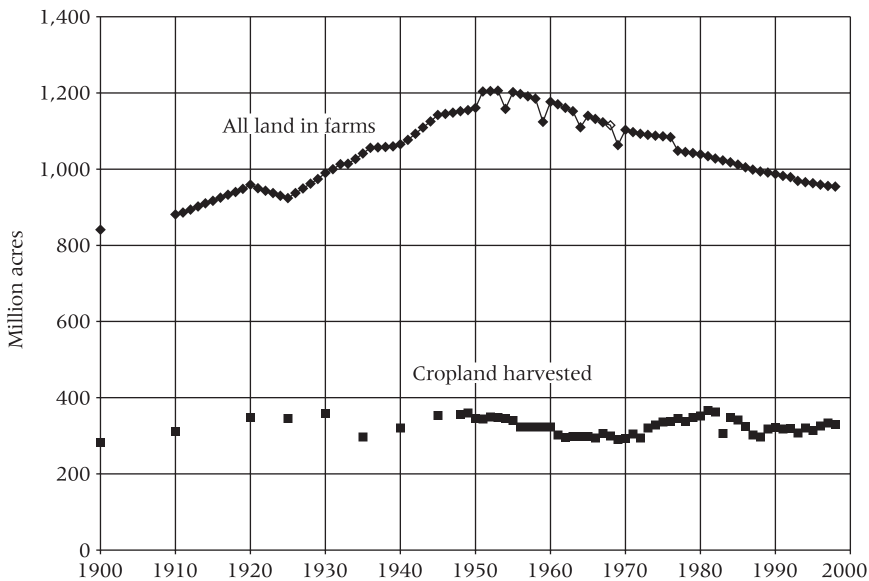

Figure 3.2 Land in farms and cropland harvested. Data from U.S. Department of Commerce (1975); for data after 1970, U.S. Department of Agriculture, *Agricultural Statistics*, various years.

break of concern was the global commodity price boom of the 1970s, plus the growing suburbanization of metropolitan areas. An estimated million acres annually was then, and still is, converted to housing and associated business and infrastructure, and several hundred thousand acres of this conversion, on average, come from productive cropland.

Attempts to assess the declining farmland issue have typically reached the conclusion of President Lyndon Johnson's National Commission on Food and Fiber, that farmland loss "does not appear to be a major threat to our national agricultural productive capacity" (National Commission on Food and Fiber 1967, p. 245). A major dissenting opinion is that of the National Agricultural Lands Study of 1981, which will be discussed later. It is a puzzle why there should be more concern about the implications for agricultural production of a modest decline in farmland than about the much larger decline in the farm labor force that has occurred. Perhaps it is thought that it is easier to substitute other inputs for labor than it is for land, or that labor can more easily be called back into agriculture than can land; but evidence is lacking for the easier substitutability, and the practical relevance of either point is dubious. Indeed, if one looks at the subset of land that is most crucial for farming, land suitable for growing crops, the point about vanishing land is largely moot. Cropland harvested shows hardly any downward trend since 1950, and in fact has a remarkable absence of trend for the whole century (Figure 3.2). It is true that substantial amounts of excellent cropland have been lost to cities and suburbs, but at the same time new cropland has been created through conversion from pasture, irrigation, or drainage. As the crop yield data of Chapter 2 indicate, moreover, there is no evidence of a decline in the quality of land that would result in overall damage to land's productivity.

Land tenure. Land is the defining feature of crop farming and of ranching, and land is a valuable asset. Yet many farmers are not wealthy; indeed many are poor. How to gain access to sufficient land for farming is therefore a serious problem facing an agriculture made up of family farms. A solution is to be a tenant farmer. Tenancy has two main forms: cash rental and sharecropping. Under cash rental, the farmer pays the landowner dollar rental payments in exchange for the right to grow and harvest crops on the leased land. Under sharecropping, the tenant pays the landowner with a share of the crop. For examples of both cash and crop-share farmland leases in use early in the twentieth century—basically similar to those of the present—see Taylor (1909, pp. 271–286). The share of the crop going to the landlord varies widely, but the most common arrangement by far is a 50-50 division.

(For an interesting discussion of reasons for the prevalence and stability of 50 percent shares, see Young and Burke 2001.)

Cash rental has the disadvantage that the tenant bears the risks of crop failure or low prices, yet is often less able to bear risks than the landowner. In contrast, under sharecropping the rental payment by its nature involves risk sharing and is made only after the harvest, and so does not place financial pressure on the renter (although some cash rental contracts allow for delayed payments). Share arrangements are also more adaptable to arrangements under which the landlord provides some of the purchased inputs and perhaps participates in the management of the operation. In the extreme form of such arrangements, for poor southern sharecroppers, the tenant is essentially a farm laborer with management and risk-bearing responsibilities. Sharecropping has the disadvantage from the landlord's viewpoint of requiring more monitoring of the tenant's behavior, since the size of the crop and price received for it can to some extent be hidden from the landlord.

In 1900, 35 percent of U.S. farms were operated by tenants, 13 percent cash tenants, and 22 percent share tenants.[1] The ideal of tenancy in a family farm system was that a young farmer without wealth or borrowing power could begin farming leased land and work up the "agricultural ladder" to farm ownership. But through the first third of the century the proportion of land farmed by tenants kept increasing. As the President's Committee on Farm Tenancy reported in 1937, "hundreds of thousands of tenant farmers, in spite of years of scrimping, have not been able to accumulate enough to make a first payment on a farm of their own" (Rasmussen 1975, p. 2103).

Since 1940 tenant farming has declined steadily, from 39 percent of farms accounting for 29 percent of U.S. farmland in 1940 to 10 percent of farms accounting for 12 percent of farmland in 1997. The nature of tenant farming has changed, too. In 1940 tenant farms were substantially smaller in acreage than the average U.S. farm, while in 1997 tenant farms were larger than average. The percentage of all U.S. farmland rented, however, has changed less since 1940, having fallen from 44 percent then to 41 percent in 1997. Most of the rented land is farmed by part-owners who own some land and rent more in order to reach a larger scale of operation. The majority of farmers are full owners, but their farms are only a little more than

1. Data on tenancy here and to follow are from the U.S. Census of Agriculture, which asked questions on the subject in 1900 and all subsequent census years, supplemented by a post-census Agricultural Economics and Land Ownership Survey in recent years. The latter is the main source of information about landowners who are not themselves farm operators.

half the size of the average of all U.S. farms, so that full owners account for only about a third of U.S. farmland.

The Evolution of the U.S. Farm as a Production Unit

In the traditional family farm, the operator's household owns much of the land and equipment used, and supplies most of the labor. There have always been many farms outside these parameters. Sugar cane farms, western ranches, and commercial fruit and vegetable growers have had quite substantial hired labor forces. Many poor farmers and young farmers have owned very little capital and land, and essentially supply labor and some variable inputs for a share of the crop. Some farms are owned by large corporations, as well as nonprofit institutions and government agencies (prisons, universities), of whom the farm manager and all workers are hired employees working for wages. Since World War II there has been a significant increase in various kinds of contracting arrangements under which a person runs a cattle-feeding, vegetable-growing, or poultry-raising operation with ownership and sometimes decision making shared with people who are not farmers according to the census definition, because they are not the decision maker at the farming location.

The Census of Agriculture asks about the type of organization of each farm, in particular whether the farm is "incorporated under state law" and, if so, whether this is a "family-held" corporation (more than 50 percent of stock owned by persons related by blood or marriage) and whether there are more than ten stockholders (U.S. Department of Commerce 1994, app. D). The importance of nonfamily farming is indicated by the data of Table

Table 3.1 Type of organization of farms, 1997

	Percentage of all farms	Sales per farm ($)	Percentage of all product sales
Individual and family ownership	86.0	62,500	52.1
Partnership and family-held corporation[a]	12.9	332,000	41.4
Corporation not family held	0.4	1,395,000	5.6
Other[b]	0.8	117,000	0.9

Source: U.S. Department of Commerce, *Census of Agriculture,* 1997.

a. Partnerships are farms operated by two or more persons who jointly contribute capital and labor and share in returns from the farm. Joint ownership of the farm by husband and wife does not constitute a partnership, nor does production under contract or crop-share land rental.

b. Farm operated by prisons, universities, or other institutions; by cooperatives; or by trusts or estates of deceased persons.

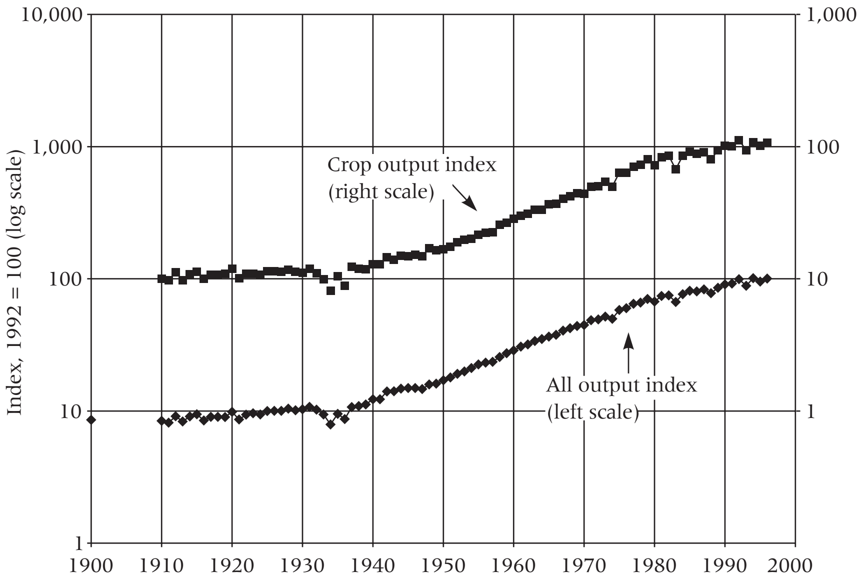

Figure 3.3 U.S. agricultural output per farm. Data from U.S. Department of Commerce (1975); for data after 1970, U.S. Department of Agriculture, *Agricultural Statistics,* various years.

3.1 for 1997. The traditional family farm (not including partnerships) accounts for 86 percent of farms but only a bare majority of U.S. agricultural production. In 1978, when questions about corporate farming were first asked, 88 percent of farms accounting for 63 percent of production were traditional family farms. Nonfamily corporate farms doubled in number between 1978 and 1997, but their economic importance remains relatively slight. They accounted for only 6.5 percent of U.S. farm sales in 1978 and 5.6 percent in 1997. The main increase has been in the importance of partnerships and family-held corporations.

FARM SIZE

A pervasive structural change is the increase in the size of farms over time. Figure 3.3 shows the long-term trend of output per farm. There is a notable increase after 1935, but the rate of growth slows after 1980. Livestock output per farm has been influenced by the emergence of large cattle feedlots. Figure 3.3 also shows the size trends for crop output only, thus omitting events in livestock. Crop output per farm also accelerated after 1935, with output per farm in the 1990s about ten times that of the 1930s. Crop output per farm increased at a slightly faster rate than livestock in 1950–1980, and livestock per farm increased faster since 1980.

Figure 3.4 shows the growth of acres per farm, a measure of size whose relevance is limited to crop growing but which gives a different perspective by looking at the input rather than the output side of farming. This measure may give a more accurate picture of the rate of change in economic organization, since output per farm increases when multifactor productivity increases, even if economic organization is unchanged. The average size of farms by the acreage measure shows the same pattern as output—slow growth until the mid-1930s with acceleration thereafter. But note that while output per farm rises by a factor of ten in Figure 3.3, acreage per farm rises by a factor of three in Figure 3.4.

Characteristics of farms by size. Two related but distinct issues are the average size of farms and the differences between small and large farms at any point in time. Taking annual sales as a measure of size, Table 3.2 shows the differences between small and large farms, using data from the 1994 USDA Farm Costs and Returns Survey. Four size categories are distinguished. First, consider farms with less than $50,000 in sales. These farms sell about one-sixth the amount of the average farm, averaging $12,000 in sales compared with

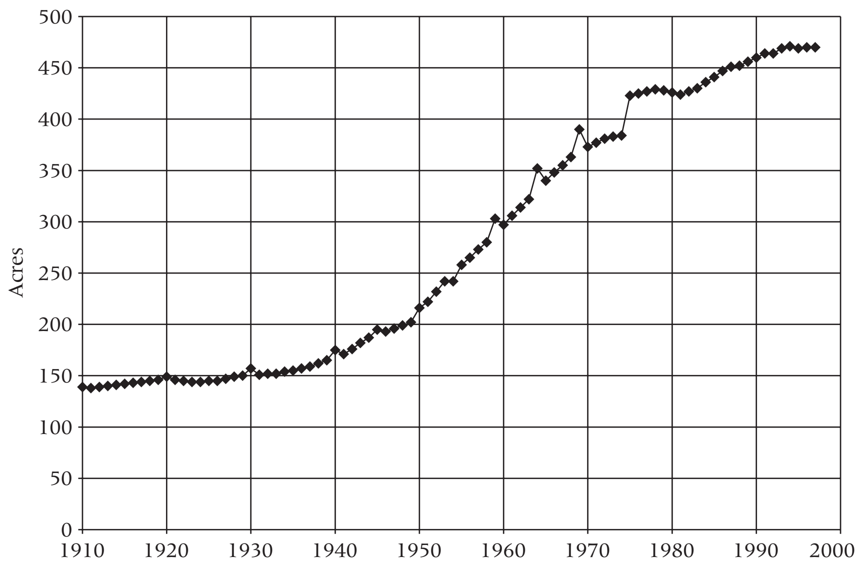

Figure 3.4 Acres per farm. Data from U.S. Department of Commerce 1975; for data after 1970, U.S. Department of Agriculture, *Agricultural Statistics,* various years.

Table 3.2 Farm characteristics by sales class, 1994

	Less than $50,000	$50,000 to $100,000	$100,000 to $250,000	$250,000 or more
Number of farms (thousands)	1,483	211	221	120.5
Acres per farm	187	719	1,186	1,834
	Dollars per farm			
Gross farm income	11,991	73,616	148,848	619,739
Net income from farming[a]	1,644	15,052	19,399	113,606
Net worth	258,083	395,584	564,903	1,150,190
Debt/asset ratio	6.2	11.9	17.1	21.3
Percentage financially vulnerable or marginally solvent	0.055	0.122	0.204	0.057
	Dollars per farm household			
Off-farm income[a]	41,603	31,625	26,000	27,725
Mean household income[a]	38,168	39,531	41,935	105,243
Government payments	1,299	5,344	8,392	15,965
Payments as percentage of gross receipts	0.108	0.073	0.056	0.026

Source: USDA (1997c).

a. Note that "net income from farming" differs from the USDA sectoral net farm income concept. Off-farm and mean household incomes are per household, not per farm, and differ because there are more farm households than farms. See USDA (1997c), table C, for details of accounting procedures.

a $69,200 average for all farms. In terms of acreage, this small-farm class averages 187 acres compared with 448 acres for all farms. But the greatest contrast is in net farm income, which averages a loss of $1,600 for small farms compared with $11,600 for all farms.[2]

The net income estimate suggests the small-farm category is economically negligible. It is then all the more striking that 1.5 million, or almost three-fourths, of all U.S. farms belong to this category. The smallest class of farms that might reasonably be characterized as commercial operations is the $50,000 to $100,000 sales class. This is roughly the range of output value generated by 20- to 40-cow dairy herds or 150- to 300-acre grain producers.

2. The numbers given in the text are rounded to the nearest 100 or 1,000 from those in Table 3.2 to better reflect the imprecision of the estimates. For example, the USDA survey's sampling error implies a one-third probability that the true value of mean household income of all farm families is outside the range of $3,000 around the estimate based on the sample. Thus even the $69,200 of the text might give an overly precise notion of our economic knowledge.

Sales at these levels typically cannot support a full-time farmer at the U.S. average standard of living, but members of this group have sufficient off-farm income to bring their average household income up to $39,500.

The $100,000 to $250,000 sales class contains what under today's circumstances are properly viewed as relatively small commercial farms in livestock, for example, 40- to 100-cow dairy herds, or 300- to 800-acre grain operations.

The most rapidly growing and economically dynamic farms are the larger farms, those with $250,000 or more in annual sales. These farms averaged $620,000 in gross farm income and $114,000 in net income from the farm. If we value the opportunity returns of the $1,150,000 average net worth of these farms at 6 percent per year, this leaves 114,000 − 69,000 = $45,000 as the return to the operator's labor and management. So these farms, on average, are economically viable and their operators are earning reasonable returns on their investment (although 26 percent of these farms reported net farm income of less than $20,000, and 18 percent reported farm losses). Their aggregate sales amount to $75 billion, or half of the $150 billion U.S. aggregate sales that USDA estimates, despite the fact that these farms number only 121,000, or 6 percent of all farms. These farms, though large, are predominantly family operations as opposed to being owned by corporations with nonfarm stockholders who hire a farm manager. Only 6,500 farms were organized as nonfamily corporations or cooperatives (USDA 1997b, p. 105).

Large farms are not simply replicas of smaller ones on a bigger scale. The fundamental reason is that there is still only one farm operator. Therefore, as farm size increases, each farmer utilizes more purchased inputs, fixed capital, land, or hired labor. More of the farmer's time is devoted to managerial decisions and coordination tasks. For example, the average hired-labor expenditure for farms with more than $250,000 in sales in 1994 was $82,000. The average wage paid to farmworkers in 1994 (estimated by the quarterly USDA survey of farm employers) was $6.20 per hour. Considering 2,000 hours annually for a full-time-equivalent worker, the wage bill indicates an average hired farm work force on large farms of 6.6 workers (in full-time equivalents). Since farm employment is typically seasonal rather than full time, these farms would typically hire more than 6.6 workers for less than 2,000 hours annually, and in many cases, the farmer simplifies labor management by hiring seasonal field hands through a labor contractor.

Large farms and ranches have always existed, of course. An issue in the development of U.S. agriculture in the twentieth century and the start of the twenty-first is the extent to which a new structure of farm enterprises is replacing traditional family farms. Data on average acreage and output of farms that have already been cited indicate growth in size. Other important structural indicators include commodity specialization, the importance of off-farm landlords, the extent of wage labor as opposed to the farm family's labor, and the involvement of nontraditional organizational forms such as nonfarm corporations and contractors.

Specialization and size. In 1900 farms were less specialized in commodity production than they are today. Of the 5.7 million farms counted by the Agriculture Census of 1900, 5.6 million (98 percent) of them had chickens, 4.7 million (82 percent) grew corn for grain, 4.5 million had at least one milk cow, and 4.3 million had pigs. Most of the farms had most of these items. In the 1992 census, of the 1.9 million farms, only 4 percent reported chickens, 25 percent corn, 8 percent milk cows, and 10 percent pigs.

Table 3.3 provides more detail about specialization. Of seventeen major farm commodities, the average farm grew five of them in 1900. In 1992 the average farm reported less than two. This is a crude index, omitting several

Table 3.3 Number of farms producing each commodity (thousands of farms)

Commodity	1900	1920	1950	1969	1992
Corn	4,698	4,937	3,202	986	504
Sorghum	20	130	142	136	71
Wheat	2,054	2,225	1,148	584	292
Oats	2,114	2,238	1,341	501	141
Barley	273	449	297	131	58
Rice	48	21	11	9	11
Soybeans	0	31	370	530	380
Peanuts	134	230	183	48	16
Alfalfa	96	542	984	834	434
Cotton	1,419	1,906	1,111	200	35
Tobacco	308	449	532	276	124
Sugar beets	14	47	28	18	9
Potatoes	2,836	2,888	1,650	108	15
Cattle	4,730	5,358	4,064	1,719	1,074
Pigs	4,335	4,851	3,012	686	191
Sheep	764	539	320	171	81
Chickens	5,578	5,837	4,216	471	88
Sum	29,421	32,678	22,611	7,408	3,524
Total number of farms	5,740	5,837	5,388	2,733	1,925
Specialization index (commodities per farm)	5.1	5.6	4.2	2.7	1.8

Source: U.S. Department of Commerce, *Census of Agriculture.*

Note: The 1969 census reported separately for oats, barley, alfalfa, and sugar beets only for the 1.7 million farms with over $2,500 in sales. Projections from the census data were used to estimate the number of all farms producing these commodities in 1969.

important commodities because uniform data were not collected in all the census years, and omitting scores of minor products. The main omissions, however, tell the same story. For example, in 1900 apples were grown on 3.0 million farms; in 1992 only 34,000 farms grew them. Grapes fell from 924,000 growers in 1900 to 22,000 in 1992. The key fact is that the number of farms producing almost every commodity has declined faster than the total number of farms.

The trend toward specialization has not been a steady one. Between 1900 and 1920 specialization decreased slightly. For the first half of the century, the changes were only modest. In 1950, 78 percent of all farms still had chickens and 68 percent, milk cows. It is the period since 1950 in which specialization has become a dominant theme in the economic organization of farming. The reasons for specialization are not necessarily the same as the causes of growth in farm size. A diversified farm could grow larger by increasing the output of all of its products. And a farmer who decided to specialize in a product that was particularly remunerative might do so at a smaller scale of output of that product than of the formerly diversified set of products. The fact that specialization and larger size have gone together suggests that economies of scale in producing particular products have been a driving force behind both farm size and specialization.

For example, automated feeding equipment has made it possible for a farmer to handle a much larger livestock fattening operation than was once the case. Assuming investment in feeding equipment is cost effective, which its adoption indicates it is, the scale of a farm's livestock operation will increase. Unless the farm's labor force increases, expanding the livestock operation requires contraction of some other farm enterprises—that is, specialization, which is what we have observed taking place. The fact that, on average, the specialized farm ends up being larger than the original diversified one indicates that scale economies must have been substantial. To understand more precisely what has transpired, further details on input use on farms are necessary.

Figure 3.5 shows the trend in manufactured inputs—aggregating expenditures on tools, fuels, machinery, fertilizers, pesticides, and other purchased inputs—as a share of total production expenses. This share is increasing over the whole time period for which we have data, but the main increase is in the first half of the century, when the share of manufactured inputs increased from about 5 percent to 12 percent of all costs. Note, however, that the relative importance of these inputs increased much less rapidly during the period of accelerated productivity growth and specialization in the post–World War II period.

Indicators of the ownership structure of U.S. agriculture also have sur-

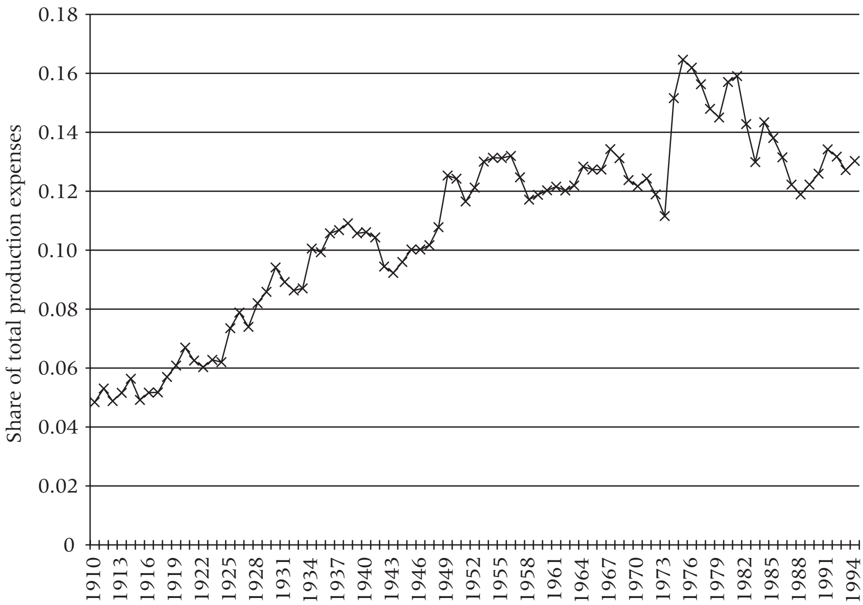

Figure 3.5 Expenditures on manufactured inputs as share of production expenses. Data from U.S. Department of Commerce (1975); for data after 1970, U.S. Department of Agriculture, *Agricultural Statistics,* various years.

prising trends in view of the situation of the larger commercial farms, which now account for half of U.S. agricultural output. The large acreage and capital investment required for large-scale farms make it difficult for the traditional family owner-operator structure to persist. The farmer typically needs outside labor, land, and, most important, capital to attain the necessary scale of operation. The indicators we have of an increased role of off-farm resource providers are: for land, rents paid by farmers to nonfarm landlords (in cash or in crop shares); for capital, interest paid to banks and other lenders; and for labor, wages paid to hired farmworkers.

Rents paid to nonfarm landlords, after declining as a share of production expenses early this century, have been quite steady at about 4 to 5 percent of the value of farm output (Figure 3.6). A rise to a 6 percent share in the 1990s indicated an increased role for nonfarm landlords in the previous fifteen years, but this just returns the situation to what prevailed in 1920.

Interest paid on farm debt comprises payments on both real estate mortgages and shorter-term operating credit. Banks and other providers of credit share in the ownership of agriculture in the same way that nonfarm land-

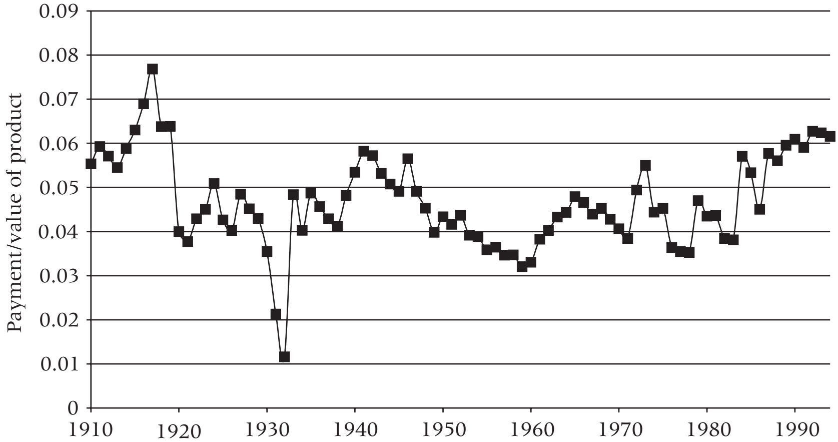

Figure 3.6 Payments to nonfarm landlords as percentage of farm output value. Data from U.S. Department of Commerce (1975); for data after 1970, U.S. Department of Agriculture, *Agricultural Statistics,* various years.

lords do. They provide resources for farming and have a claim on the fruits of farm enterprises. Despite the capital requirements of large-scale farming, interest payments did not increase in importance over the last century. Interest payments by farmers amounted to more than 10 percent of the value of farm product sales in the 1920s and early 1930s, and again in the 1980s. These were periods of financial distress in agriculture, amplified in the 1980s by high interest rates on debt acquired in 1978–1981 during a land price boom. By the mid-1990s interest on farmers' debt had settled at the same magnitude as land rental payments to nonfarm landlords, about 6 percent of the value of farm products (Figure 3.7).

Perhaps the most surprising element in the supply of nonfarmer inputs is the decline in the importance of hired farm labor. Hired labor accounted for more than 20 percent of production expenses in 1910, but in the 1990s averaged about 9 percent of all expenses (Figure 3.8). In part this reflects the declining importance of labor as compared to capital as mechanization and other labor-saving technical change has occurred. The ratio of hired farmworkers to owner-operator family workers has had no apparent trend. There was one hired worker for every two farm operators in 1910, and that same ratio prevailed in the mid-1990s. However, hired farmworkers, as is the case for other input indicators, are more concentrated on the larger farms now than was the case prior to World War II.

In short, for purchased inputs and hired labor we see a slowdown in their importance as a share of U.S. agricultural inputs in the period after World

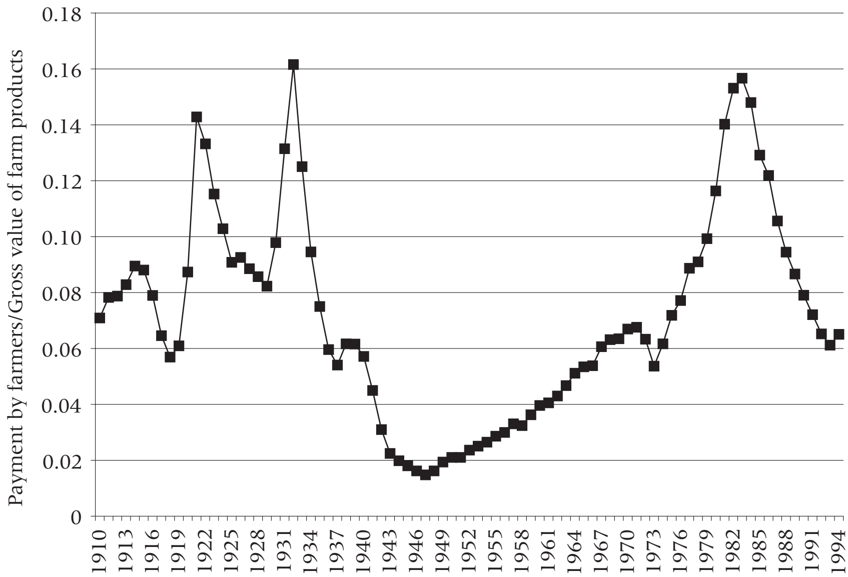

Figure 3.7 Interest as share of output value. Data from U.S. Department of Commerce (1975); for data after 1970, U.S. Department of Agriculture, *Agricultural Statistics,* various years.

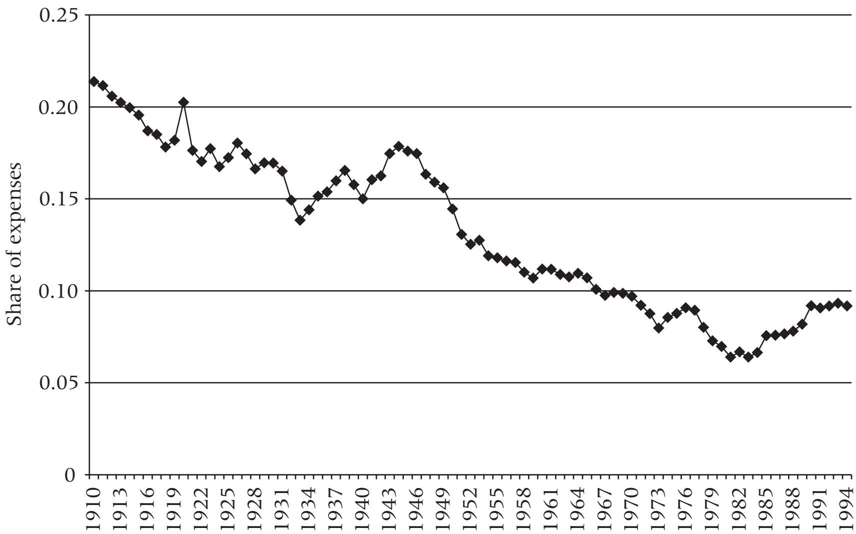

Figure 3.8 Hired farm labor expenditures as share of production expenses. Data from U.S. Department of Commerce (1975); for data after 1970, U.S. Department of Agriculture, *Agricultural Statistics,* various years.

War II, just the period when the growth of average farm size accelerated. Thus the scenario does not appear to be one in which technology leads to industrialization in the sense of "factory farms," with bosses, stockholders, and wage workers replacing owner-operator farms. Rather, technology permitted owner-operators to mobilize the capital needed to produce a great deal more output on traditionally organized farms. However, the aggregate data hide a sharp distinction between farms producing the major field crops (for which the preceding characterization roughly applies) and those producing livestock and specialty (fruit and vegetable) crops. Some of the latter sectors have moved notably in the direction of industrialization. Generally, it is important to disaggregate and consider more fully the diversity of U.S. farm operations.

Dominance of large farms. The disparity in size between small and large farms is great, but we have not yet considered evidence of trends in disparity. Large and small farms have always coexisted. The question is whether the growth of U.S. farm size has occurred across the board, so that both small and large farms grew, or large farms have become ever larger relative to small farms.

Consider acreage as a measure of farm size. Just over a century ago a generally well informed observer, the U.S. secretary of agriculture, forecast for the long-term future that "the average size of our farms will be considerably less than now. There will be large farms, no doubt; but under such a modernized system of agriculture as will unquestionably prevail a hundred years hence, what will be a large farm then would not be regarded as a particularly large farm at the present day" (Rusk 1893, p. 263). The way in which Secretary Rusk's forecast missed the boat is apparent from his earlier statement that "I do not think it probable that farm implements will be improved very much." What we have experienced instead is a remarkable development of machinery that enables a crop producer to handle acreages that would have been unthinkable a hundred years ago. But though the average harvested crop acreage on crop-producing farms has increased from about 55 acres in 1929 to 220 acres in 1997, there remain many smaller crop operations. What has happened to the concentration of acreage on large farms as compared with smaller ones?

A simple indicator of concentration is the percentage of all U.S. farmland accounted for by the largest farms. The top panel of Table 3.4 shows this measure of concentration for the largest 10 percent and 20 percent of all farms, and for the smallest 50 percent. Thus, the figure of 0.13 for 1900 means that the 50 percent of farms that had the least acreage accounted for only 13 percent of all acreage (implying the largest 50 percent had 87 percent). This suggests quite high concentration of land in farms even in 1900.

Table 3.4 Shares of farm acreage and sales accounted for by farm size categories

	Smallest 50% of farms	Largest 20% of farms	Largest 10% of farms	Ratio of acreage (sales) per farm of largest 10% ÷ smallest 50%
By acreage				
1900	0.13	0.60	0.45	17
1920	0.12	0.61	0.46	19
1930	0.10	0.64	0.50	25
1940	0.09	0.69	0.55	31
1959	0.08	0.74	0.63	39
1978	0.05	0.84	0.73	73
1992	0.04	0.87	0.76	95
By value of sales[a]				
1930	0.15	0.58	0.41	14
1940	0.12	0.64	0.48	20
1950	0.10	0.68	0.52	26
1959	0.06	0.69	0.45	38
1969	0.05	0.76	0.60	60
1978	0.043	0.83	0.63	73
1992	0.023	0.85	0.70	152

Source: Calculations based on U.S. Department of Commerce, *Census of Agriculture* data.
a. Includes on-farm consumption prior to 1950.

But as the data for later years show, concentration has steadily increased since 1900. By 1992, the smallest 50 percent of farms had only 4 percent of U.S. land in farms. Looking at the very largest farms, the biggest 10 percent had 45 percent of U.S. land in farms in 1900 but 76 percent in 1992. The trend toward increasing concentration runs through the whole century, although the transformation is not substantial before 1920.

Objections can be raised to using acreage as an indicator of concentration. In recent years, when farms have become more specialized, some farms that feed livestock have become very large in an economic sense, but without large acreage. So the trend toward concentration of acreage could understate or overstate the trend toward economic concentration. A better indicator of size is the level of output. The bottom panel of Table 3.4 shows the share of aggregate farm sales accounted for by the smallest 50 percent of farms, by the largest 20 percent, and by the largest 10 percent of farms, with size measured by value of sales from the farm. The sales-based measure indicates less concentration than the acreage-based measure did, but the trend is the same for the two measures. (The data on sales only go back to 1930 because the Census of Agriculture did not collect information on the value of sales until 1930.)

The fact that, in the top (1930) row of the panel, the lower 50 percent of farms generate 15 percent of sales means that these farmers had sales equal to $^{15}/_{50}$ = 30 percent of the sales of an average farm in 1930. Similarly, the largest 10 percent of farms had sales $^{41}/_{10}$ = 4.1 times the sales of the average farm. Thus the largest 10 percent of farms are roughly 14 times the size, on average, of the smallest 50 percent of farms.

There is no inherent reason why these concentration measures should increase over time, even if average farm size increases. For example, if all farms double their sales, the share-based concentration indicators will be unchanged. But in fact concentration has increased steadily and substantially over the past seventy years. By 1992 the smallest 50 percent of farms had only 2 percent of farm sales—their sales are $^{1}/_{25}$ the average farm's sales. The largest 10 percent had sales over 7 times the average farm's sales. The largest 10 percent are about 190 times the size of the bottom half, and this measure of disparity increased twentyfold between 1930 and 1992.

The overall picture of concentration can be seen graphically using the cumulative-frequency curves shown in Figure 3.9. These graphs plot the cumulative percentage of sales against the cumulative percentage of farms, ranked from smallest to largest. If all farms had the same level of sales, the curve would be a "line of equality" from the 0,0 coordinate to the 1,1 coordinate. What is striking is how much further from equality the 1992 curve is as compared with 1940.

CONTRACTORS AND VERTICAL INTEGRATION

A final element of structural change in U.S. agriculture is the increasing involvement of people who are not themselves farmers, farmworkers, or hired farm managers. Involvement in agriculture by corporations, which would grow their own agricultural raw materials rather than buy these products from farmers, was seen as a threat to family farming through much of the twentieth century. Several states enacted statutes placing limits upon or even banning ownership of farmland or farming operations by nonfarm corporate enterprises (see Chapter 6). This form of vertical integration has never become important, but a closely related institutional innovation has, namely production contracts with farmers that give a contractor control over key aspects of the farm operation. These contractors, who may be processors, input suppliers, or other "integrators" in the marketing chain, make many of the decisions, provide many of the inputs, and underwrite many of the risks that have traditionally been the province of farmers. In some cases, for example, under broiler production contracts, the person meeting the USDA definition of a farm operator may be more realistically described as a part-time farmworker paid on a piece-rate basis by a contractor. Contractors

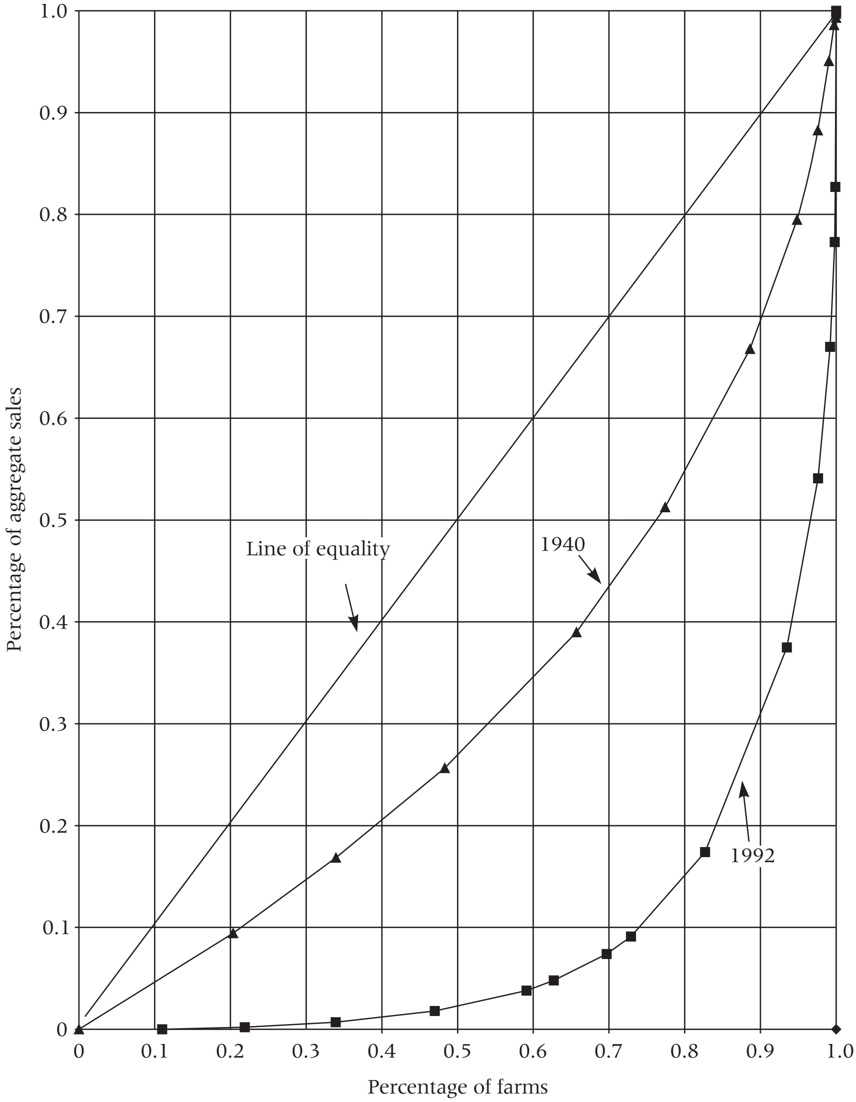

Figure 3.9 Concentration of value of farm sales. Data from U.S. Department of Commerce 1975; for data after 1970, U.S. Department of Agriculture, *Agricultural Statistics,* various years.

are known as integrators because the economic rationale for contracting is typically akin to vertical integration—the coordination of production at several levels of the marketing chain that runs from farm inputs to the retail purchaser of the food products.

In the case of broilers, the integrator is typically a chicken-processing corporation. The processor wants control of a supply of chickens and, to the extent feasible, of their quality. The processor could use an auction market or a traveling buyer to acquire chickens, but prefers a better guarantee of availability and uniformity of product than these methods of acquisition can provide. The processor could alternatively raise chickens as part of the corporate enterprise, hiring workers to tend the flocks, but finds the necessary monitoring of dispersed individual workers uneconomic. Contracting provides a third alternative that both gives the processor control over the quantity and quality of birds and reduces the need for monitoring by providing incentives for the grower to deliver the quantity and quality of chickens desired by the processor.

These arrangements have come to dominate the broiler industry, typically through production contracts under which the processor supplies the chicks, often the feed and specialized services for health maintenance (of the growing chickens), and markets the chickens when ready. The grower provides the chicken house and equipment and the labor, including monitoring the needs of the growing birds and acting to manage crises like heat waves, power outages, or disease outbreaks. The grower receives a "growout fee" of a prespecified amount per pound of live bird delivered to the processor for slaughter, with bonuses and discounts rewarding efficient and penalizing inefficient production.

Statistical information about contracts and contractors is quite limited. The Agriculture Censuses of 1959 and 1969 first carried out follow-up surveys that asked farmers about contracting. In 1959, 147,000 farms were estimated to have contracts, and in 1969, 156,000 (6 percent of all farms) reported using production or marketing contracts. The value of production sold under contract was estimated at 12 percent of all farm sales in 1969. Annual surveys have asked growers about their contracts in more recent years, and from these it appears that as of 1993 about $47 billion, or 32 percent, of the value of U.S. agricultural production was produced under contracts (USDA 1996). This figure includes not only production contracts of the broiler-grower type but also marketing contracts. These are simpler arrangements that offer a prearranged price for a farm product sold to a particular buyer. In these cases the contractor, often a vegetable processor, agrees in advance to accept a grower's output at a price mutually agreed upon between buyer and grower, in exchange for the grower's commitment to supply the farm's output at that price. There is little or no integration of production decisions or input supply, so that in these cases the grower still carries out all the main functions normally ascribed to farmers.

Table 3.5 shows the extent of contracting for various types of farms. Production contracts are most heavily used for broilers. Marketing contracts are used most heavily for fruits and vegetables, and in cotton. A low percentage

Table 3.5 Contracting by farmers in 1993

	Total farms (thousands)	Percentage using contracts	Percentage using production contracts	Percentage using marketing contracts	Share of production under contract
All farms	2,063	11	2	9	32
Poultry farms[a]	27.6	89	85[b]	8	86
Dairy farms	125	28	2	26	43
Hog farms	82.1	11	6	6	14
Cattle	740	1.7	—[c]	1.4	23
Fruits and vegetables	108	36	2	35	53
Cotton	21.6	30	—[c]	30	30

Source: USDA (1996), p. 7.

a. Farms that get 50 percent or more of their gross revenue from poultry. Similarly for other commodity types.

b. Percentages using production and marketing contracts add up to more than the total percentage using contracts (85 + 8 > 89), because some growers use both types of contract. For example, over 2,000 poultry growers had crop-marketing contracts in addition to poultry production contracts.

c. Less than 0.5 of 1 percent.

of cattle farms use contracts, but the ones that do are large ones. Thus although only 1.7 percent of growers have contracts, 23 percent of the value of cattle is marketed under contract.

OFF-FARM WORK

The mirror image of nonfarmers' involvement in agriculture is farmers' involvement in the nonfarm economy. Here the prime motive is not integration in production but rather diversification of income sources. The Agriculture Census first asked about off-farm work in 1929. At that time 6.3 percent of farm operators reported 200 or more days of off-farm work. By 1949 this percentage had risen to 17.5 percent, the largest increase having occurred during labor-scarce World War II. In 1997, 35 percent of farm operators reported 200 or more days of off-farm work, 45 percent reported something other than farming as their principal occupation, and USDA estimated that about 85 percent of the average farm household's income came from off-farm sources (USDA, *Agricultural Outlook,* December 2000, table 31).

ECONOMIC INTERPRETATION OF STRUCTURAL CHANGE

Taken together, the growth in the average size of farms, the concentration of production and net farm income on the largest of them, the increasing importance of purchased inputs and services, and the increase in vertical integration and contracting have been labeled the “industrialization” of agriculture. What to make of these developments—why they occurred, what they portend for the future of U.S. agriculture, the extent to which they are an opportunity or a threat—is hotly debated.

The trend toward larger farms with production concentrated in fewer of them has been viewed with alarm by many economists as well as by broader-based agriculturalists and social critics. Marty Strange (1988) believes that “the family farm is an institution eroding from within, struggling somewhere between decline and death to hang on to the things it stands for. A long-term transformation is under way in American agriculture from small-scale, broad based family farming to large-scale, industrial farming . . . But most important, this transformation is unnecessary and, to many of us, undesirable” (pp. 1–2). Neil Harl (2001) sees the question as being “whether agriculture is populated by independent entrepreneurs or serfs” (p. 45). Yet the Council on Food, Agricultural, and Resource Economics (C-FARE), a public outreach arm of professional agricultural economists, states that “the emerging food and fiber system is expected to be highly competitive in global markets, more efficient, more responsive to consumer demands, less dependent on government assistance, and able to more rapidly adopt new technologies” (1994, p. i). C-FARE nonetheless expressed concerns about the consequences of industrialization for the survival of small farms, the autonomy of contracting farmers, environmental quality, food safety, income distribution, and rural communities.

Willard Cochrane summarizes a wide-ranging examination of the evolution of U.S. agricultural technology as follows: “Thus it turns out that rapid and widespread technological advance in American agriculture from 1920 to 1990 worked to the advantage of two groups: (1) urban consumers and (2) the small, select group of farmers who were in the technological vanguard. For the rest, the agricultural development process based on rapid and widespread technological advance has been a nightmare” (1993, p. 388).

The pros and cons can be roughly summarized as a tradeoff between efficiency and other virtues. Those who focus on virtues other than efficiency see industrialization as a menace. Moreover, it has been questioned whether industrialized farming is truly more efficient, when operations extend beyond a fairly modest size (see Strange 1988, chap. 5; USDA 1998; and earlier studies reviewed in Jensen 1977). It can also be argued that an industrialized agriculture would be associated with sufficiently increased market power of agribusiness enterprises that any efficiency gains at the farm level would be offset by exploitation of both farmers and consumers (Harl 2001).

ECONOMIES OF SCALE

We have seen evidence of remarkable increases in U.S. agricultural productivity, as measured by output obtainable from given inputs. How do those increases fit with the changes in economic organization of farms and farm size that have occurred? An important distinction to make is one between measured productivity gains attributable to technological improvements and gains resulting from changes in the economic organization of farms using a given technology. Economies of scale in a given technology exist if a proportional increase in all inputs results in a reduction in a farm's costs per unit of output.

How, then, should we interpret the observation that over time farms are growing larger? Three possible reasons for an increase in average farm size should be considered: technological change is increasing the size of operation at which unit costs are minimized; disequilibrium exists (at least at an earlier point in time) in which farm size has not yet reached the optimum for the existing technology; and changes in marketing are decreasing the costs or increasing the revenues of large as compared with small farms, for example because buyers are increasingly willing to pay more for large, uniform lots of farm product.

It is difficult to sort out these three possibilities, because technological and market changes are constantly occurring and it always takes time to adjust to new opportunities. It isn't just that time is *required;* often it is optimal not to adjust immediately. For example, milking parlor dairy technology for 100 cows may produce milk at a lower cost per gallon than stanchion barn technology for 50 cows; but if you have a stanchion barn, it may nonetheless pay not to switch. So old and new equipment and production methods are observed side by side for decades, even though hardly any new stanchion barns are being built.

A further complicating factor is that farms are not identical, and what is the best technology or scale for one may not be for another. A 100-cow dairy herd in Wisconsin may have the same cost per gallon of milk as a 5,000-cow California herd, because different technologies, which generate their minimum unit costs at different outputs, are best suited to the different climatic, water, and soil conditions of the two states.

Despite adjustment delays and the heterogeneity of farms, it would be expected that average farm size would not grow much after a sufficient adjustment period, if technology stopped changing: eventually a steady-state distribution of farm sizes would emerge. When we see a persisting growth in farm size, therefore, it is appropriate first to seek an explanation in terms of technological change. Do the data bear out the idea that the growth in farm size is related to changes in technology? With respect to the growth of output per farm (Figure 3.3), there is one clear break in the trend and one possible but not so obvious break. The clear break is at about 1940, after which output per farm grows for forty years at a significantly higher (and remarkably steady) rate. The possible break comes at about 1980, after which output per farm grows more slowly, though still faster than before 1940. The first break has an obvious similarity to agricultural productivity growth as shown in Figure 2.9, but the second does not.

Output per farm will increase when productivity (output/inputs) increases, even if farm size stays the same. Therefore we should consider measuring size by inputs and resources committed per farm as well as output per farm. Acreage per farm, though relevant mainly to crop farming, gives an alternative indicator of changes in the economic organization of farms. As shown in Figure 3.4, land per farm grows at a slow rate until 1940, then accelerates, and differs from output per farm in accelerating more sharply between 1950 and 1975 (with the sharp jump in 1975 the result of a change in farm definition), and then decelerating to a slower growth rate in the 1980s and 1990s. Almost two-thirds of the growth in acreage per farm during the century occurred in the twenty-five years between 1950 and 1975. The 1940 and 1950 accelerations in farm size are plausibly related to the technological developments that underlie the acceleration of productivity growth of the late 1930s. Farm size growth slowed after 1980, for reasons yet to be determined.

Indications of changes in the economic organization of farming are also apparent in factor shares (Figures 3.5–3.8). The period in which labor costs as a fraction of all input costs declined most rapidly was 1945 to 1980. But the share of expenditures on manufactured inputs did not grow notably faster during this period. These inputs increased in importance most rapidly between 1915 and 1930. So not every episode of change in input use patterns is associated with growth in either productivity or farm size.

Farm Income and Well-Being

The single most important issue that arises for the farming sector as a whole under changing technology and greater polarization between small and large farms is what happens to farm income, especially the income of farmers who are least capable of taking advantage of new technology. The net income from an average farm, excluding farmers' incomes from off-farm sources, has increased substantially over time in real terms (Figure 3.10). This is not true, however, for a long subperiod. Over the thirty-year period from 1910 to 1940, real net income fell. Since 1940, real net income per

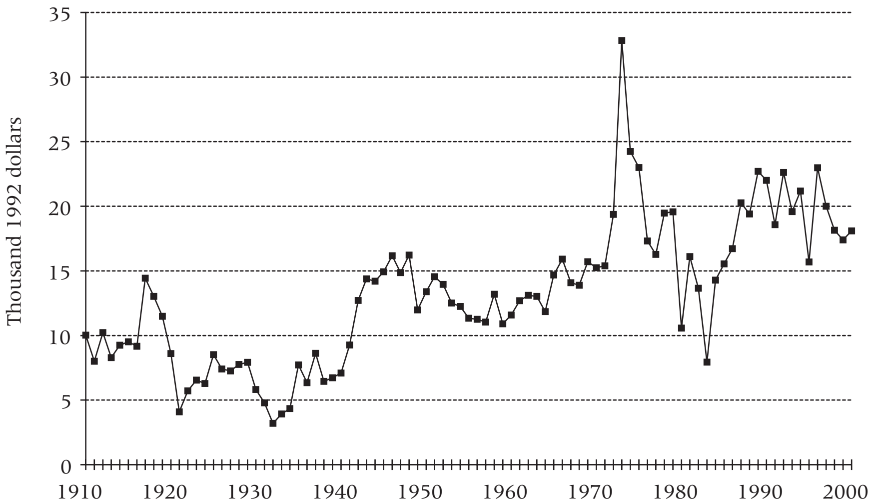

Figure 3.10 Net real farm income per farm (1992 dollars). Data from U.S. Department of Commerce (1975); for data after 1970, U.S. Department of Agriculture, *Agricultural Statistics,* various years.

farm has almost tripled, from $7,000 to $19,300 (in 1992 dollars), implying an average annual growth rate of 1.7 percent over the period between 1940 and 2000. Thus the period of economic gain roughly coincides with the period of rapid technological change. In addition, the importance of off-farm work to farm households was rising, and average incomes of farm people from all sources were rising even faster. But during much of this period the real incomes of workers in almost all industries were rising; so the question remains how farmers have fared relative to the nonfarm population.

In the past, farmers' incomes have been well below those of the nonfarm population. One of the earliest attempts at farm/nonfarm income comparison, that of L. C. Gray (1923, p. 176), estimated the per capita income of the farm population in 1918 at $359 (or $3,560 in 1992 dollars), which was 53 percent of the per capita income of the total population. That estimate was made on the basis of quite ad hoc procedures, using limited census data and supplementary survey data from nonrepresentative samples of farmers. E. L. Kirkpatrick (1926) summarized surveys of 2,886 white farm families in eleven states in 1922–1924 to obtain a standard-of-living measure that averaged $1,598, which with an average household size of 4.8 implies a per capita income of $333 (p. 34). Since Gray's and Kirkpatrick's work, more systematic income estimation efforts have been undertaken by many scholars, including John D. Black (1928), Theodore W. Schultz (1945), and

Thomas H. Johnson (1985). Recent USDA farm/nonfarm income comparisons have been made as described in Mary Ahearn, Janet Perry, and Hisham El-Osta (1993).

Cost-of-living differences between rural and urban areas account for some of the differences between income levels, but only a small part. Abner Hurwitz and C. P. Stallings (1957) used Bureau of Labor Statistics estimates that as of 1929 rural costs of living were about 7 percent less than in urban areas, but the difference had essentially disappeared by 1945. Farm and nonfarm income comparisons are also made difficult to quantify by differences in income sources. Farm households rely more on nonmoney income than nonfarm households do, and this reliance has changed greatly over time. USDA estimates that in 1910, 16 percent of farm output was consumed on the farm; in the 1990s less than 1 percent was so consumed. So comparisons of money income in the past understate the relative standing of farm households.

Ideal accounting would also incorporate the stock of consumer capital that results from purchases of durable consumer goods. Wheeler McMillen (1929, p. 106) noted as a telling statistic of rural deprivation that in the 1920s more than three-fourths of urban residents, but less than one-fourth of the rural population, had bathtubs. George M. Warren (1926) reported that only one in ten farms had plumbing to supplant carrying water in buckets and averred that "the farmer is unlikely to regret the day he took up the study of his plumbing problem. Few investments will yield surer, larger returns" (pp. 2473–2474). Those returns, though they do not show up in agricultural productivity or income, are a real contribution to nonmoney income.

USDA estimated 6 percent of gross farm income as of 1910 as the rental value of farm dwellings. The housing component of nonmoney income remains substantial up to the present. This element of gross farm income, which includes the value of items such as plumbing investments, arguably does not belong in farm income accounting at all, since housing is not an agricultural product. It is also notable that measuring the rental value of farm dwellings is a difficult matter statistically. USDA uses, in its data prior to 1983, an estimate of housing value multiplied by an interest rate. But when interest rates became very high in the 1970s and early 1980s, this approach to measurement was providing a distorted estimate as compared, for example, with the market rental value of housing. Therefore in 1984 USDA switched to a method relying more on house rental values and less on interest rates. This adjustment in statistical estimation method caused the income imputed to farmers from farm dwellings to fall from $12.6 billion to $4.9 billion between 1983 and 1984. Often when such changes in statistical methods are made, the historical data are also revised, but USDA did not do so in this case. Hence the huge decline in the share of nonmoney farm income in 1984 is entirely a statistical artifact. It should be noted that USDA's estimates of home-consumed farm products also have a shaky statistical base for some periods in which surveys were not carried out. USDA's data indicate a decline in the value of such goods from $895 million in 1986 to $577 million in 1987, but this is mostly due to a revision of the estimation procedure in 1987 that was not carried back to earlier years.

Data problems notwithstanding, the decreasing importance of home-produced goods, shown in Figure 3.11, is an indicator of the pace of change in U.S. agriculture. Like the indicators of technical change in farm production, a lack of trend until the 1930s was succeeded after the Depression by a remarkably fast transformation between 1940 and the mid-1960s.

Figure 3.12 shows an estimated ratio of farm to nonfarm average household income from 1910 to 1997. Both farm and off-farm sources of farm household income are included. The series is based on the farm/nonfarm household income comparisons described in Ahearn, Perry, and El-Osta (1993). They use a farm household money income concept comparable to that of the Census Bureau's Current Population Survey for nonfarm house-

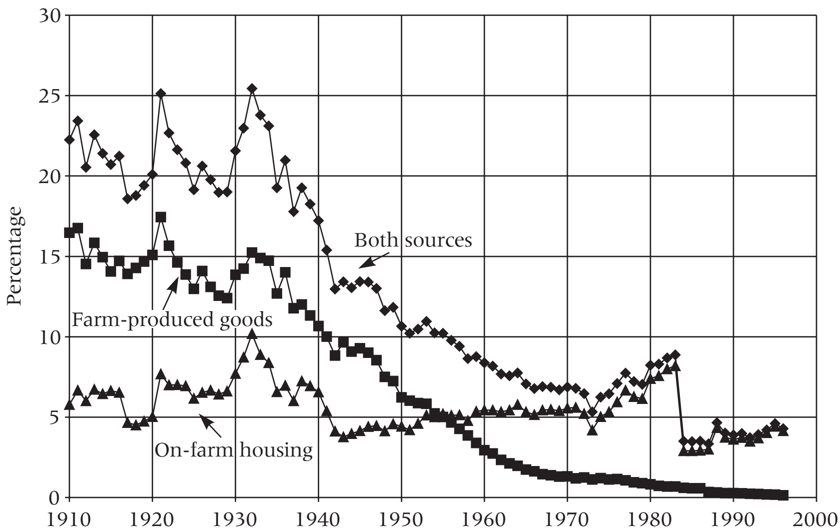

Figure 3.11 Percentage of gross farm income from nonmoney income. Data from U.S. Department of Commerce (1975); for data since 1970, website of U.S. Department of Agriculture, Economic Research Service, <http://www.ers.usda.gov/>.

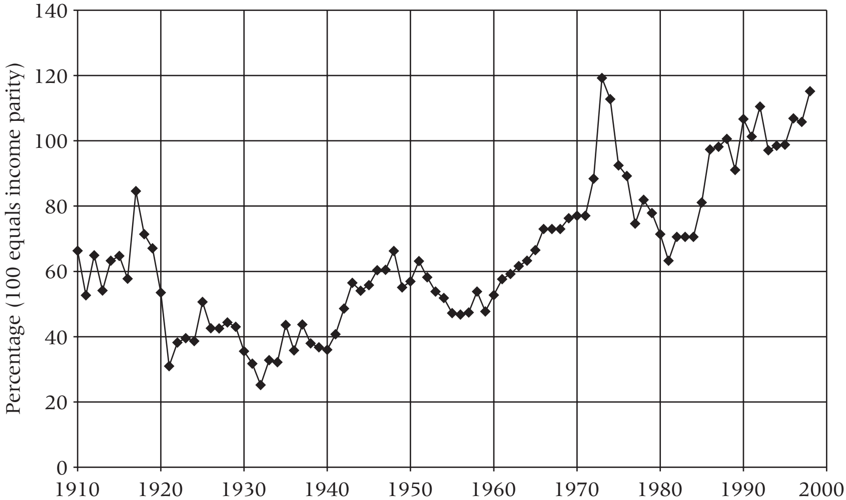

Figure 3.12 Farm as percentage of nonfarm household income. Data from U.S. Department of Agriculture, *Agricultural Outlook,* December 1999; U.S. Department of Commerce (1975).

holds. For the years between 1934 and 1978, the ratio's movements are proportional to those reported in USDA (1979), based on disposable personal income in the U.S. national accounts. Data for the years before 1978 include nonmoney income of farmers, but the years since do not. Although the importance of nonmoney income is much reduced in recent years, it is still the case that this inconsistency between pre- and post-1978 data means the overall trend understates the rate of growth of farm household income (since income included in earlier years is excluded in later ones).

According to these estimates it was not until the mid-1960s that farm income had regained the position relative to nonfarm incomes that prevailed in the pre–World War I period. Since the 1960s the ratio of farm to nonfarm income has continued to increase, albeit with large year-to-year fluctuations, until in the 1990s farm households attained, on an average basis, income levels equal to or exceeding those of the nonfarm population.

This remarkable improvement in economic status occurred notwithstanding the inclusion among farm households of the 1.5 million small-scale farms discussed earlier. That discussion asserted that technological change has rendered small farms unviable as commercial entities that could support their households on their farm-generated income alone. A full picture of economic well-being in the farm population should not merely average small farms in with large ones.

Reasonably complete data on the distribution of economic well-being among farm families are available only since the census of 1950. Before that time there is good information on farm costs and returns, but much less on off-farm work and other ways in which farm families supplement their incomes. The 1950 census introduced the concept of "economic class of farm," based on the dollar value of sales from a farm. The smallest class, farms with less than $2,500 in sales, was further subdivided into part-time farms and farms operated by farmers over sixty-five years of age, who were taken to be (mostly) retired. And that census, for the first time, collected data sufficient to estimate off-farm income received by farm operator households.

Table 3.6 provides indicators of disparity of total income as one moves from smaller to larger sales classes. In order to permit comparison across years, the table shows relative income levels by percentiles of the size distribution. The first entry for 1950 means that at the twentieth percentile—where one-fifth of the farms are smaller and four-fifths are larger—the household's income is 69 percent of the average income of all farm households in 1950. The 2.48 for the ninety-fifth percentile means that farms that qualify to be in the largest 5 percent of all farms have household incomes 2.48 times the average farm household income. The difference between the 2.48 and 0.69 is an indicator of inequality. Successive rows of the table provide the same information for later years. Comparability is not assured,

Table 3.6 Income of farms by size relative to mean income of all farms

	20th percentile	50th percentile	80th percentile	90th percentile	95th percentile
1950	0.69	0.75	1.21	1.58	2.48
1960	0.71	0.76	1.11	1.47	2.50
1969	0.76	0.78	1.06	1.20	1.94
1978	0.83	0.73	1.07	1.15	1.85
1994	0.90	0.90	0.92	1.01	1.32

Sources: 1950 data are from the U.S. Department of Commerce, *Census of Agriculture*, 1949, "Farms and Farm People," p. 28; 1960–1978 data are from USDA (1979), p. 59; 1994 data are from USDA (1997c), p. 34. Percentiles are linearly interpolated from discrete sales classes whose limits do not line up precisely with the percentiles used in this table.

Note: Percentiles by size are determined by ranking all farms from smallest to largest, with size being measured by sales of farm products by farm, using USDA's sales classes. At the 20th percentile, 20 percent of farms are smaller and 80 percent are larger. At the 50th percentile, half the farms are smaller and half are larger. The 90th and 95th percentiles are thus the larger farms. Income includes all sources of income for the farm household, including income from off-farm jobs by the operator and family members, and income from other farms or nonfarm investments.

however, because of differences in the details of how the income estimates are made. The 1950 estimates use the one-time census survey. Beginning in 1960, USDA utilized census and other data to make yearly estimates of the distribution of income by economic class, which were carried out in the same way through 1978. The 1994 data make use of still more detailed survey data and refined information about farm households (for example, that often there is more than one family on a farm). Note that the trends for the years when the data are identically constructed each year, from 1960 to 1978, are the same as when 1950 and 1994 are included. What is most striking in Table 3.6 is the declining disparity over time. At the lower end of the distribution, after the mid-1960s total household incomes are actually a little lower for mid-size than for lower sales classes (compare the twentieth and fiftieth percentiles). Thus while farms are increasingly polarized in the sense that large farms keep getting larger relative to small farms, the total household income of an average small farm is actually increasing relative to the household income of the larger farms.

To get a sense of how this seeming contradiction occurs, refer back to the data presented in Table 3.2, considering particularly the 1.5 million farms with annual sales of less than $50,000. Their low farm income, taken by itself, would suggest that an underclass of small, poor farmers existed in the 1990s. However, the mean household income of the small-farm group is $38,200, compared with $42,500 for all farms. In addition, only 5.5 percent of the small-farm group is classified as financially vulnerable or "marginally solvent" by USDA, compared with 9.1 percent of all farms (USDA 1997c). Moreover, the average net worth of small farms, at $258,000, is well above the wealth of the average nonfarm family. Probably the best characterization of the small farms as a group is not as poor and oppressed, but rather as part time, with off-farm income as the main means of economic support. Surely they cannot as a group be well accommodated in Cochrane's "nightmare" picture. Indeed, the data provide a quite optimistic picture of the economic status of farm operators generally. Farm household income does not fall far below the average nonfarm household income for any sales category, even for the smallest sales class of farms.

A complicating element of a farm operator's income is difficulty in estimating returns attributable to the farmer's land and capital, as well as to family labor. There is no direct market observation for most of these returns. Consequently, returns to labor and to property owned cannot be separated except by arbitrary assumptions, such as valuing the farmer's hours (which are not precisely known) at the hired farm wage rate and attributing the remainder to land and capital. An early attempt along these lines is the estimate of "income available for operator's capital and management," calculated by the USDA's Bureau of Agricultural Economics and reported in USDA's 1933–1935 *Yearbook of Agriculture* and 1936 *Agricultural Statistics* for the years 1924 through 1934 (1933, p. 702; 1936, p. 336). The farm operator's labor was valued at a year's hired-hand wage rate without board, with a 22 percent supplement for each working family member. The implied average rate of return to farmers' invested capital, after depreciation and property taxes, ranged from 3.0 percent to 5.1 percent per annum in 1925–1928, a negative 1 to 4 percent in 1930–1932, and returning to a positive rate of return of 2.3 percent and 4.3 percent in 1933 and 1934, according to the 1936 estimates (estimating procedures varied slightly from year to year). Assumptions without a solid statistical basis had to be made for costs borne by nonfarm landlords and for depreciation of buildings and machinery, as well as for family labor allowances.

A market-generated measure of returns to land, analogous to the wages of hired farm workers, is cash rent paid for farmland. Unfortunately, there are no national average cash rental statistics, although USDA does collect these data for many states. An indication of how the rental value of land has changed over a long period of time is available for the state of Iowa. USDA has a consistent data series for 1921–1984 cash rental rates there. These data, supplemented with a more recent USDA cropland rental series since 1984 and the historical data used in C. R. Chambers (1924) for 1900–1920, are shown in Figure 3.13. The time series reveals a pronounced transition

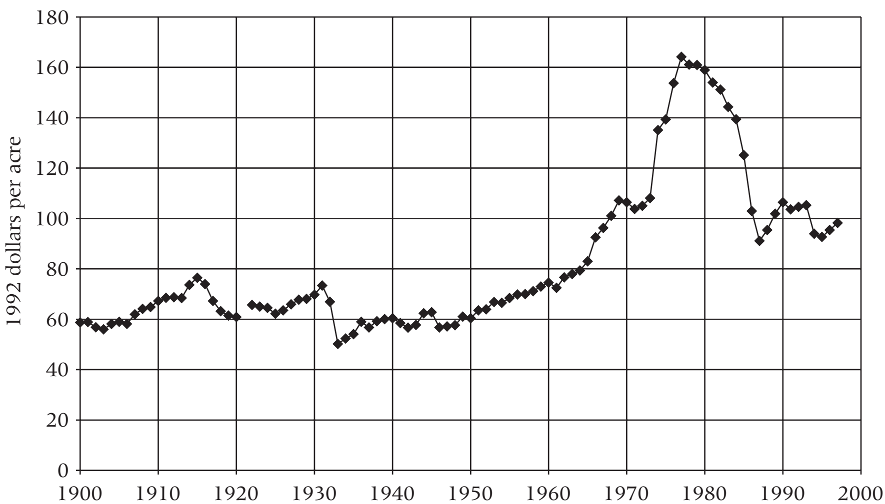

Figure 3.13 Iowa cash rent for farmland (real). Data from C. R. Chambers (1924) and USDA (1997d).

from a practically constant real value between 1900 and 1950, to a trend rate of increase of about 1.2 percent annually since 1950 (ignoring the boom and subsequent bust of 1970–1985).

A complication in the measurement of land income results from land's status as a durable capital good: the returns to land are not just the current net income from land (its rental value), but also include increases in the real value of land because of investment such as irrigation works and changes in the real price of land. In addition, the value of land today depends on the expected value of future returns from owning land. Therefore, the land component of a farmer's returns is affected by changes in expectations about the future of agriculture. And how expected future rental values translate to the value of land as an asset depends on the real interest rate, which has varied over time for reasons unrelated to the agricultural economy.

Figure 3.14 shows the real value per acre of farm real estate (land and buildings). This value is derived from a survey of farmers by USDA and from the Agriculture Census, which asks farm operators for their estimate of the value of the farm. The question asked in the 1992 census was: "Please give your best estimate of the current market value of the land, dwellings, barns, and other buildings for all acres reported," for all land owned, rented to others, or rented from others. Similar questions were asked in earlier censuses. In some years enumerators were instructed to remind respondents to report market value, not assessed value. Presumably farmers answer this question

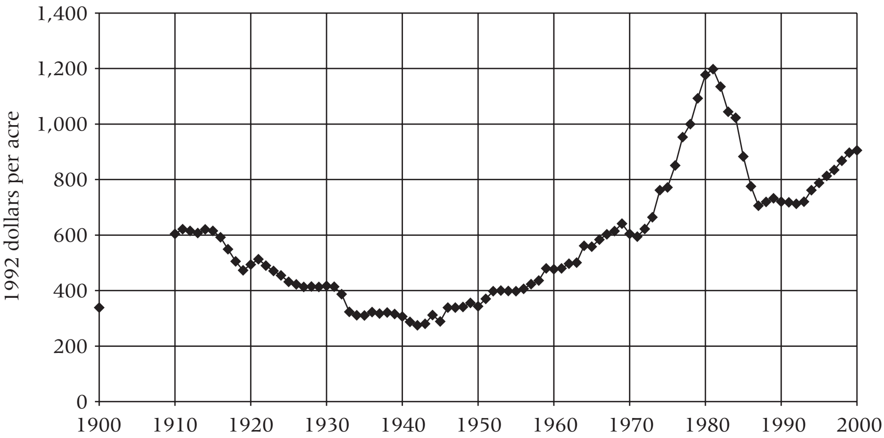

Figure 3.14 U.S. farm real estate value per acre. Data from U.S. Department of Commerce (1975); for data after 1970, U.S. Department of Agriculture, *Agricultural Statistics,* various years.

on the basis of the local farmland market, but they may adjust their valuation according to their own optimism or pessimism about the value of their holdings.

Despite these complications, cash rental rates and farm real estate values are likely to be a reasonably good indicator of how technological change plays out economically for the interests of landowners. Returns to farm labor may be strongly affected by labor market conditions in the overall economy, and to this extent are less sensitive to developments in farm commodity prices relative to costs of production. Even if technological change is harmful to farm labor demand, sufficient off-farm opportunities can result in returns to labor in agriculture not being significantly impaired in the long run. But farmland by and large has less earning potential outside agriculture, so if yield-increasing innovations make land redundant, its price will fall while the acreage in farms changes little.

Real farmland asset values, like rental rates, do not show as strong an upward trend over the long term as wages do. U.S. farms were valued at an average of $20 per acre in 1900 and $1,050 per acre in 2000. This looks on the surface like proof that farmland has been a good long-term investment, but the increase is mostly a matter of the almost twentyfold decline in the value of the dollar over this period. The real value of farmland increased from an estimated $350 (1992 dollars) in 1900 to $900 in 2000, a rate of real appreciation of just under 1 percent annually.

Land price and cash rental data also reflect the boom and subsequent bust that constituted the “farm crisis” of the 1980s. In 2000, U.S. farmland values were still 25 percent below their levels of 1981 in real terms. The most persistent trends in Figure 3.14, however, are the twenty-five-year decline in real farmland prices after 1915, and the switch to a thirty-year increasing trend after 1940 that more than doubled the real price per acre. Now that the boom and bust of the 1972–1985 period is behind us, it is clear that U.S. farmland is still on an upward price trend, albeit at a slower pace than from 1940 to 1970. This is perhaps the best simple indicator that the productivity explosion since 1940 has been a boon and not a millstone around the neck of farm prosperity.

An overall estimate of returns to farm operators can be made by adding to USDA’s farm business income data (which are essentially net farm income minus nonmoney income in the form of housing and farm-produced goods consumed directly) the real capital gains on farmland owned for each farm. These real returns per farm are shown in Figure 3.15. What is striking about this time series is, first, the upward trend since 1940, at about the same average growth rate as real farm wage rates, and second, the great volatility of these returns. And the downside volatility is not just a matter of an isolated

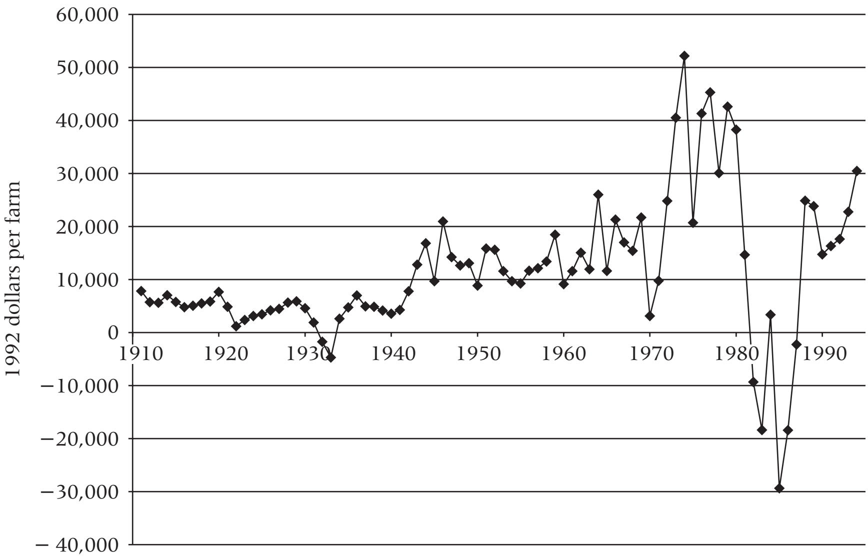

Figure 3.15 Real returns per farm. Data from U.S. Department of Commerce (1975); for data after 1970, U.S. Department of Agriculture, *Agricultural Statistics*, various years.

bad year once in a while. In 1981–1987, five of six years saw negative returns. The preceding years of extraordinarily high returns in the mid-1970s might have provided a savings cushion against the crisis years. But for too many farmers the effect was the opposite. They bought more land and increased their debt in the 1970s. This was the main recipe for bankruptcy in the 1980s.

FARM FAILURES

The loss of a family farm, sometimes after generations of hard work and investment, is the most emotionally wrenching event in the economy of agriculture. Forced auction sales became for a time in the 1980s almost a staple of television news shows, and observation and reports of foreclosures during periods of hard times in farming have generated sympathy for farmers in political debate. Kathryn Marie Dudley (2000) provides a sensitive review of the Midwest experience.

The main statistical indicators of farm failures are foreclosures and bankruptcies. Foreclosure occurs when a borrower who has defaulted on loan payments is required to transfer title of assets pledged as collateral for the loan to the lender. The association with forced auction sales results from the farmer's sale of other assets to finance the family's living, or sometimes to repay debts not covered by the market value of the loan security (for example, if the price of land has fallen since the purchase that a mortgage had financed). Bankruptcy is a legal proceeding that the farmer may undertake in order to protect certain assets or delay foreclosure.

Data on foreclosures were collected in annual surveys of farm real estate transfers by USDA between 1913 and 1980. From these data Lee Alston (1984, p. 888) estimated foreclosure rates of almost 4 percent of all farms in 1933 and averaging 2 percent annually in the period from 1926 to 1940. Thus over this fifteen-year period perhaps 30 percent of U.S. farms faced foreclosure (or somewhat less, to the extent that some farms were lost to foreclosure more than once). Farm bankruptcy data, obtained by USDA from the Office of the U.S. Courts, have been compiled for 1899 to 1979. (Under provisions of the Bankruptcy Reform Act of 1978, the data are no longer reported.) Those data indicate farmers used bankruptcy protection in only about a third of foreclosures in the 1920s, but at a steadily increasing rate after 1950 (Stam 1997). By the 1960s and 1970s farm failures as measured by foreclosures as well as bankruptcies had declined to just over 1 percent of farms annually.

The farm financial crisis of the 1980s rekindled the widespread concern of the 1920s and 1930s. In both the 1920s and the 1980s a period of economic boom in commodity and real estate prices came to an abrupt end. USDA's estimate of the average value of Corn Belt farmland (without buildings) fell from $1,572 per acre at its peak in February 1981 to $794 per acre in February 1986—a decline of almost 50 percent. A buyer who financed the purchase of land with a mortgage of more than half the market price in 1981 would not have sufficient collateral to cover the loan.

Most farm borrowers have other assets, and most lenders are not interested in foreclosure, an expensive process, as long as the farmer can keep making scheduled interest and principal payments. But two other problems of the 1980s intervened: commodity prices had tumbled and real interest rates were extraordinarily high (a product of Federal Reserve tightening aimed—successfully as it turned out—at ending the double-digit inflation of the late 1970s). Thus highly leveraged farm borrowers were caught in both a commodity-market and a macroeconomic squeeze, able neither to repay nor to service their debt.

By 1985, USDA estimated 110,000 farms (16 percent of the 700,000 U.S. commercial farms) to be in sufficient financial difficulty to be classified as "financially stressed." These farms had an average debt of $316,000, and their cash flow less scheduled payments on debt left them, on average, $47,000 short of covering their estimated living expenses. An estimated 56 percent of them were not making payments on their debt, and 42 percent were technically insolvent (Hanson, Parandash, and Ryan 1991). If the lender could not see a plausible route to future profitability and solvency for the farmer, foreclosure ensued.

The U.S. General Accounting Office (GAO) estimated about 2,100 farm business failures annually in 1985 and 1986 (U.S. General Accounting Office 1988, pp. 60–61). This suggests that most farmers in trouble were finding a way to reschedule debt or use nonfarm sources of funds to stave off foreclosure. Many farmers were greatly assisted by federal lending through the Farmers Home Administration and the liberalized bankruptcy protection through a new "Chapter 12" bankruptcy provision that came into effect in 1987.

Apart from business failures that are forced through bankruptcy and foreclosure, many financially stressed farmers left farming voluntarily after incurring substantial losses in the 1980s, and these people are also casualties of the farm financial crisis. While acknowledging that a precise figure is impossible, USDA used a variety of sources to estimate that during the main years of the crisis, 200,000 to 300,000 farmers quit for financial reasons (Stam et al. 1991). These were largely drawn from the ranks of the 700,000 commercial farmers of 1980 as opposed to the 1.5 million smaller-scale farms that depend almost completely on off-farm income sources to support themselves economically. Whether one looks at financially stressed farms in relationship to all farms or only the commercial family-farm subset makes a big difference and has led to confusion. In March 1985, USDA estimated 93,000 commercial farms, 14 percent of the total of 679,000 such farms, were under extreme financial stress. Reporting on President Ronald Reagan's subsequent veto of an emergency farm credit bill, the *Washington Post* wrote: "Reagan said, 'The truth of the matter is, in need of immediate help are less than 4 percent or around 4 percent at best of all the farmers in the United States.' " While the *Post* went on to treat this as an illustration of the president's failure to grasp evident realities, 93,000 is in fact 3.9 percent of the 2.4 million farmers in the official USDA total. Over the 1981–1988 period the rate of farm business failures implied by USDA's estimated total of 300,000 is about 2 percent of all farms annually. This rate is slightly lower than the foreclosure rate of the 1926–1939 period, although the rate of forced foreclosures in the 1980s was lower than in the Depression. Note also that a 2 percent failure rate of the 1980s is about 1 percent in excess of the "normal" rate of the 1950s and 1960s.

Compared either with 1926–1939 or with the post–World War II period generally, the incidence of farm failures in the 1980s did not turn out to be as catastrophic as it looked like it might become. The question at the end of the century was whether the global economy and policy changes had placed U.S. farmers in a precarious position in which substantial numbers of them could expect financial failure in the future. A pessimistic view gained credibility from the low prices and economic emergency legislation that Congress enacted in 1998, 1999, 2000, and 2001. However, though this legislation reacted to what some in Congress called a crisis as bad as that of the 1980s, and though the sums of money being spent were as large, the 1998–2001 period was crucially different. There was no crash in farmland prices, interest rates remained relatively low, and farm failures did not rise appreciably. Farmers and lenders remained cautious about taking on debt, and the funds appropriated by Congress were for lump-sum payments to farmers across the board, not to advance ill-secured additional debt to failing farmers. Overall, with respect to financial insecurity as well as other aspects of the agricultural economy, U.S. agriculture ended the century on generally favorable terms.

INCOME INEQUALITY

The fact of bankruptcies, and the even larger incidence of financial stress that falls short of bankruptcy, impels an inquiry into the distribution of the fruits of agriculture's economic successes. We have already seen that disparity between small and large farms in terms of sales and acreage has increased phenomenally since 1950. Yet we also saw that the disparity in total household income between small farms and large farms has decreased, and that small farms on average have off-farm income sources that place them near U.S. average income levels. To get the full picture of inequality within agriculture, one must look at the whole range of household incomes and measure the inequality of that size distribution.

Past studies of the size distribution of household income have found incomes in agriculture to be more unequally distributed than in the economy generally. The best available annual data on size distribution of farmers' total income—farm plus off-farm net income—are from the Census Bureau's Current Population Survey. This survey is carried out in the spring of each year and asks about income received in the preceding year. The survey asks about farm net income directly (instead of the USDA survey procedure of asking for receipts and expenses, which the statistical agency then uses to construct a net income estimate for each respondent). David Boyne (1965) worked with these data for 1948–1963. He found that income was substantially more unequally distributed within the set of U.S. farm households than was the case for all U.S. households. This may be surprising, since all U.S. households would be expected to be a more diverse group, aggregating everyone from laborers (including farmworkers) to Wall Street bankers. Farmers, however, had about the same degree of income inequality as other self-employed individuals who reported their net income in the survey (p. 1223).

Since 1960 a surprising trend toward equality of household incomes within agriculture has occurred. The best evidence on this subject is from the decennial Census of Population. In 1950, 1960, 1970, 1980, and 1990 it asked rural farm residents for their total household income from all farm and nonfarm sources. Figure 3.16 shows the increase in real median household income and the Gini concentration index for each of the 1950 to 1990 censuses. Median income is the level at which half the outcomes have higher incomes and half lower. It is less than mean income because of skew-

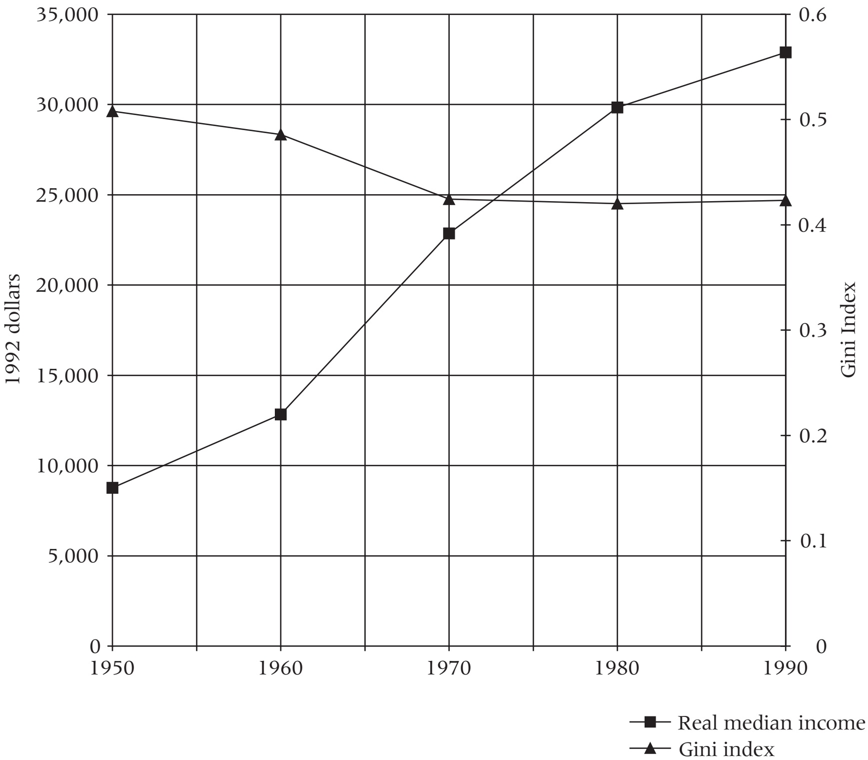

Figure 3.16 U.S. median farm household real income: level and dispersion. Data from U.S. Department of Commerce, Bureau of the Census, *Census of Population,* "Characteristics of the Population for Families and Unrelated Individuals," various years; census estimate of median; my estimate of Gini concentration index.

ness in the income distribution—more people have extremely high than extremely low incomes relative to the mean. Median income is a better indicator of how the average household has fared. Over the forty-year period, real median income of farm households grew at an annual average rate of 3.3 percent, and at a phenomenal 5.8 percent rate during the 1960s. The result was an almost quadrupling of real income over the period, and a complete catch-up of farm relative to nonfarm income levels.

At the same time, as the Gini index shows, farm household income became more equally distributed. Figure 3.17 shows the concentration of income by percentiles. In contrast to the increasing inequality in farm sales data (Figure 3.9), there is less inequality of farm household income in 1990 than in 1950. The Gini index summarizes the information in Figure 3.17 in that its value for 1990, for example, is the area between the curve la-

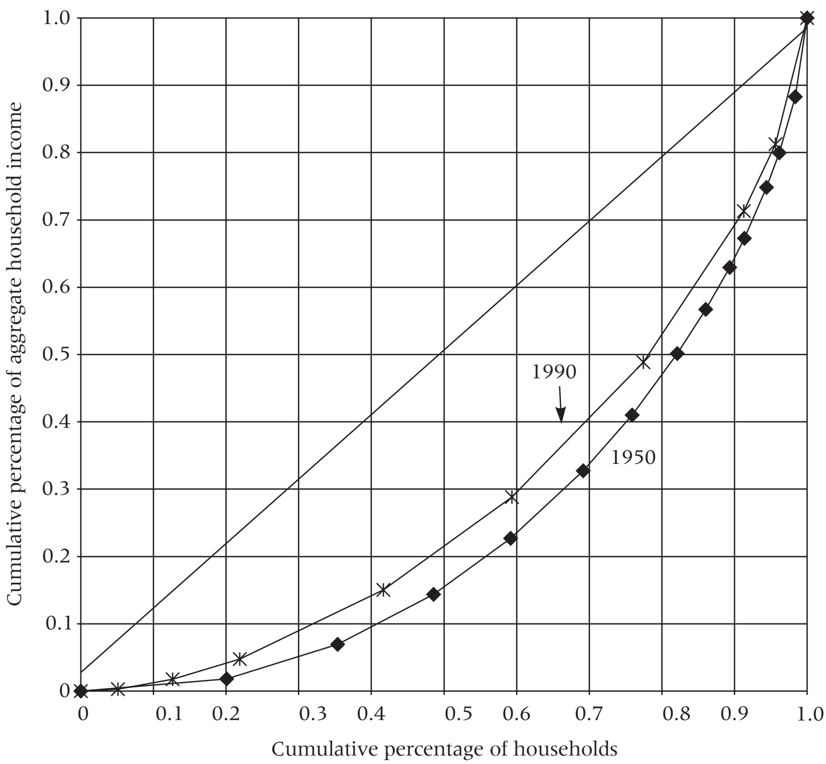

Figure 3.17 Concentration of rural farm household income. Data from U.S. Department of Commerce, Bureau of the Census, *Census of Population*, various years.

beled 1990 and the diagonal divided by the area of the lower right triangle bounded by the diagonal and the two axes. Thus with full equality the 1990 curve would coincide with the diagonal and the Gini index would be zero; but if one household had all the income, the curve would follow the axes and the Gini index would be 1.0. Figure 3.16 shows that inequality declined between 1950 and 1970, even as average real income rose, and has remained about constant since then. This finding is the more striking in that nonfarm incomes became less equally distributed in recent decades. In the 1990 census data and in the 1991 Survey of Current Population, the Gini index indicates slightly more equal incomes in agriculture than for nonfarm households.

Summary

Every operating farm has to deal with a myriad of problems: deciding how much to produce and with what commodity specialization, choosing production techniques, acquiring sufficient land through purchase or rental, mobilizing necessary family and hired workers, determining what tasks to perform using the farm's labor and management as opposed to buying services, obtaining credit as needed in order to gain access to sufficient input materials and services, marketing the farm's products, and managing production and marketing risks. The trends in specialization, size of farm, labor allocation, credit and input use, and contracting are the results of farmers' experimentation in the context of changes in technology and market conditions that they have faced. The result as the new century begins is an agriculture that has generated great rewards for technologically alert and commercially astute farmers who invest and grow as technology permits. Moreover, today's agriculture still leaves room for smaller, more traditional farmers, with the important proviso that if they aspire to a level of money income comparable to that of nonfarm people, they typically must have off-farm income sources. In fact, a substantial majority of farm households now get the bulk of their income from off-farm sources. The overall result for the structure of farming is that while agricultural production has become concentrated on fewer farms, the distribution of income among farm households has become more equal. Farm people as a whole have seen their economic status relative to the nonfarm population steadily improve over the past fifty years until today parity has been achieved.

This chapter has not fully considered the situation of the very poorest farmers and farmworkers or of rural communities, including the rural nonfarm population. The fate of those who left farming in earlier decades has not been addressed, nor have the costs of the governmental programs that have been mentioned at several points. And while the efficiency of U.S. agriculture is impressive by almost any indicator one chooses, we have not considered issues such as soil erosion and environmental degradation that have been tied to industrialized agriculture. These aspects of rural life are more difficult to quantify and assess than the (already difficult) questions of profitability and income we have been considering. Questions of quality of food products and quality of life in rural communities are most difficult of all. The next chapter attempts to come to grips with these issues.

4

Farm Communities

Many issues concerning technology and farming have been contentious, and broader issues in rural communities are no less so. The pessimistic view of rural trends has been succinctly expressed by Jim Hightower: "As statistics indicate, and as visits to the countryside make clear, rural America is crumbling. Not just the family farm, but every aspect of rural America is crumbling—schools, communities, churches, businesses and way of life" (1973, pp. 1–2). To put together a data-based assessment of the situation and trends that will enable us to judge whether Hightower's view is warranted, we again need to start from the statistical base provided by the censuses that go back to 1900.

The rural population is defined by the Census of Population as a residual—everyone who lives outside urban territory. Urban territory is defined by the census as a "place" whose population is more than 2,500 (even if that place is surrounded by farms). The definition of urban places has changed somewhat over time, the most important alteration coming in 1950, when residents of many unincorporated housing developments were included in the urban population. This changed about 4 percent of the 1950 population from "rural" to "urban." With respect to the "rural farm" population, before 1960 the definition of a farm household was more informal in the Census of Population than was the definition of a farm in the Census of Agriculture. (The two censuses are conducted as completely separate surveys. See Truesdell 1949 or Fuguitt, Brown, and Beale 1989, pp. 304–307, for a fuller discussion.)

In 1900, 46 million of the 76 million U.S. population counted in the census were rural residents, and of this 46 million, 30 million lived on farms. We could say, then, that the United States at least numerically was a rural society, and with 40 percent of the population on farms, largely a nation of farm people. The urban population grew rapidly, however, and by 1920 had overtaken the number of rural residents (see Figure 4.1a). Throughout the last hundred years the population outside urban areas has also grown, even

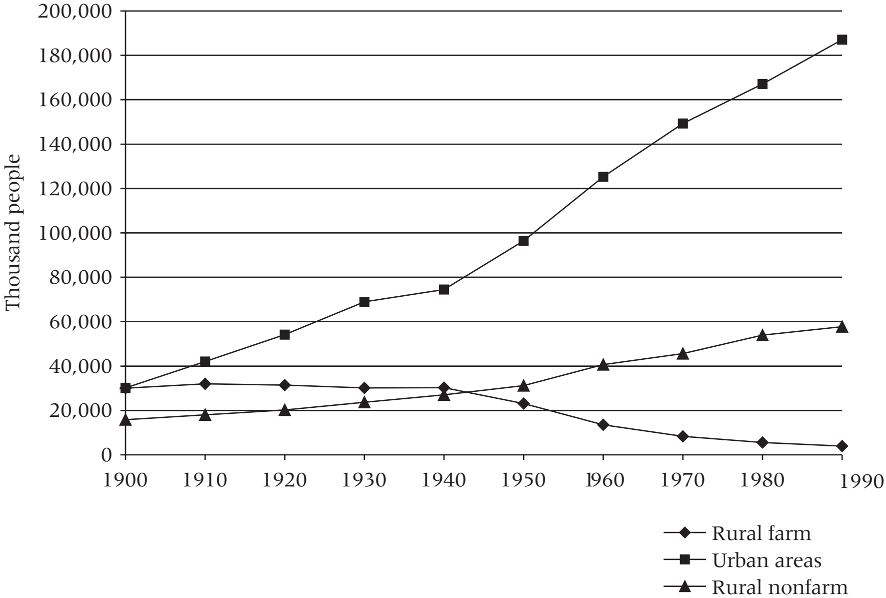

Figure 4.1a U.S. urban, rural nonfarm, and farm populations. Data from U.S. Department of Commerce, U.S. Bureau of the Census, *Census of Population,* various years.

though the geographical spread of urbanized America has occupied more and more land. The big decline is in numbers of farm people. In the 1990 census, the farm population was less than 2 percent of the total population, and only 7 percent of the rural population.

Within the rural nonfarm population, there has been a major shift away from incorporated towns. In 1900, almost half of rural nonfarm residents lived in small towns and cities of less than 2,500 population. About 10 million rural nonfarm people lived outside towns, but they added up to less than a third of the farm population. By 1950, rural nonfarm people in the countryside almost equaled the farm population of about 20 million. By 1990, the great preponderance of the country population was nonfarm, with 47 million rural nonfarm people outside towns, and a farm population of 4.5 million. Figures 4.1a and 4.1b show consistent trends since 1900: the farm population is declining, the rural nonfarm population in towns of less than 2,500 is about stationary, and the rural nonfarm population in the countryside is rising—the phenomenon known as "sprawl." The decline in farms and the rise in the nonfarm country population have been especially pronounced since 1950.

Culturally as well as economically, the growing presence of nonfarm peo-

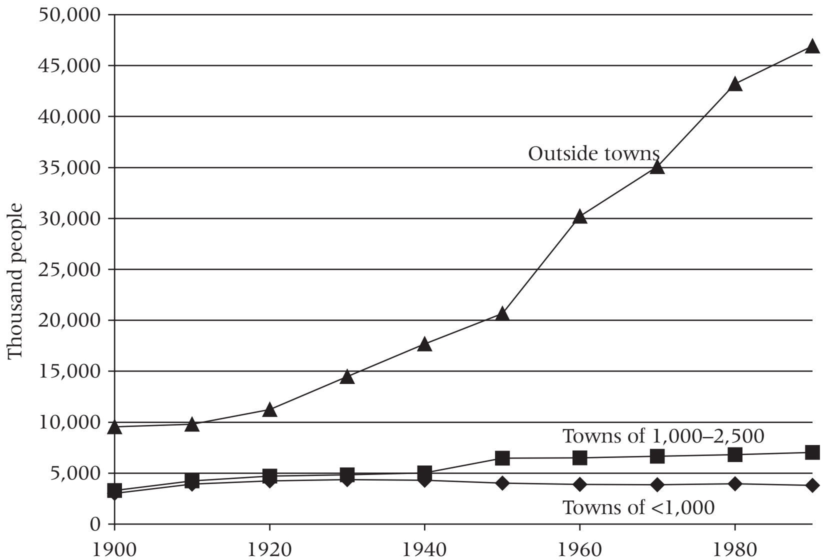

Figure 4.1b Rural nonfarm population. Data from U.S. Department of Commerce, U.S. Bureau of the Census, *Census of Population,* various years.

ple in rural areas makes a significant difference. This difference bears on one of the most contentious issues in rural society: how increasingly large and industrialized farms and increasingly numerous nonfarm residents can coexist peacefully. Many remote areas have remained immune to sprawl, but since the farm population began its big decline in the 1930s the problem for people remaining in declining areas is whether farm communities and the cultural characteristics they foster can survive.

A farm population that drops from 30 million to 4.5 million over the course of five decades (1940 to 1990) has to undergo a variety of large and perhaps traumatic adjustments. There are two main groups to consider: those who remain in farming and those who leave it. Because our primary interest is in U.S. agriculture as it has evolved to its present state, we will consider in most detail the less numerous group who remain in agriculture. The characteristics of this group that can be reliably traced are members' age, education, race, family structure, employment, and income situation. This chapter will focus on demographic attributes, venture into the realm of the cultural aspects of farming and rural living, and supplement the earlier economic data with more on income distribution, particularly the incidence of poverty in rural areas. But I will also review some evidence on the fate of those who left.

Demographic Characteristics of the Farm Population

AGE

As life spans have increased and birth rates declined, the average age of the U.S. population rose throughout most of the twentieth century (except the period of the post–World War II "baby boom"—see Table 4.1). The rise in average age has been more pronounced for the farm population, which was younger than the urban population in the first half of the century, but now is older. This reflects both the faster decline of rural than urban fertility rates and the migration out of agriculture, with younger people having a higher propensity to leave than older ones. The rise in median age of the farm population from twenty-one to thirty-seven years between 1920 and 1990 cannot help but have significant cultural as well as economic consequences.

The high average age of farm operators, fifty-four years in 1997, may be seen as more directly problematic for agriculture. It means the average farmer is quite close to retirement, raising with urgency the question of where the next generation of farmers will come from. The change in farm operators' age over the century, however, was not so dramatic as for the overall farm population. The average age of farm operators was already forty-five years in 1900.[1]

RACE

One of the most drastic changes in U.S. agriculture has been the decline in the number of African American farm operators. In 1920 there were 950,000 nonwhite farmers, 920,000 of them in the South, making up 15 percent of U.S. farm operators. "Nonwhite" includes Native Americans and Asian Americans as well as African Americans, but the last group accounted for more than 95 percent of nonwhite farm people. By 1950 nonwhites had been reduced to 10 percent of all farm operators, with 560,000 nonwhite farmers remaining. With an even greater rate of loss after 1950, the 1997 Census of Agriculture counted 19,000 African American farm operators, less than 1 percent of the U.S. total.

In 1920 more than three-quarters of nonwhite farmers were tenants who owned none of the land on the farm they operated. In 1992, only 11 percent of African American farmers were tenants, with almost two-thirds

1. The Agriculture Census calculates a mean age rather than the median reported in the Census of Population. But because the age distribution is not highly skewed, the mean and median are similar. In 1992, both are fifty-three years (53.3 for the mean and 52.7 for the median).

Table 4.1 Median age of rural and urban population

	Total U.S.	Urban	Rural		Farm operators
			Nonfarm	Farm	
1900	22.9				45.3
1910	24.1				44.2
1920	25.3	27.4	25.1	20.7	44.8
1930	26.5	28.4	25.8	21.6	46.2
1940	29.0	31.0	27.7	24.4	48.1
1950	30.2	31.6	27.9	26.3	48.4
1960	29.5	30.3	26.8	29.6	50.5
1970	27.9	28.1	27.2	32.0	51.2
1980	30.0	29.9	29.8	35.8	50.3[a]
1990	32.8				53.3[a]

Sources: Fuguitt, Brown, and Beale (1989), pp. 108, 111, and U.S. Department of Commerce (1996); farm operators data from U.S. Department of Commerce (1975) and U.S. Department of Commerce, *Census of Agriculture,* 1992.

a. The 1980 and 1990 farm operator ages are from the 1978 and 1992 Agriculture Census, respectively.

owning all the land they farmed. (The remaining 23 percent owned part of their farm.) These figures summarize an epochal socioeconomic transformation: the virtual demise of the system of sharecropping that prevailed in the South until World War II.

Note, however, that there were even more white than nonwhite tenant farmers in the South in the 1920s and 1930s—in 1930 over a million white tenants were counted compared with 700,000 nonwhite. Black tenancy has occupied center stage in recent years, thanks to books such as those of Nicholas Lemann (1991) and Gavin Wright (1986), but the literature that first brought the plight of sharecroppers to general attention focused on white tenants. In the most notable nonfiction writing, James Agee and Walker Evans's *Let Us Now Praise Famous Men* (1941), those interviewed are white tenants, as are all of those depicted in the photographs that added so effectively to the power of the articles and the book that grew from them. Fictional treatments such as John Steinbeck's *Grapes of Wrath* (1939) were also overwhelmingly about white sharecroppers.

White tenancy in the South declined to 70,000 farms in 1992, roughly parallel to the decline of African American tenancy. Still, the even greater percentage decline of nonwhite tenancy requires explanation. One hypothesis is that black farmers were particularly ill placed to take advantage of the technological changes in agriculture that accelerated in the late 1930s (see Christy 1991). Lack of credit, often linked to discriminatory policies, may have played a role. In the 1990s black farmers won important legal victories concerning discrimination against them in obtaining farm program benefits, mainly subsidized USDA loans. Another factor is declining discrimination against blacks in nonfarm employment during and after World War II.

GENDER, FAMILY, AND FERTILITY

The isolated family farm has idyllic aspects, but it is in some ways a difficult environment for women and for children growing up. A recurrent theme in 1900–1940 was improving the social conditions of country life, with a major impetus from the country life movement early in the century. Nonetheless, women have consistently been more likely than men to leave the farm and less likely to come back.

In 1920 there were 109 males for every 100 females on farms, and the ratio remained about the same sixty years later (U.S. Department of Commerce 1986). Women have always been important contributors to farm production as well as to the farm household. For a survey of information about women's contributions to farmwork from the 1920s to the 1980s, see Fassinger and Schwarzweller (1984). But women still are seldom identified as the farm operator in Census of Agriculture surveys. In 1992 the census counted 145,000 female farm operators, running 7½ percent of all U.S. farms. Female farm operators tended to have smaller and more diversified farms and to be older, with an average age of fifty-eight, compared with fifty-three for males (U.S. Department of Commerce 1994, table 17).

In 1900 there were about 800 farm children under five years of age for every 1,000 women of conventional child-bearing age (twenty to forty-four years), twice the number of children that urban women had. By 1980 the number of children per 1,000 rural farm women had declined to 450, and the rural farm fertility rate was only about 10 percent higher than that of urban women. The convergence in birth rates speaks to general socioeconomic convergence between the rural and urban populations. In 1990 there were 2.1 persons per farm household. In 1900 there had been 5.2. The major reduction in household size did not begin until 1940, but after that change came quickly. Table 4.2 provides details.

More directly relevant for the economics of agriculture is the excess of farm children over the number needed to replace retiring farm operators. In 1900, with about 3 million farm women of child-bearing age, there were 2.4 million farm children under the age of five. If we count only half of these as being potential replacements for retiring or deceased farmers, 1.2 million potential new farmers were available to take the place of about 400,000 leaving in each five-year period. These figures indicate that if the number of

Table 4.2 Farm population, number of farms, and persons per farm

	Farm population (in thousands)	Farms (in thousands)	Percentage change in population	Percentage change in farms	Persons per farm
1900	29,875	5,740			5.2
1910	32,077	6,366	0.074	0.109	5.0
1920	31,974	6,454	−0.003	0.014	5.0
1930	30,529	6,295	−0.045	−0.025	4.8
1940	30,547	6,102	0.001	−0.031	5.0
1950	23,048	5,388	−0.245	−0.117	4.3
1960	15,635	3,962	−0.322	−0.265	3.9
1970	9,712	2,949	−0.379	−0.256	3.3
1980	6,051	2,440	−0.377	−0.173	2.5
1990	4,591	2,146	−0.241	−0.120	2.1

Source: U.S. Department of Commerce, Bureau of the Census.

farms were to remain constant, about two-thirds of the young men and women being raised on farms would have had to leave farming (even if no one had entered farming from the nonfarm population). By 1992 the five-year cohorts of farmers aged 60 and above had about 200,000 farm operators each. The roughly 400,000 farm children under the age of five that 1980s fertility rates produced will, by calculations like those for 1900, generate just the number of future farm operators needed to replace those who retire or expire as we enter the twenty-first century.

Thus in the first part of the twentieth century, high rural fertility itself created tremendous pressure for out-migration from agriculture, particularly of young people; but by 1990 the rural fertility rate had declined enough, and the age structure of farm households had changed enough, that this source of pressure had disappeared.

Out-migration from Agriculture

The preceding demographic discussion sets the stage for, but does not explain, the century's historic out-migration of people from agriculture, which is more properly an economic than a demographic phenomenon. Because the number of births exceeded replacement needs, out-migration was occurring even in the early decades of the century, when the number of farms was still growing. The rate of out-migration was about 2 percent annually during the 1920s and 1930s, despite two years of net movement into agriculture during the Depression (1932 and 1933). After 1940 the rate of movement of people off the farm rose and remained at a rate of about 5 per-

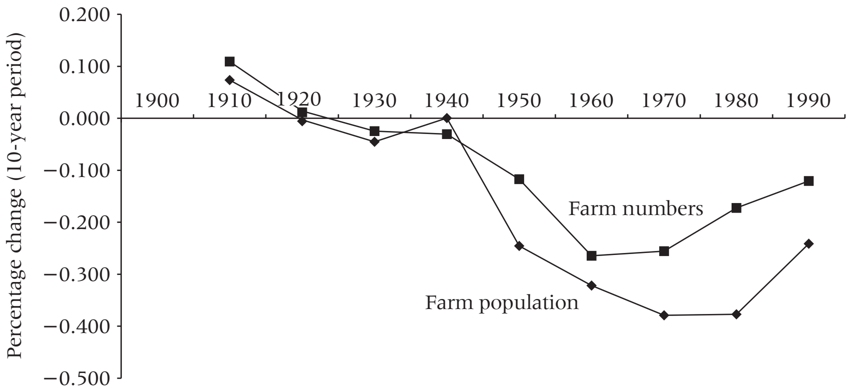

Figure 4.2 Rate of decline of farms and farm population, by decades. Data from U.S. Department of Commerce, U.S. Bureau of the Census, *Census of Population,* various years.

cent annually until 1980, after which the rate declined until there was almost no net outflow in the 1990s.

The situation for those remaining in rural areas changed notably around 1940. Before 1940, out-migration just about offset the natural increase of the farm population, so farm numbers and the farm population did not decline a great deal. But after World War II, when both birth rates fell and out-migration increased, the rate of rural farm population decline accelerated, averaging 30 percent per decade between 1940 and 1990 (Figure 4.2). Note also that in 1970–1990 the farm residential population fell substantially faster than the number of farms. This reflects not only declining farm family size but also the fact that an increasing number of farmers do not live on the farm they operate. In the 1940 Agriculture Census, 5.3 percent of farmers reported living elsewhere than on the farm they operated. By 1997 the percentage residing off the farm had risen to 23 percent (U.S. Dept. of Agriculture 1999e, table 16).

After the extension of Social Security retirement benefits to farmers in 1954, the Social Security Administration's work history sample (of 1 percent of workers) provided systematic data on both occupational mobility and residential migration of farm people. Dale Hathaway and his coworkers carried out a number of studies using these data, greatly advancing our knowledge. They found that in 1957–1963, 14.2 percent of farm-employed persons in a given year were exclusively employed in nonfarm jobs in the following year (Hathaway and Perkins 1968, p. 186). This extraordinary gross mobility rate—roughly sufficient to shift the whole farm work force to nonfarm employment in seven years—varies by region, race, and most importantly by age. Of those under twenty-five years of age, 34 percent annually shifted to nonfarm employment, while only 7.6 percent of those aged over forty-five did. Even greater differences occur by farm employment situation. Of those who both engaged in farm wage work and had a nonfarm job, 47 percent left the farm job in the following year. Table 4.3 shows mobility rates for other situations. Even in the least mobile group, farm operators with no off-farm employment, 1.8 percent annually moved to nonfarm employment.

Perhaps even more surprising than these high rates of mobility out of agriculture is the high rate of movement of workers into farming. During the 1957–1963 period, for every ten people who moved out of farm employment, nine moved in (Perkins and Hathaway 1966). The in-mobility is largely a return flow of those who saw their earnings decline after leaving agriculture—almost half of migrants in their first year. Moreover, the net movement of workers is responsive to economic conditions. Despite a general net mobility rate out of agriculture of about 3 percent a year in the 1950s, during the 1957–58 recession there was net movement *into* agriculture at a rate equal to 2 percent of the farm labor force (Hathaway 1967, p. 74).

ECONOMIC GAINS AND LOSSES FROM MIGRATION

Chapter 3 documented the rising incomes of people who have remained in agriculture, but this does not address the problem of those who left. Did they successfully improve their economic situation? Evidence from the Census of Population reviewed in D. Gale Johnson (1953) indicates that in aggregate they did. C. E. Bishop (1969) reaches a similar conclusion. Paul Johnson (1968) studied the economic returns to off-farm migrants in North Carolina as related to the costs of moving. He found a significant net gain for the average migrant. Moreover, Glenn Johnson and Joel Smith (1959) cite findings that out-migrants evaluated their migration in positive terms, and

Table 4.3 Gross annual off-farm mobility rates, 1957–1963

	Hired farmworkers	Self-employed farm operators
From farm work only	9.5	1.8
From farm and off-farm work	47.3	19.3

Source: Hathaway and Perkins (1968), p. 187, table 2.
Note: Figures show the percentage of workers who moved completely out of farm employment.

they conclude that "the social and psychic costs of the move to the city are not of great consequence" (p. 267).

The fate of migrants in cities turned out to be a lesser concern than the fact that some of the poorest migrants returned to the farm. This observation led Hathaway and Perkins to dismiss the hope that "most low income farm problems could be solved if the rate of outmovement of farm people could be increased" (Hathaway and Perkins 1968, p. 24). Indeed, if pervasive, this selectivity of migration would lead to increasing polarization of income between urban and rural areas. A further cause for pessimism is the observation that the poorest farm residents—notably southern sharecroppers—had the least opportunity to engage in off-farm work while retaining farm residence. In 1959, for example, 30 percent of U.S. farm operators worked 100 or more days off the farm, while only 15 percent of sharecroppers did (Coughenour 1984, p. 9). Such observations resulted in the 1960s in a focus of attention on "the people left behind" (the title of a publication of President Johnson's National Advisory Commission on Rural Poverty). Subsequent econometric analysis also indicated that the "selective process of migration to the urban sector during those years [1950–1970] was a 'brain drain' on the farm labor force" (Gisser and Dávila 1998, p. 678).

It is therefore all the more surprising that by 1990 the incomes of farm and nonfarm people had largely equalized, and indeed by the mid-1990s the mean income of farm households was higher than that of nonfarm households, as discussed in the preceding chapter. It also appeared that by the mid-1990s movements of people into and out of rural areas was driven more by amenities (climate, open space, scenery) than by the pursuit of higher income (McGranahan 1999). A labor market development that fostered these unexpected outcomes was the further expansion of off-farm work by farm household members.

MOBILITY VERSUS MIGRATION

The prevalence of multiple job holding, by both farm operators and hired farmworkers, makes it possible to have occupational mobility without residential migration. Underlying the increase in off-farm work by farm family members are road improvements and the increasing ease and decreasing cost of personal transportation. These developments have made commuting between farm and town ever more feasible. In addition, reduced shipping costs for goods, increasing housing costs in urban areas, and less onerous regulatory and labor-union constraints fostered the movement of manufacturing and other nonfarm enterprises to rural areas, especially rural areas relatively close to metropolitan areas. Thus in Hathaway and Perkins's data, only one-third of those who moved completely out of farmwork migrated to a different residence.

A Bureau of the Census survey of 1947 and the 1950 Population Census provided the first nationwide database designed to measure the longer-term movements of people between rural and urban communities. The 1947 data summarized in Table 4.4 show residential migration during the seven-year period from 1940 to 1947, when World War II and its aftermath were causing large labor market and other demographic changes. More than a quarter of the 1940 farm population, 7.5 million people, moved from farm to nonfarm residence during these years. At the same time, however, despite wartime pressures that drew labor out of agriculture in World War II, about 5 percent of the nonfarm residents of 1940 migrated to farms over the course of the next seven years. The net movement of 3.2 million people out of agriculture amounts to an average rate of farm population decline of 2.4 percent annually. Table 4.2 shows how this rate fits in with the longer-term rate—a 2.4 percent rate of decline in the 1940s and a more than 3 percent annual rate over the following three decades.

The people who move tend to be young, as do the people who change jobs but do not change residence. However, people who change residences tend to have higher than average income, while job mobility is greater for lower-income workers. It is also noteworthy that the heaviest off-farm migration is to rural nonfarm or smaller urban areas rather than to large central cities. The story of poor, ill-educated black sharecroppers moving to northern cities is only a part, and not the predominant part, of the off-farm migration picture (Duncan and Reiss 1956; Johnson and Smith 1959). Moreover, the contribution of southern out-migration to the problems of northern cities can be exaggerated. As of 1960, when the concentration of poverty in urban ghettoes had reached the explosive mix revealed later in the decade, the percentage of black central-city residents born in the South

Table 4.4 Migration status of the 1940 population in 1947 (million persons)

	1947 residence		
1940 residence	Nonfarm	Farm	Totals
Farm	7.5	19.4	26.9
Nonfarm	90.7	4.3	95.0
Total			121.9

Source: U.S. Department of Commerce (1948), table 4.

Note: Persons born or deceased between 1940 and 1947 not included. Data show population aged seven or older in 1947.

was only 7 percent in eastern and 12 percent in midwestern cities (Kain and Persky 1968, p. 293).

Rural Poverty

In addition to low average incomes as compared with the nonfarm population during 1930–1960, the rural poor as compared with more prosperous farm people have been a special subject of concern. Southern sharecroppers, migrant farmworkers, the "Okies" driven out of the Plains in the Depression/Dust Bowl of the 1930s, farmers in Appalachia, and indeed the broad category of small, traditional versus large, "progressive" farmers have all received attention as a social problem calling for an economic solution.

Two conceptions of rural poverty should be distinguished: first, the situation of the poorest rural farm households relative to the better-off households, an aspect of income inequality; and second, the standard of living of poor households. The former is relative and the latter absolute poverty.

The bearing of inequality on poverty is that, for a given income standard, or poverty line, and a given level of mean income of a group, the greater the inequality of income the larger the percentage of the group below the poverty line. David Boyne (1965) found that in the years 1948–1960, 47 to 56 percent of farm households were below the income level of the lowest twentieth percentile of all U.S. households. This reflects both a lower average income and a greater inequality among farm as compared with nonfarm households.

The United States developed an official poverty line by an evolutionary process that still retains the basic approach introduced in the 1960s by Mollie Orshansky for the Social Security Administration (see Orshansky 1965). Her approach was to estimate the income needed by individuals and families of various sizes to afford an adequate consumption package. Calculation of this poverty-line income level was based on the cost of a frugal but nutritionally adequate diet, which had been developed by USDA. Because a 1955 expenditure survey had found that about one-third of consumers' income was spent on food, the expenditure needed for a low-cost diet was multiplied by 3 to obtain the presumed income needed for the full consumption package that goes with the low-cost diet, and this income level is the poverty line. Since the cost of an adequate diet varies with family size and composition and with the price of food items, the poverty line varies with family size and the consumer cost of food.

Farm families were estimated to require less income than nonfarm families to be out of poverty. In 1965 the poverty line for a nonfarm family of four was placed at $3,100; for a farm family of four the poverty line was

$2,200. Even so, a substantially larger percentage of farm than nonfarm families were reckoned to be in poverty: 15 percent of nonfarm and 31 percent of farm families (Bryant 1969, p. 229). Subsequent work indicated that the farm differential overstated the differences in the cost of living for the urban and rural poor, and the differential poverty line was soon adjusted from a 40 percent to a 15 percent difference (see Bonnen 1966; Bryant, Bowden, and Saupe 1981). Thus the measured preponderance of rural farm poverty was further increased.

Awareness of and concern about low incomes peaked politically in the 1960s, with the Johnson administration's War on Poverty. The high incidence of poverty in rural areas drew special attention. President Johnson's National Advisory Commission on Rural Poverty reported that despite many studies, a full understanding of the reasons for rural poverty remained elusive (President's National Advisory Commission 1967). Nonetheless, the commission recommended a series of specific government remedies, including guaranteed employment, relocation assistance, federal investment in rural elementary education starting with age three preschools, public housing in rural areas, new programs in support of small farms, and other ambitious activities of the type characteristic of that time.

The commission's recommendations remained largely ignored, but the perhaps surprising good news is that farm poverty eventually diminished in any case. Subsequent annual Current Population Surveys indicated an incidence of farm poverty that fluctuated a good deal from year to year (in part because the relatively small number of farm people in the surveys made the sampling error rather large) but with a definite trend toward a smaller percentage of the farm population below the poverty line (Figure 4.3). The Current Population Survey is conducted by the Commerce Department, which has no inherent reason to focus on farms; and as farm households have declined, the survey has not oversampled that population sufficiently to provide statistically reliable statistics on the distribution of income within the group. Consequently poverty data on farm households are no longer published. The last survey to identify farm residents as a separate group, in 1991, found 10.1 percent of farm families below the poverty line as compared with 11.5 percent of nonfarm families.

Poverty remains more prevalent in the rural nonfarm population than in either farm or urban households. Indeed, recent studies of rural poverty and its causes say little about farm poverty and tend to play down factors related to the farm economy as determinants of rural poverty. See Fitchen (1995) and other generally pessimistic contributions in Castle (1995). I ignore rural nonfarm poverty not because it is unimportant but because my agenda here is focused on agriculture and farming.

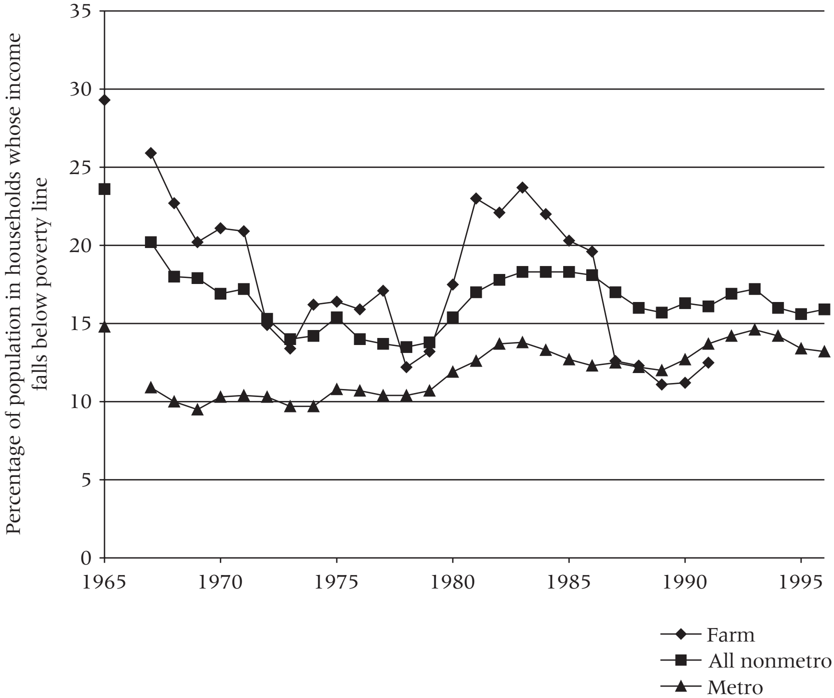

Figure 4.3 Poverty rates: percentage of population poor. Data from U.S. Department of Commerce, Bureau of the Census, <www.census.gov/hhes/poverty/histpov/hstpov>.

The U.S. Department of Agriculture has provided evidence on farm poverty since 1991, using its detailed annual survey of the economic situation of about 10,000 farms—the basis for the USDA's farm household income data presented in Chapter 3. Jeffrey Hopkins and Mitchell Morehart (2000) used the 1998 survey data to provide the most comprehensive picture to date of the incidence of poverty among farm households. Using a poverty line of $13,003 for a family of three, they estimate that 18 percent of farm households fell below the poverty line in 1998, well above the 10.1 percent the Consumer Population Survey found in 1991. Some features of the data create problems, however, as Hopkins and Morehart discuss, especially the transitory component of reported farm income. Hopkins and Morehart find that while the households below the poverty line report an average income of $4,844, they also report average household consumption expenditures of $19,733 and an average net worth of $508,994 (larger than the net worth reported by nonpoor farmers and well above the net worth of the average nonfarm household). Hopkins and Morehart also consider household expenditures and net worth as indicators of poverty. For expenditures, using a threshold of $7,381 (half the median of the farm population surveyed) they find 15 percent of farm households to be poor. But this group has an average income of $26,373, well above the poverty line, indicating that the reason for low consumption is, for many of them, not a constraint imposed by low income. Hopkins and Morehart then look at the 9 percent of farm households with less than $32,651 in net worth, which is half the median net worth of the sampled farms. These households have an average income of $31,882, again well above the poverty line. Concluding that use of any single criterion substantially overstates the incidence of poverty, Hopkins and Morehart attempt to get at an indisputable core of poor farm households by estimating the number that are low on all three measures—income, consumption, and net worth. According to this lower-bound measure, they find only 1 percent of farm households to be poor.

Hopkins and Morehart also make use of recent developments in the statistical analysis of poverty to improve upon the statistics reported above that focus on the number of households below a poverty line. Sen (1976), Thon (1979), and later investigators such as Shorrocks (1995) and Jenkins and Lambert (1997) have developed poverty measures that additionally consider how far below the poverty line the poor fall, and the inequality or concentration of poverty. Hopkins and Morehart use 1995 USDA survey data to calculate an overall SST (Sen-Shorrocks-Thon) poverty index of 0.053 for farm households, which is considerably smaller than the most comparable index available for the entire U.S. population, 0.125.

In addition to an improved picture for absolute poverty, the trend over the last thirty years has been toward less income inequality within agriculture as compared with that of the nonfarm population, as discussed in Chapter 3. Farm households in the lowest 20 percent of the overall U.S. income distribution, which Boyne found to be 47 to 56 percent of all farm households in 1948–1960, had declined to 17.4 percent in 1991. Moreover, farmers were also underrepresented in the top 20 percent of the U.S. income distribution in 1991. That is, farm households have a lower incidence of poverty than nonfarm families not because farm households had higher average incomes—the 1991 median was $30,270 for farm and $30,120 for nonfarm households—but because farm income was more equally distributed.

The reasons for this rather complete turnaround in farm relative to nonfarm poverty and inequality between 1960 and 1990 are not obvious. We should note, however, that the earlier discussion of migration provides no support for one possible explanation: that the farm population disproportionately sent its poorest people to urban areas. No doubt many very poor farm people left; but an opposite tendency also exists for some of the youngest and best-educated rural farm people to leave. For rural communities, the more serious problem of migration is that they may lose the "cream" of their citizenry. For citations and criticism of such arguments, see Johnson and Smith (1959).

Another possible demographic explanation for higher income and less poverty in the farm population is that the elimination of the smallest farms by redefining the statistical population also eliminated some of the lowest-income people. Although the data discussed earlier suggest that small farms remaining in the farm population in the 1990s did not have much lower incomes, because they had a relatively high off-farm income, those data may not be pertinent to the very smallest farms in the earlier years, when the definitional changes were made. The biggest change was the raising of minimum sales to $1,000 in 1974. Population Census data of 1980 indicate that if the 1970 definition had been followed in 1980, there would have been 440,000 more farm families than the 1.6 million that the 1980 census counted.

Census data provide the distribution of income among the farm families who were defined out of the farm category. The number of farm families was reduced by 21 percent by the definitional change. The number of farm families in the lowest income class was reduced by 22.5 percent. Taking $10,000 as a low-income boundary, 24.6 percent of farm families fell below this level according to the 1980 census. If the 1970 definition had been maintained, 25.3 percent of families would have had incomes below $10,000. Thus little of the poverty reduction we have been measuring is attributable to definitional change. The same is true for the growth of average income. The 1980 census gave the median income of farm families as $17,562. The median income if the 1970 definition had been maintained would have been lower, but not much lower, at $17,540 (U.S. Department of Commerce 1985, table 7).

Hired Farmworkers

Looking at even the smallest economic class of farm operators excludes a set of people who are likely candidates for pauperization under U.S. agricultural development: hired farmworkers. In 1998 hired-farmworker families had the highest incidence of poverty of any occupational group, except domestic household help. Their hourly wage rates were only a little more than half those of nonfarm workers (Runyan 2000). To quantify trends in the economic situation of farm labor, Figure 4.4a shows real wage rates of hired farmworkers, and Figure 4.4b an index of the wage rates of farmworkers

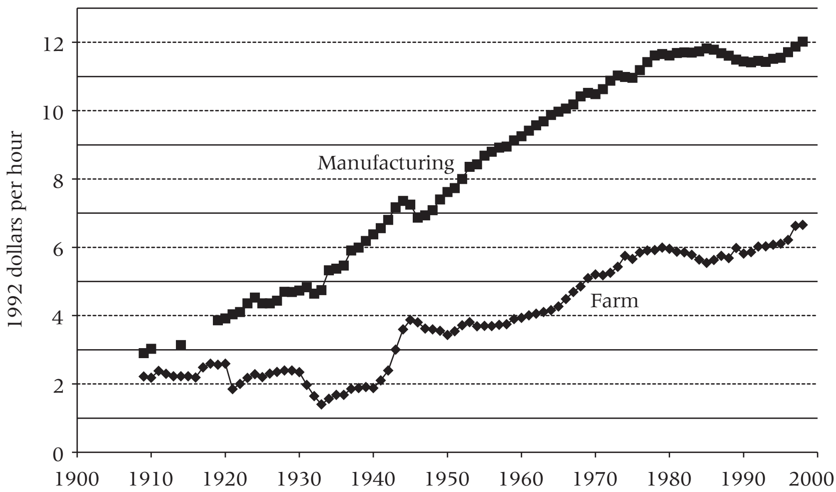

Figure 4.4a Real hourly wage rates. Data from U.S. Department of Commerce (1975); for data after 1970, U.S. Department of Agriculture, *Agricultural Statistics*, various years.

relative to workers in manufacturing. Farm wages have always been relatively low. In his early study, W. I. King (1969 [1915], p. 195) estimated the average wage per hour in agriculture at 11.7 cents in 1912, compared with 27.5 cents in manufacturing and 21.9 cents for his "all industries" average.

The data of Figure 4.4a illustrate the long advance of U.S. manufacturing wages, a relatively unskilled part of the U.S. labor force, throughout the twentieth century, with the much-lamented leveling off of this growth since 1980 apparent in the chart. The data are placed in real terms by measuring in 1992 dollars. Real farm wage rates are also rising for most of the century, but the path is different from that of manufacturing wages. From the chart it appears that manufacturing wages are rising faster, but this is mostly an illusion due to the vertical-axis scaling. For example, between 1970 and 1980, real farm wages rose from $2 to $6 per hour, while manufacturing wages rose from $4 to $12 per hour. Both tripled, even though the gain in dollar terms was larger in manufacturing.

Figure 4.4b shows data more relevant for farm/nonfarm comparisons, the ratio of farm to manufacturing wage rates. Farm wage rates were about 50 percent of manufacturing wage rates in both the 1920s and after 1970. The largest departure from this ratio occurred in the Great Depression, when high unemployment drove some workers into agriculture and the farm wage rate dropped to only 30 percent of the wage of those who retained employment in manufacturing. Farm wage rates also lagged behind the

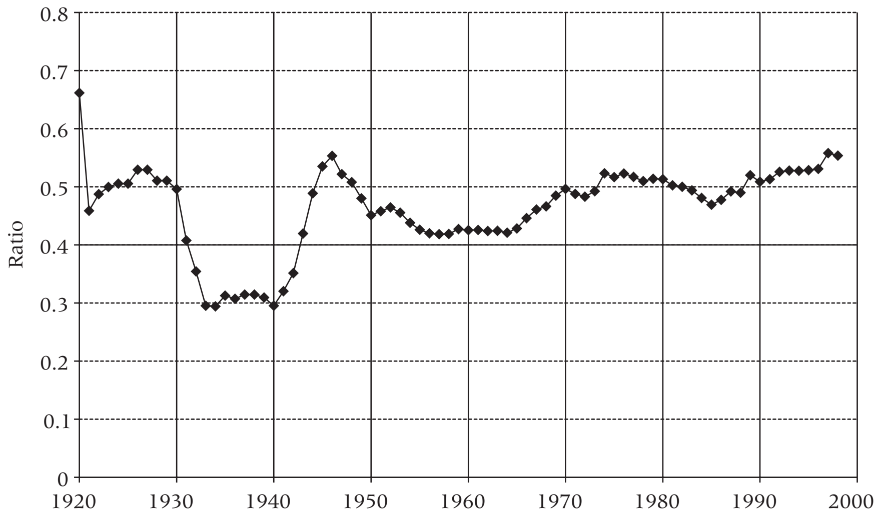

Figure 4.4b Ratio of farm to manufacturing wage rates. Data from U.S. Department of Commerce (1975); for data after 1970, U.S. Department of Agriculture, *Agricultural Statistics,* various years.

rapid rate of real wage growth in manufacturing that occurred in the 1950s and 1960s. But after 1965 wages in agriculture experienced a notable catch-up, and after 1980 farm wages as a percentage of manufacturing wages held their gains and even increased slightly in the 1990s.

Farm and nonfarm wage comparisons are fraught with difficulties that have been much discussed in the economics literature. Lee Alston and T. J. Hatton (1991) provide a useful summary of measurement issues. The main problems concern nonmoney wages, particularly room and board provided to farmworkers, the cost of living in rural versus urban areas, regional aggregation of high-wage and low-wage areas (primarily the South), and differences in age, schooling, and other income-generating characteristics between the two populations. Alston and Hatton estimate that in 1925 real farm wages, properly measured, were only 5 percent less than manufacturing wages, and that the ratio fell from 0.95 to 0.57 by 1941. Their data draw our attention to the Depression of the 1930s as compared with the period preceding 1920 as the key problem in the pre–World War II farm economy. D. Gale Johnson (1953) estimated that as of 1940, farm people had "a labor capacity approximately 90 percent of nonfarm people of the same age and sex" (p. 311). This means the remaining gap of about 40 percent between farm and manufacturing wages was likely a matter of differences in skills or locational disequilibria in markets.

Small Towns

Demographic data present a bifurcated picture of the evolution of rural America. On a nationwide basis, the rural nonfarm population, in open country and towns of fewer than 2,500 inhabitants, grew throughout the twentieth century and continues to grow. At the same time, the number and population of many small towns have been declining since 1940, especially in areas such as the Great Plains (see Burns 1982 for a review of evidence). A question that arises in declining towns is how well, or even whether, the public functions of an organized community can be maintained. What has happened to schooling, law enforcement, roads and other public amenities, the tax burden, and the culture in which farm and small-town households live?

The publication of the 1950 Population Census provided the first comprehensive look at the consequences of population changes accompanying World War II and its aftermath. In reporting on the census findings, *Time* magazine noted the rise of the suburbs and the decline of small towns in a story focusing on two towns, Shannon City, Iowa, and Mart, Texas. Shannon City had lost 119 of its 288 residents since the previous census, and Mart had lost 583 of 2,856. Remaining residents remarked upon the even more striking change in population composition, with a man from Mart noting that the town had about as many families as ever, “but the families now consist of 1 or 2 old people” (*Time*, July 3, 1950, p. 10). The future for such places looked bleak. Reading this story a half century later, do we find that the decline culminated in extinction? Shannon City declined further to 127 residents in 1960 and 100 in 1970, but at that number it leveled out. The 1990 census still counted 100 residents. Mart did not decline appreciably further after 1950, when the population was 2,273. In 1990 it was 2,004.

For a broader picture of rural communities at greatest risk, consider the towns that function as service centers for farmers. A census category that enables us to get nearer to that concept is the set of all places with a population under 1,000. A surprising fact is the existence of as many places of this size in 1990 as there were in 1910, about 9,500. A study of the period of greatest off-farm population movement, 1940 to 1960, found 10,099 incorporated places with a population less than 1,000 in 1940 (U.S. Congress 1971, p. 19). By 1960 their number had declined to 9,870. But new incorporations added 1,236 towns, and 271 of the 1960 towns in the less than 1,000 population category had declined to that number from a population greater than 1,000. At the same time, 1,433 towns grew from less than

1,000 into a larger-size category. The overall accounting of towns of under 1,000 population is

Towns under 1,000 population in 1940	10,099
plus new incorporations	+1,236
plus declines from larger population	+271
minus growth to larger population	−1,433
minus disappearance of town	−303
Equals towns under 1,000 population in 1960	9,870

Thus the actual demise of towns of less than 1,000 population during 1940 to 1960 was 303, or 3 percent of the 1940 total. Even in these places, people may have continued to make their home. Nonetheless, "demise" usually means a catastrophic loss of economic activity.

Let us further narrow our view to attempt to isolate the smallest settlements in a particular area of decline, the Great Plains. In "The Collapse of Small Towns on the Great Plains," Nancy Burns (1982) cites Hudson's technology-based assessment of the reasons for decline:

> Too many towns were built on the Great Plains. If any generalization about Plains towns has been documented adequately, it would have to be this one. . . . Plains towns were based on a transportation technology consisting of railroads, teams, and wagons just as surely as today's gargantuan shopping centers are based on the family automobile. When transportation shifted from horse power to reliance on the internal combustion engine, the settlement pattern of the Plains (and other areas) was antiquated. (Hudson 1977, p. 99)

No state has been hit harder than North Dakota by overall population decline as well as by an inherited pattern of too many small towns. The 1940 Census of Population found 223 towns of fewer than 500 inhabitants and 59 between 500 and 1,000. Table 4.5 summarizes what happened to these towns over the next forty years. The smallest of them, eighty towns with fewer than 200 inhabitants, lost on average 45 percent of their population by 1980. Even in the least viable group, however, only five towns disappeared altogether during these four decades. Several more were clearly on their way to oblivion, such as Hanks in Richland County which declined from a population of 192 in 1940 to 10 in 1980, and indeed thirty more towns of population less than 1,000 had disappeared by 1990. Nonetheless, the total population of towns with less than 1,000 population increased by 12 percent during the 1980s, reversing a long-term decline and almost recovering to their collective population level of 1950.

The larger towns of North Dakota fared much better, with only 1 of the

Table 4.5 North Dakota towns with fewer than 1,000 inhabitants in 1940

1940 population	Number of towns in 1940	Number of inhabitants per town			
		1940	1960	1980	1990
<200	80	137	104	75	
200–499	143	315	291	245	
500–749	39	601	672	656	
750–1000	19	905	995	1103	
Sum of inhabitants					
All towns <1,000 in 1940		97,320	95,419	87,602	
All towns <1,000 in census year		96,808	83,653	76,067	84,200
Outside of towns		429,598	250,977	187,809	203,400

Source: U.S. Department of Commerce, *Census of Population,* for years 1940–1990.

201 towns between 250 and 1,000 population in 1940 having disappeared from the census by 1980 (Sanish, in Mountrail County).

The varying fate of small North Dakota towns is shown by the range of outcomes for towns of 200–500 inhabitants in 1940. Of 143 towns of this size in 1940, 65 remained in that category in 1980, 66 had shrunk to fewer than 200 inhabitants, 10 grew to the 500–1,000 range, and 2 grew to over 1,000 inhabitants in 1980. Despite this variability, it is clearly advantageous to begin larger, as Table 4.5 indicates. Both the variability of outcome and the advantage of initial size are illustrated in Figure 4.5. The points plotted each show the percentage change in population from the 1940 base. Thus the highest point (which represents Sykeston, in Wells County) grew from 273 to 999, more than tripling (a 200 percent increase means a tripling). A logarithmic function fit to these data, shown as a solid curve, indicates that when a town's population exceeds 600 it has a greater chance of growing than declining.

These findings are similar to those of Glenn Fuguitt (1968) for a nationwide sample of villages in 1950–1960 and of Fuguitt, D. L. Brown, and C. L. Beale (1989) for 1960–1980, except that in the national picture a population gain occurs in even the towns of fewer than 500 inhabitants. But almost as many towns are shrinking as are growing. John Fraser Hart (1998) finds the same trends for Minnesota towns as described here for North Dakota. He advances as a reason for the survival of small towns, despite the loss of their traditional business purposes, the attraction of large houses at low prices as a drawing card for commuting residents (p. 317).

The idea that towns in rural areas have largely disappeared, or are doomed to do so, is thus mistaken, even for small ones in remote areas. This

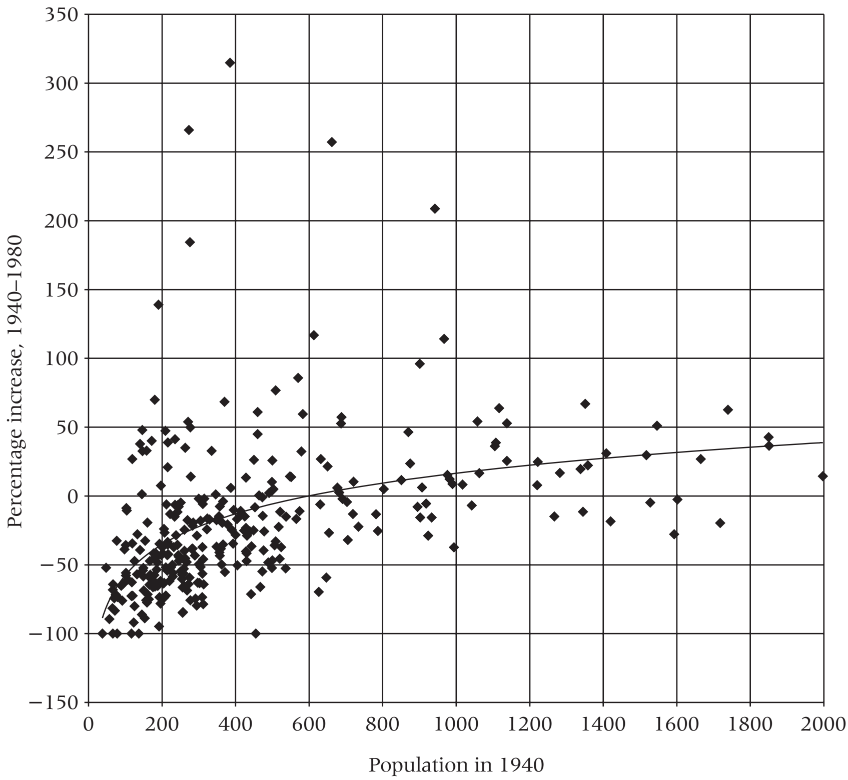

Figure 4.5 Percentage change in population of North Dakota towns, 1940–1980. Data from U.S. Department of Commerce, U.S. Bureau of the Census, *Census of Population,* vol. 1, "Number of Inhabitants," 1960 and 1980.

does not, however, imply that no economic hardship has been visited upon these places. Many of them have been converted from rural business centers to primarily residential communities, with consumer-oriented specialty shops or convenience stores the more usual retail establishments.

Data are not available on income levels for particular towns, so we cannot compare incomes in shrinking and growing towns. Nonetheless, we can tentatively surmise that in the broad picture of developments in rural communities in the United States, the decline of small towns is probably not a major part of the story. Low income levels in rural areas, both farm and nonfarm, appear most closely associated with problems of the whole area rather than with small towns or farms as such. For example, in three rural low-income counties in Mississippi (Holmes, Jefferson, and Tunica) the 1990 Census of Population found 4,000 families with incomes below the poverty line (47 percent of the counties' families); but only 170 of these were farm families. The situation is similar elsewhere in the Mississippi Delta and in the poor counties of Appalachia.

Schooling of Farm People

With respect to elementary schooling, the main development, largely accomplished in the 1940s and 1950s, was consolidation of small rural school districts into larger ones. Prior to World War II, typical rural elementary schools were small, often single-room schools covering grades 1–8. The teacher had to rotate attention among several different grades each day, leaving the children largely to self-instruction once they learned to read. In just fifteen years, between 1945 and 1960, the number of U.S. school districts declined 68 percent, with 76,000 of them disappearing (Ilvento 1990, p. 112). Consolidation allowed specialization in teaching, so that teachers could concentrate on one or two grade levels or on specific subject matter. The key innovation that permitted this appealing educational reform was the linked technological development of economical cars and school buses, and construction of all-weather (or most-weather) roads.

School consolidation coincided with a general trend toward increased schooling of rural as compared with urban children. Figures 4.6a and 4.6b show the increase in schooling attainment for urban and farm males over

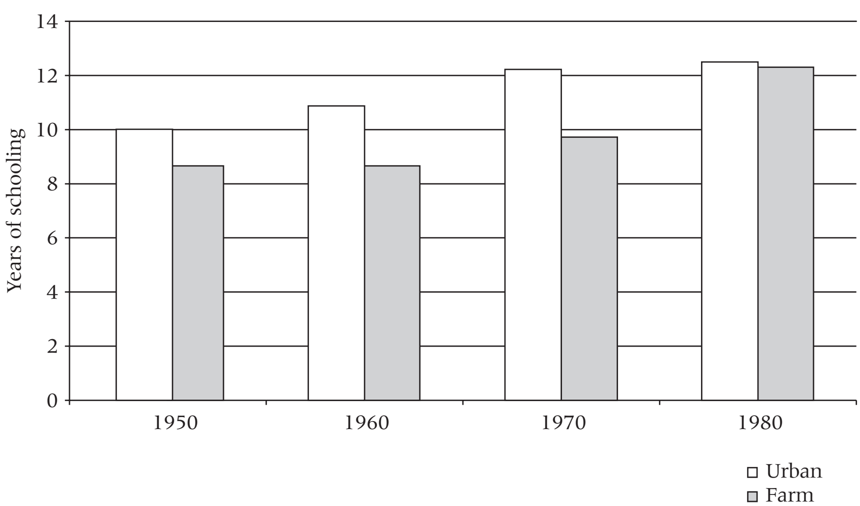

Figure 4.6a Median schooling of males aged twenty-five and over. Data from U.S. Department of Commerce, U.S. Bureau of the Census, *Census of Population*, various years.

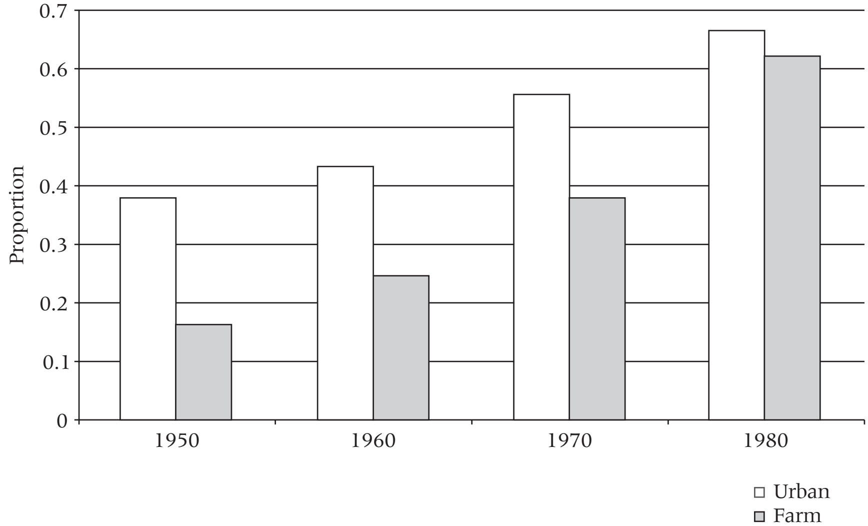

Figure 4.6b Proportion of males aged twenty-five and over completing high school. Data from U.S. Department of Commerce, U.S. Bureau of the Census, *Census of Population,* various years.

the age of twenty-five for the period 1950 to 1990. The most widely used indicator is median years of schooling—the schooling level compared to which half the population has more schooling and half less. Schooling by this measure has increased for both the urban and the farm populations. By 1990 the average farm adult male had about the same level of schooling as urban males. But farmers' schooling had lagged behind for many years. The percentage completing high school, an alternative measure shown in Figure 4.6b, tells the same story, but with a bigger relative difference in 1950, when only 15 percent of farmers but 37 percent of urban males had completed high school.

A problem with these measures of schooling is that they reflect education received long before the measure is observed. Adults of age twenty-five and over in 1970 received their schooling starting in 1950 for the younger people and before 1925 for those fifty-five and older. If we recall that the median age of farm operators is over fifty years, and about five years higher than the comparable urban population, the urban-farm differences reflect schooling obtained longer before for farm than for urban people. With a general upward trend in years of schooling, the data thus overstate the urban-rural difference in schooling that was delivered at any given time in the past.

Age-specific schooling attainment is more revealing. Table 4.6 shows ur-

Table 4.6 Comparisons of farm and urban schooling by age group, males

Age	Median years of schooling completed									Period of last schooling	Urban–farm difference
	1950			1960			1970				
	Urban	Farm	Difference	Urban	Farm	Difference	Urban	Farm	Difference		
25–29	12.2	8.9	3.3	12.4	11.5	0.9	12.7	12.4	0.3	1955–1960	0.3
30–34	12.1	8.7	3.4	12.3	10.6	1.7	12.6	12.3	0.3	1950–1955	0.3
35–39	11.1	8.5	2.6	12.2	10.0	2.2	12.5	12.2	0.3	1945–1950	0.9
40–44	10.3	8.3	2	12	8.9	3.1	12.4	11.8	0.6	1940–1945	1.7
45–49	9.1	8.2	0.9	10.9	8.7	2.2	12.3	11.0	1.3	1935–1940	3.3
50–54	8.8	8.1	0.7	10.1	8.5	1.6	12.1	9.7	2.4	1930–1935	3.4
55–59	8.6	8	0.6	8.9	8.3	0.6	11.3	8.9	2.4	1925–1930	2.6
60–64	8.4	7.8	0.6	8.7	8.2	0.5	10.3	8.7	1.6	1920–1925	2.0
65–69	8.3	7.3	1	8.4	8.1	0.3	8.9	8.5	0.4	1915–1920	0.9
70–74	8.2	7.1	1.1	8.2	7.9	0.3	8.7	8.4	0.3	1910–1915	0.7
75+	8.1	6.8	1.3	8.1	7.5	0.6	8.4	8.2	0.2	1905–1910	0.6

Source: U.S. Department of Commerce, *Census of Population*, various years.

ban and farm schooling attainment by age group in 1950 to 1970. For the youngest age groups, aged 25–39, the difference is small in 1970, suggesting rough rural-urban parity for those ending their schooling after about 1955. By 1990, a slightly higher percentage of farm people aged 25–34 have graduated from high school (85.1 percent farm compared with 83.6 percent urban for males, and 87.5 percent and 85.8 percent, for females). The percentage obtaining a bachelor's degree or higher remains twice as large in 1990 for nonfarm as for farm people—11.8 percent for farm males aged 25–34 compared with 25.9 percent for urban males of that age (see U.S. Department of Commerce 1993b, U.S. Summary, table 17). There is evidence that higher levels of education earned a larger premium in metropolitan than nonmetropolitan areas in the 1980s (McGranahan and Ghelfi 1991, p. 68). But "nonmetropolitan" may not say much about the more narrowly defined farm population.

A complication in the 1970 data of Table 4.6 is revealed when one looks at similar data for 1960. In 1960, farm males aged 25–29 years had 11.5 median years of schooling, 0.9 years fewer than urban males of that age. Yet ten years later, the 1970 data say that farm males aged 35–39 years had 12.2 median years of schooling, which is only 0.3 years fewer than urban males aged 35–39. Aren't the 25–29 group in 1960 and the 35–39 group in 1970 the same people in two different years? If so, how did the farmers acquire the additional schooling? A plausible answer is that the farm people aged 35–39 in 1970 are not the same as those aged 25–29 in 1960. We have already discussed the high mobility rates of farm people in the 1960s, and the concentration of this mobility among younger people. Indeed, the census counted 272,000 farm males aged 25–29 in 1960 and 203,000 aged 35–39 in 1970. The net out-migration of 22 percent of the 1960 group seems to have moved more of the less-educated farm males out of the farm population. The gap between urban and rural schooling provision was thus understated by the 1970 comparison. This inference is not certain, however, because some people acquire more education when adults, through high school equivalency programs, for example. Another possibility is that people tend to increasingly overstate their schooling in interviews as they get older (eliding from attending high school to graduating from high school, for example). Claudia Goldin (1998) reviews evidence that such overstatement is a common phenomenon and is especially noticeable in periods when expectations of schooling levels normally achieved have increased.

The far-right column of Table 4.6 shows age-group comparisons of schooling attainment, giving the data for each group at the youngest possible age after the schooling has been completed (to minimize selectivity effects of migration). Thus to estimate the difference in farm and nonfarm schooling for those who left school in 1935–1940, we use the difference between the schooling of urban and rural farm males aged 25–29 in 1950 (rather than, say, those aged 35–39 in 1960). These comparisons indicate that the main catch-up in rural schooling took place in the 1950s rather than earlier.

Whatever the precise timing, the increase in secondary schooling has to enter our thinking about causal factors for the acceleration in agricultural productivity and growth of real farm income that occurred after 1940. Goldin (1998) documents "America's graduation from high school," which began in about 1920, and associates this educational investment, which was unique to the United States, with improvements in workers' earnings both absolutely and relative to other countries. It is natural then to hypothesize that the later "graduation of farmers' children from high school" played a role in the catch-up of farm relative to nonfarm incomes.

Quality of Life and Technological Change

Any examination of the community-wide situation in farming areas has to take account of the increasing and by now overwhelming numerical dominance of the nonfarm economy in rural areas. We have so far focused on socioeconomic information about farm people, and only on the demographics of small towns. Unfortunately, when it comes to overall rural nonfarm income levels, public service availability, and cultural or quality-of-life issues, we will learn little about linkages with agriculture from data on the whole rural nonfarm population, 60 million strong. Even more unfortunately, the U.S. Census of Population has in recent years collected and published less and less specifically farm-related data. This leaves us with mostly a metropolitan/nonmetropolitan area distinction, which is too grossly drawn to address agriculture-related issues.

USDA analysts have undertaken efforts to provide information on rural communities that are most closely linked to agriculture. Peggy Ross, H. Bluestone, and F. K. Hines (1979) narrowed down the rural nonfarm population by selecting a subset of 626 "totally rural" counties, defined as not adjacent to a metropolitan county and having no urban population (in settlements of more than 2,500 inhabitants). More recently, P. J. Cook and K. L. Mizer (1994) developed a category of 556 "farming counties," defined as deriving 20 percent or more of their earned income from farming. The two sets of counties are both heavily concentrated in the Great Plains, with a substantial additional number in Iowa, Minnesota, and Arkansas (see USDA 1995, p. 12).

Farming counties have not shared in the growth of the U.S. rural nonfarm population. Their aggregate population declined 7 percent during the 1980s and at larger rates in earlier decades. In 1989 they had about the same average household income and poverty rate as other nonmetropolitan counties, but less income and more poverty than metro counties. The 1979 USDA study made a broad range of socioeconomic comparisons as of 1970, summarized in Table 4.7. The income and poverty indicators are least favorable in farming counties as compared with other nonmetro and urban counties. But we have seen that dramatic improvements on the farm-income front have been made since 1970.

Other indicators suggest that rural counties are culturally more traditional, as they have long been believed to be. Nonetheless, a set of comprehensive surveys in the mid-1980s, in which farm and nonfarm people were asked a wide range of questions on political, social, and economic opinions using the same survey instruments, is notable mainly for the similarities exhibited among farm and nonfarm people (Center for National Policy 1991).

Still, the thought persists that the traditional family farming community is a repository of strong virtues that are in danger of being lost. This view is expressed not only by social scientists such as Walter Goldschmidt (1978) but also in novels and in movies of the 1980s and 1990s such as *The River* or in the depiction of the Amish in *Witness.* An alternative viewpoint, also well represented in literature, finds rural culture characterized by ignorance, meanness, and bigotry. Exemplars of this view include the jibes of H. L. Mencken, a clutch of potboiler novels (Erskine Caldwell's *God's Little Acre,* for example), and movies like *Deliverance.*

Table 4.7 Social indicators for urban and rural counties, 1970

Indicator	Completely rural counties	All nonmetro counties	Metro counties
Median family income (dollars)	6,429	7,032	9,362
Male household head not in poverty (%)	85.7	88.7	94.8
Median years of schooling	10.5	10.7	11.6
Infant mortality (deaths per 1,000 births)	24.1	24.7	21.9
Age-adjusted total mortality (deaths per 10,000 persons)	97.0	96.3	92.1
Children living with both parents (%)	85.4	83.7	84.0
Female-headed families (%)	7.6	8.8	9.6
Suicide rate (per 100,000)	11.4	11.0	10.3
Alcoholism (cirrhosis deaths per 100,000)	8.6	8.6	11.4

Source: Ross, Bluestone, and Hines (1979). Data from U.S. Department of Commerce, *Census of Population,* 1965–1970, depending on item.

Among mainstream social observers, a slowly evolving but ultimately decisive change has occurred in the way U.S. rural culture is seen. In the first decade of the twentieth century, an influential view was that "one finds, in the out-of-the-way places in different sections of our country, a degree of ignorance, inefficiency, and moral degeneracy which it would probably be impossible to find in any of the countries of Western Europe" (Carver 1911, p. 27). President Theodore Roosevelt's Country Life Commission took a similarly disapproving tone, recently summarized by Jonathan Raban: "Rural society in the United States was in a bad way, and much of the fault lay in the inherent character of the American farmer" (1996, p. 162).

The idea of a rural culture of backwardness and ignorance was taken seriously as an obstacle to economic success for U.S. agriculture. A 1940 USDA assessment of agricultural technology stated, "It takes several generations for farm people, long accustomed to an agrarian economy, to develop the art of living in a complicated technological world. True but pathetic are stories like that of the sharecropper family going to town to buy clothes for the children and returning with toys for each of them!" (USDA 1940, p. 69). The historian David Danbom (1979) takes the main thrust of the Country Life Commission to have been the reform of rural culture for the principal purpose of making farmers more receptive to the adoption of innovations in farming practice.

For purposes of understanding the economic development of U.S. agriculture, an important question is how farmers' attitudes and outlook fit in the adoption of new technology. A sociological study of hybrid corn in Iowa during 1928–1941 stimulated a large literature on the diffusion of innovations, focusing on information transfer and social networks (Ryan and Gross 1943; Rogers 1995). Zvi Griliches (1957) showed that one can go far without invoking factors other than profitability to explain the adoption of hybrid corn, and it is hard for economists to accept that a profitable innovation would fail to be adopted. Nonetheless, the material and informational situation in rural areas has changed so much that it would be surprising if it had no influence on how farmers behave. David Danbom concludes that: "What agricultural reformers had desired for nearly a century—that farming would become an enterprise requiring specialized technical knowledge and that farmers would be accomplished, self-confident, and respected professionals—increasingly became reality after World War II" (1995, p. 248).

Material progress influenced, and perhaps was a central cause of, a twentieth-century trend toward greater emphasis on the positive, bucolic view of farming and less on the negative aspects of rural life. Conditions that in the early twenty-first century may appear quaint were more likely to be viewed as oppressive one hundred years ago. Albert Sanford cites this memoir:

> My recollections of the farm consist of going barefoot through the frosty grass along about daylight after the cows; in having to carry the wash water up a steep hill from the spring before breakfast, in order to get time to gather the sheaves after the cradlers and binders; of the stubbly grain field the rest of the day; of having to go out after supper for another load of hay, and of hunting up the cows again and helping to milk them until after bedtime; of seeing my mother, sober faced and weary, dragging herself, day after day, about the house with her entire life centered upon the drudgery of her kitchen, and all the rest of the world a closed book to her; of seeing my father, broken down with long hours and hard work, finally relieved of the task of paying for the old place—just a few months before he died. (1916, p. 364)

Technology and economic growth have left many problems of U.S. agriculture unsolved, and have created some new ones, but credit must be given for the panoply of changes that have made that memoir a record of a time truly past.

Natural Resources and the Environment

Just as positive and negative views of the quality of rural life contend, so do conflicting ideas about agriculture and the environment. The positive view emphasizes the amenities of open space, greenery, and lack of congestion in the countryside. Since 1977, eleven states have enacted farmland preservation programs which as of 1996 had enrolled 346,000 farm acres in programs intended to forestall their conversion to nonfarm uses. In addition, USDA has counted 1,145 private-sector organizations active in agricultural land preservation. The largest of these, the Nature Conservancy, has programs primarily intended to foster biodiversity on 8 million acres (USDA 1997d, p. 37). These and other recent developments reflect the sense that the physical spread of urban and suburban development is endangering the rural character of too great an area.

Negative aspects of agriculture and the environment are emphasized by authors such as Michael Fox, who argues that industrialized agriculture has become "ecologically unsound" and points with alarm to "widespread soil erosion, the depletion of deep-water aquifers, the deterioration of soil quality, and the pollution of our water and food" (1986, p. xi). One environmental problem making recent news is a 1997 episode in Maryland, with precursors in North Carolina earlier in the 1990s, where major fish kills and cases of human illness have been linked to agriculture in the belief that nutrients leached from poultry-farm (Maryland) or hog-farm (North Carolina) manure have caused the destructive microorganism *Pfiesteria* to reach toxic concentrations in rivers and estuaries.

A long-standing concern that has been studied in some depth is preserving the quality of farmland, especially stemming soil erosion. Scenes of unusable gullies where cultivated fields once flourished are a paradigm of the devastation people can thoughtlessly wreak upon their surroundings, and the tremendous dust storms of the 1930s are about as pure a portent of doom as can be imagined. But while severe droughts have occurred in the post–World War II period and wind-blown soil has been a problem in some recent times, we have seen nothing approaching dust storms such as those that so impressed the nonfarm public in the spring of 1935: "As far out as Memphis, people covered their faces with handkerchiefs, a dust cloud seven thousand feet thick darkened the city of Cleveland, yellow grit from Nebraska sifted through the White House doors, and bits of western plains came to rest on vessels in the Atlantic 300 miles at sea" (Leuchtenburg 1963, p. 172).

What has happened to soil erosion as farms have become fewer and larger? Methods used to assess soil loss remain alarmingly imprecise, based on models rather than on direct observation. Recent improvements in observation suggest the models have been overestimating soil loss substantially (Trimble and Crosson 2000). The models may nonetheless say something about trends over time. Earl Swanson and E. O. Heady (1987) review a series of independent assessments made between the 1930s and the 1980s and find all of them indicating significant reductions over time in the rate of soil loss from farmland. M. S. Argabright and colleagues (1996) carried out an assessment of agricultural production and land-use practices in 1982 and 1992 for a hilly area of 12 million acres in the northern Mississippi Valley that had been well researched previously in 1925–1935. They estimate the average annual rate of soil loss to have been 14.9 tons per acre in 1930. By 1982 they estimate the rate of loss to have been reduced to 7.8 tons and by 1992 to 6.3 tons per acre (p. vii). The gains are attributed to improved crop, pasture, and woodland management, resulting in part from federal and state programs providing information, technical assistance, and subsidies for conservation practices.

The best national-level data on the quantity and quality of land resources are the result of U.S. government surveys, going back to the Soil and Water Conservation Needs Inventory of 1945, a "reconnaissance study" (USDA 1999c). Successor inventories in 1958, 1967, and 1975 evolved to a standard survey approach that has been carried out comparably over time in USDA's Natural Resource Inventories (NRI) in 1982, 1987, 1992, and 1997. The 1997 NRI estimates that soil erosion on U.S. cropland has decreased 38 percent between 1982 and 1997, a larger rate of improvement than estimated in the more geographically isolated study of Argabright.

The NRI has made substantial efforts to measure the area of different uses and qualities of land and to quantify rates of conversion among different uses. There is a continuing movement of land from less economically valuable to more highly valued uses—swamps drained, dry areas irrigated, range and pasture land converted to cropland, lands of all types converted to residential and commercial development. Conversions that have generated concern are loss of wetlands, loss of forests, and loss of farmland to development. Between 1982 and 1997, 29 million acres of land were developed for housing, golf courses, factories, and other public and private commercial uses; but the total of developed land still amounts to only about 5 percent of U.S. land. Cropland declined by 13 million acres during 1982–1997, but the NRI estimates that many more million acres of potentially good cropland remain in pasture and other uses from which they could be readily converted to crops if needed. Forested land has slightly increased.

The overall U.S. picture is one that looks less land-constrained than what is felt in the major urbanized areas. As we found in our examination of rural towns, there are plenty of places with good physical infrastructure and established community life where the more prevalent shortage is of people. It is said that the problem is a lack of jobs in such areas. One could have said the same of Florida a hundred years ago. The hypothesis is worth serious consideration that if people want to go to a place, jobs will go there too. We live close together because that is how we feel we live best; having then found our surroundings congested, we see major costs, but not costs large enough to make us move to escape them. This reality does not mean that nothing can be done. The antisprawl policies mentioned earlier can be viewed as an attempt to find ways to have the benefits of an urbanized lifestyle and at the same time some access to rural amenities. The general economic problem, in this view, is to place a price on the congestion costs that each of our activities causes for ourselves and those around us; but these costs, irritating as they are, have not risen to the level that would generate public policy action to place a price on congestion-causing choices (for example, tolls on rush-hour driving).

Water-quality degradation due to agricultural chemicals, fertilizers, and pesticides is less studied and is probably a less serious problem. But it is not clear that the trends are favorable. Particularly worrisome are the industrial-scale livestock feeding enterprises that generate large quantities of manure that when used as fertilizer place far more nitrates and phosphorus on nearby fields than can reliably be absorbed by growing crops. At the same time, if manure disposal using waste treatment facilities has to be undertaken, large farms may be more reliable in getting this done than small farms. The leaching of pesticides into water, with subsequent damage to aquatic life and to humans from the contamination of drinking water, has been harder to pinpoint as a problem. Attempts to quantify the risks have followed the application rates of pesticides and the characteristics of pesticides. The resulting environmental risk indicators rose sharply in the 1960s and early 1970s, but since 1980 have generally leveled off and then declined (see Kellogg et al. 2000).

Intensified farming is damaging to wildlife in farming areas, but this does not seem to be a highly visible problem. The species that add most to the rural ambience—deer, waterbirds, and other game—are thriving in many areas. Indeed in the case of deer and geese, their recent increased abundance is a problem. The horror story concerning wildlife is the destruction caused by DDT of birds in the insect-eating food chain, publicized to great effect by Rachel Carson in the 1960s. But this is a problem of the past. Severely threatened birds of prey such as the bald eagle—which concentrate in their tissues the chemical residues found in their prey—have had impressive revivals in number. DDT was banned in 1972, and today's pesticides are relatively benign in that they decompose rapidly.

A related problem is illness and death from exposure to pesticides by farmworkers, most importantly workers who apply pesticides or work in fields that have been recently sprayed. Even here the risks are not huge. R. Levine (1991) reports estimates of the 1980s that the annual incidence of clinically observable symptoms is about two per thousand workers, and that occupational fatalities from pesticides occur at the rate of one every few years.

Farmwork is hazardous for different reasons. Although the data are imprecise even in recent years, and were just guesswork in earlier times, John Rush (1962) estimated about 3,000 farm-accident fatalities annually in the 1950s, and more complete surveys indicate about 1,300 such deaths a year in the early 1990s (Runyan 1993). Though the incidence of accidental deaths in the farm labor force has declined, it remains the case that the mortality rate from accidents in agriculture, roughly 25 per 100,000 workers each year, is the highest of any major U.S. industry. Despite educational efforts and requirements to install shields and other safety devices on farm equipment, accidents involving tractors and other farm machinery are the main causes of injury and death. Farm use of motor vehicles, falls from ladders or other heights, accidents in grain storage bins and manure pits, and lethal gases in enclosed silos are all serious risks. Unfortunately, children on farms are victims of such accidents more than proportionally. But chemical and biotech hazards are a minor part of the story.

Large Farms and the Rural Community

Chapters 2 and 3 emphasized the role of technological progress in causing major changes in farm input use, the size and economic organization of farms, and farm income. In this chapter I have emphasized the technological influences on broader changes in rural communities. These influences include farm-level developments, but perhaps even more important are nonfarm technology-based innovations. Chief among these are the rise of the automobile and vastly improved road networks, making it possible for more and more nonagricultural businesses to locate and commuting workers to live in rural areas, and more and more farm household members to work at nonfarm jobs and reside in towns. Cheaper personal transportation has also fostered the centralization of retail activities and schools in fewer places, realizing economies of scale even as larger farms and smaller farm families reduced the number of customers per square mile. School consolidation and more widespread educational opportunities have caused successive generations of rural people to be less distinctive culturally from urban society. Off-farm migration, backflow from repenting migrants, and contacts between migrants and their relatives remaining in rural areas also contributed to this cultural homogenization—which was not just a matter of the adoption of an urban outlook by rural people. The increasing reach of mass media—first radio, then television, and finally satellite and cable hook-ups and e-mail—helped complete the cultural unification. The technological basis of change on all these fronts creates an aura of inevitability about the process.

There are other views about social change in rural communities. One of the most discussed is that put forth by Walter Goldschmidt (1947, repr. 1978). His view is that a particular aspect of agricultural practice has a crucial influence on rural communities, namely the concentration of production on fewer and larger farms relying on hired labor, under a form of economic organization he characterizes as "corporate agriculture." Equally provocative is a second aspect of Goldschmidt's view, that "this growth of corporate agriculture is not inevitable nor simply a product of efficiency, but it is rather a result of national policies favorable to large-scale enterprises" (p. xlviii). This second, political hypothesis will be addressed later. Here I consider briefly the more basic association between the economic organization of farms and social life in rural communities.

Understanding social life in rural communities is an objective of rural sociologists, and they more than economists have given detailed attention to Goldschmidt's hypothesis and alternatives to it (as well as attempting to specify the hypothesis more precisely than its author did). Goldschmidt relied heavily on case studies of two California towns in rural areas, Dinuba and Arvin, with Dinuba characterized by smaller-scale farming than Arvin. He found the socioeconomic situation more attractive in Dinuba. Don Albrecht and Steve Murdock (1990, chap. 8) assess more than twenty studies that addressed some aspect of Goldschmidt's hypothesis. Critics have been justifiably skeptical of a finding based on two observations, and have found fault with details of the Arvin-Dinuba comparison. An article by Michael Hayes and Alan Olmstead (1984) is a good example, pointing to differences between the two communities other than the ones Goldschmidt studied as possibly explaining the socioeconomic differences that he attributed to corporate agriculture. Nonetheless, the idea of a connection between farm structure and the economy and quality of life in rural communities still gets general support. Louis Swanson (1990) concludes that "farms characterized by industrial relations of production tend to be associated with highly unfavorable community characteristics" (p. 32), but that large owner-operator farms are not associated with such problems. That is, large-scale farming is not a problem but corporate ownership is.

The issue of suburban sprawl seems not to have been addressed in the sociological literature on the Goldschmidt hypothesis, but that issue does shed a slightly different light on the desirability of small farms. Small farms may be more vulnerable to piece-by-piece conversion to residential or rural small businesses, while large ones may be easier to hold intact and thus may preserve a critical mass of commercial agriculture in a given community. Another contra-Goldschmidt point is suggested by Linda Lobao (1990), who doubts that small, part-time farming is desirable for rural communities because "farmers' work time is considerably lengthened by both on- and off-farm work leading to self-exploitation and deterioration in labor power" (p. 215). This point, stressed more generally in recent "overworked American" literature, also serves to temper the optimism with which off-farm work was discussed in Chapter 3.

Summary

Our ability to make socioeconomic, environmental, and cultural comparisons across the years is constrained by limitations of data. U.S. Census and other systematically collected data are available for basic facts about farm numbers, acreage, and commodities for years prior to 1920, but estimates of farm income and other socioeconomic characteristics of farm people were collected only sporadically and often informally. Improved income data are available for years after 1940, and more information about farmers' schooling, off-farm work, and other socioeconomic variables became available in the 1950s. The 1960s were the peak period for production of relevant social science data. The 1964 Census of Agriculture published matched farm production and farm household data in quantity and scope unequaled before or since. Studies and surveys connected with the War on Poverty provided new information about marginal farmers, migrant workers, and general social conditions. Budget cuts and the rise in salience of other social issues led to a decline in agricultural and rural area data in the 1980s and 1990s. In the early 1980s, USDA ceased its quarterly employer survey of farm employment and wage rates, although it was later restored at a reduced scale and frequency. The 1990 Census of Population substantially reduced its publication of farm household data, which are no longer available by county. In 1993 the Current Population Survey dropped the "rural farm" designation completely.

USDA's cost and returns surveys countered this trend by developing better individual-farm economic data in the late 1980s and the 1990s. In addition, data collection efforts by many federal agencies and others improved our knowledge of resource and environmental aspects of farm practices—chemical use, water quality, and wildlife data, for example. A problem with recently developed environmental data, for our purposes, is that we do not have comparable data for earlier times. So it is difficult to judge trends. Social indicators for rural areas have similar limitations. The patchwork of information gives a snapshot quality to the facts available. Later chapters will be more systematically analytical in confining the analysis to data that are available on a roughly consistent basis for the periods analyzed.

Nonetheless, the data available indicate improvements in rural communities that are just as strong as and perhaps more surprising than the farm income increases discussed earlier. As farm and nonfarm standards of living have converged, so have attitudes, schooling, and other social indicators. Despite the decline of small towns in some areas, the rural nonfarm population is larger and better off than ever, albeit less agricultural. Within the farm population, the last thirty years have at long last seen a definitive reduction in the incidence of poverty, both in absolute terms and relative to average nonfarm incomes. And in contrast to the recent trend in the nonfarm economy, inequality within agriculture has declined.

5

Markets

Scholars of early U.S. economic development have put forth effective arguments and evidence that the creation of a market economy in rural areas was perhaps the single most important stimulus to productivity and income growth in agriculture, without which our rich base of soil and climatic resources would have remained in economic limbo indefinitely (for example, Rothenberg 1995 and Wright 1995). The basic idea is that a larger market provides scope for specialization and attendant efficiencies, an application of Adam Smith's principle that the division of labor is limited by the extent of the market. Nonetheless, the market economy has been seen as much as an economic curse for farmers as a source of economic opportunity. Commodity markets are characterized by variability and unpredictability, and farmers have seen themselves as being at a disadvantage in market power as compared with the businesses from which they buy inputs and to which they sell their output. How has this market context influenced technical innovation, farm incomes, and the organization of farming activities (size of farms, specialization, family versus corporate farms)?

The spirit of optimism that characterized writing on the agricultural economy before World War I is strikingly similar to late twentieth-century enthusiasm about information technology and the "new economy." Agricultural optimism was even deeper, in the sense that farming was seen as open to a broad range of people and not just to a technologically skilled subset of the population. Boosters such as T. Byard Collins, for example, were promising that "we are at the beginning of an era wonderful in the annals of agriculture . . . There are probably not less than two millions of people in the country at present who, by leaving the places they now occupy, could, by earnestly and intelligently adopting the avocation of agriculture, better both their own condition and that of those who are dependent upon them" (1906, pp. 18, 14). That optimism has been replaced by chronic apprehension and uncertainty about future economic prospects in farming. What happened?

A mighty shock was necessary to cause so strong and long-lasting a change in view. That is what the commodity markets delivered in the 1920s and 1930s, bringing about a sharply changed perspective that subsequent events have not dispelled. Figure 5.1 shows USDA's index of prices received by farmers for all the products they sell, placed in real terms by dividing by the price deflator that has been used in preceding chapters. In real terms, the average rate of real farm price decline is about 1 percent, with the biggest drop in 1919–1921.

Both before and after the Depression, farmers have been vulnerable to wide swings in prices that have wiped out many, but have also made fortunes. Many farmers have experienced both. Jimmy Carter recalled that in his youth he "saved enough money to purchase five bales of cotton at the then all-time low price of five cents per pound. I kept this cotton in one of

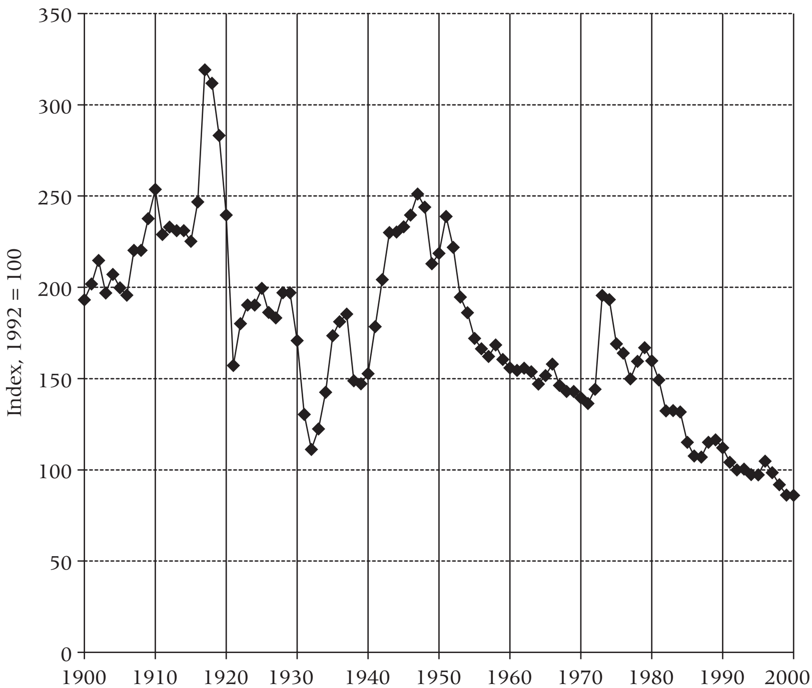

Figure 5.1 Real prices received by farmers. Data from U.S. Department of Commerce (1975); for data after 1970, U.S. Department of Agriculture, *Agricultural Statistics,* various years.

my daddy's farm storehouses until the price increased after a few years to eighteen cents, at which time I sold it for enough money to purchase five houses" (1975, p. 25). Yet upon returning to his peanut-growing and farm supply business after his presidency he found himself $1 million in debt and essentially broke, as a result of drought and questionable management under a blind trust he had established during his term of office.[1]

Selling products in the market and purchasing goods and services with the money accrued enables farmers to specialize in productive activities at which they are most efficient and increase their standard of living. The business connections made with people outside the farming community lead to a general broadening of interests and activities by rural people. But many disturbing events in U.S. farming in the twentieth century resulted from farmers being tethered to forces of supply and demand outside their control, and it is these that the antimarket tradition in rural thought has emphasized.

The discussion in earlier chapters placed the evolution of agricultural technology as the fundamental driver of change. Real commodity prices decline as output from given inputs increases, and the rate of price decline is a measure of the rate of decline in costs of production. Evidence discussed in Chapter 2 indicated that since 1940 multifactor productivity growth in U.S. agriculture increased roughly 2 percent annually, with the point estimate for recent USDA data being 1.8 percent. If the cost of production also fell by 1.8 percent and competition causes commodity prices to equal costs in the long run, then we should expect prices to fall by 1.8 percent annually in real terms. The actual trend rate of decline in real farm prices received for the years after 1940 is 1.5 percent annually.

As so often in economics, equality between the rate of increase in productivity and the rate of decline in real market prices holds only under assumed conditions, which are often questionable. In the present case the main doubtful assumption is that real input costs are constant. USDA's index of prices paid by farmers, in real terms, has declined at a trend rate of 0.3 percent annually since 1940. This decline would imply real farm product prices declining at a faster rate than productivity increases; however, the index of farm prices paid excludes the price of the farmer's own labor and land, and the real prices of both labor and land have increased since 1940. Consequently, one cannot conclude that the productivity and real product price rates of change are inconsistent. Indeed, given the severe problems of measurement discussed earlier, it is reassuring for our economic approach that the rates of change in productivity and real product prices are as close as

1. See interview reported in the *New York Times,* February 16, 2000, p. E1.

they are, and that both show a similar change in trend rates of growth before and after the 1930s.

Nonetheless, a causal role for technology cannot be the whole story, because economic conditions influence the development and adoption of technology. Some fundamental changes in rural society stemming from participation in the market economy have already been cited. In addition, the sustained period of low prices in the 1920s and 1930s, by creating conditions calling for large-scale governmental intervention in markets, indirectly influenced events in the longer term. Moreover, on the demand side a worldwide growing population and the evolving tastes and growing incomes of consumers both in the United States and abroad influenced the incentives for the adoption of technology. And once output-increasing technology is adopted, an expanding market is necessary if the additional output is not to depress prices enough to erode most or all of the gains to farmers.

Technological progress in processing farm products also warrants attention as a force changing farm-level technology. Farmers produce raw materials that are qualitatively ever more distinct from the goods consumed by households, and demands for specific, uniform characteristics of these raw materials influences the technology used to produce them.

A final market-related phenomenon is the integration of the farm and nonfarm labor markets. The returns to labor in agriculture were low even in the prosperous pre–World War I period. The Country Life Commission concluded in 1909 that "agriculture is not as commercially profitable as it is entitled to be for the labor and energy that the farmer expends" (Faulkner 1968, p. 318). A major element in subsequent developments is the migration of labor that this situation entailed, and its economic consequences, as was discussed in Chapter 4. In short, we cannot hope to understand the course of twentieth-century U.S. agriculture without a fuller understanding of the role of both commodity and input markets.

Commodity Markets

The record of price variability in farm product markets is even more evident for individual commodities than for the aggregate farm price index plotted in Figure 5.1. Crop prices seasonally start from harvest-time lows. They also vary randomly from day to day, month to month, and year to year. And most importantly, farm commodity prices are characterized by a few extraordinary peak years amid longer periods of fluctuating but generally lower prices. This means most farmers spend most of their years confronted by prices that barely cover their costs, or worse.

The data of Figure 5.1 indicate three short-lived episodes of high prices, during and just after World War I, World War II, and the "commodity boom" of the mid-1970s. While the uncertainties of crop production are widely appreciated as a cause of price instability, these large demand-driven shocks are more significant market movers. As a contributor to instability in farm income, the predominance of demand-side over supply-side shocks is even greater than for price instability. The reason is that price rises triggered by output declines are tempered by prices and quantities moving in opposite directions, so the rise in one counters the effect on revenue of the decline of the other. But during a surge in demand we see even larger quantities accompanying higher prices.

The impact upon farmers of the price collapse that has followed each boom period is amplified by worries that the collapse in prices may continue indefinitely (as compared with a drought that even pessimists generally expect sooner or later to end). The prime example is the devastating price collapses of the 1920s and 1930s. To assess the likelihood of future economic problems in agriculture, it is essential to understand why this price collapse and other sustained periods of low prices have occurred. The typical approach to achieve such understanding is to interpret the year-by-year evolution of prices in terms of underlying longer-term forces of supply and demand. These forces are well understood in theory but application to observed conditions is tricky. It is usually easy enough to see at least part of what is causing currently observed conditions; for example, in the commodity price declines of 1997–2000 the major culprit is seen to be weakness in the demand for U.S. exports (although what lies behind export-demand weakness is not so straightforward). It is also easy to be mistaken about causes. Such mistakes show up most readily when one tries to make market forecasts. Even close observers with a good deal of information often make huge mistakes.

After the post–World War I price collapse had been tempered by a few years of better experience in the 1920s, Secretary of Agriculture William Jardine summed up the situation by saying: "Each year sees some headway made toward improvement of the condition that we have been in the habit of calling the 'farm problem' " (foreword to McMillen 1929, p. ix). Unfortunately for his reputation as a forecaster, this assessment was published in 1929. In 1981, and with more detailed analytical support based on trends in food needs and agricultural productivity, the National Agricultural Lands Study estimated that in order to meet the demand for U.S. farm output in 2000 without an increase in real prices, 113 million acres of additional cropland would be required (National Agricultural Lands Study 1981, p. 59). As it turned out, by 2000 the United States harvested 20 million acres *less* cropland than in 1980, yet real prices of crops fell by about 50 percent.

In the 1990s fears based on limitations of U.S. production capacity waned, but as foreign markets developed, analysts worried that a surge in worldwide grain demand would cause shortages. One of the best-known worriers, Lester Brown, stated the case: "As the world progresses in the 1990s, each year brings evidence that we are entering a new era, one quite different than the last four decades. An age of relative food abundance is being replaced by one of scarcity" (1995, p. 121). He quantified his forecast with reference to Chinese grain imports, expected to rise rapidly and persistently through the mid-twenty-first century. He estimated 80 million metric tons of Chinese imports in 2000 (almost as much as the total of world grain trade in the mid-1990s). But by 2000 China had become a net *exporter* of grain. And instead of reaping the financial benefits that would have accrued to U.S. farmers under the big-import scenario, grain prices were at their lowest real levels ever. With much more analytical firepower, moreover, USDA, congressional, and university economists made similar projections at the time of the 1996 Farm Act that proved only moderately less erroneous.

With these cautionary episodes as sobriety checks, let us examine several perspectives on the causes of events in twentieth-century commodity markets.

AGRICULTURE AND THE BUSINESS CYCLE

The Great Depression brought home the extent of problems that can be caused by lack of demand. Decreases in aggregate demand are central to the analysis of macroeconomic fluctuations generally, and the question arises whether similar events in food and fiber demand caused economic problems for the agricultural sector. Although food demand tends to be less cyclically sensitive than that for nonagricultural products, it is also true that agricultural demand and supply are less responsive to market prices. It is therefore plausible that in recessions farm prices and incomes will fall by an even larger percentage than the overall economy's gross domestic product (GDP). This reasoning, together with observation of the fate of farm income in the Depression, led Theodore Schultz to the view that U.S. agriculture's "growing dependence on the exchange system makes agriculture increasingly vulnerable to business fluctuations. In an industrial economy, this dependency may well be the Achilles' heel of agriculture" (1945, p. 128).

It may be questioned whether the business cycle continues to play an important role in net farm income. Food consumption of even the poor is cushioned by the Food Stamp Program and other government food assistance policies, so recession would be expected to have a smaller effect on farm commodity markets today than prior to the 1960s. However, the

American diet includes increasing amount of foods and other agricultural products that are not necessities. The demand for these products may well be sensitive to the business cycle.

Table 5.1 provides evidence on real farm prices and net incomes during twentieth-century business downturns. The criterion for a downturn is that real GDP in a calendar year is less than in the preceding year. (This may seem an obvious criterion, but it is not the one most widely used by macro-economists.) Since 1910 there have been nineteen years of economic downturn: 1914–15, 1921, 1924, 1930–1933, 1938, 1946–47, 1949, 1954, 1958, 1974–75, 1980, 1982, and 1991. During these years real prices received by farmers fell by an average of 1.4 percent and real net farm income fell by an average of 13.5 percent. In contrast, farm prices rose by an average of 1.2 percent in the sixty-nine nonrecession years in 1910–1998, and real net farm income rose by an average of 6.6 percent. It thus appears that agriculture indeed is negatively affected by economic cycles. Moreover, this is as true of post-1950 recessions as it was earlier in the century. In the seven post-1950 years of economic downturn, real farm prices fell by an average

Table 5.1 Farm prices and income during recessions and inflation

Period of downturn	Annual percentage change in real farm prices	Annual percentage change in real net farm income
1914–15	−1.2	7.4
1921	−34.4	−52
1924	0	−4.2
1930–33	−10.4	−12.8
1938	−19.8	−26.4
1946–47	3.8	0.3
1949	−12.7	−27.2
1954	−4.4	−6.1
1958	3.9	15.8
1974–75	−7	−20.8
1980	−4.5	−46.1
1982	−11.5	−16.5
1991	−7.5	−16.9
Average of 19 recession years	−1.4	−13.5
Average of 69 nonrecession years	1.2	6.6
Addendum: Average of 31 years when inflation exceeded 4% annual rate	2.4	4.4
Average of all years, 1910–1998	−0.7	−0.4

Sources: U.S. Department of Commerce (1975) and Council of Economic Advisers (2000).

of 5.4 percent and net farm income fell by an average of 15.9 percent, a larger rate of decline than in the average of the pre-1950 downturns. Nonetheless, no other recessionary period has approached the economic damage done to agriculture in the four successive years of decline in the Depression of 1929–1933.

A related hypothesis about agriculture's dependence on the macroeconomic situation goes back to the thinking encapsulated in William Jennings Bryan's "cross of gold" oration of 1896—the idea that inflation is favorable for agricultural commodity prices and hence for farm income. Of course, prices generally rise in inflationary periods; the putative gains to agriculture occur if farm prices rise in real terms, that is, rise more rapidly than the general price level. The addendum to Table 5.1 presents data relevant to this hypothesis, showing the average increase in *real* farm prices and net income in the thirty-one years when the annual rate of inflation (measured by year-average increases in the deflator discussed earlier) exceeds 4 percent. In those years real farm prices and incomes did in fact increase at higher rates than in noninflationary years.

COMMODITY SUPPLY AND DEMAND

Wheat prices, after doubling or more in 1973 and 1974, crashed in subsequent years to the point that by late 1977 wheat growers asking for price-support policies were driving their tractors on the Mall in Washington, D.C. The main reason for the crash in prices was a huge increase in wheat acreage harvested, from 47 million acres in 1972 to 71 million acres in 1976, an increase of roughly 50 percent. The additional land devoted to wheat was permitted by a relaxation of acreage restraints in the federal wheat program, and in response farmers harvested additional acres equal in area to the entire wheat acreage of Kansas, Oklahoma, and Texas. Wheat was grown on marginal land within the traditional Great Plains wheat states, but also by expansion of wheat acreage in other states, replacing other crops or pasturelands. In Illinois and Indiana wheat acreage doubled between 1972 and 1976. These data indicate a large response of supply to price.

The analysis of supply response was well established by the work of Marc Nerlove (1958), who focused on pre-1933 data in order to observe farmers' economic responses unrestricted by governmental commodity programs. In work since confirmed by hundreds of econometric studies, he found that growers of the main crops tend to increase their production in response to higher prices, typically by 2 to 5 percent for every 10 percent increase in the crop's expected price. An implication is that while commodity prices are variable owing to shocks in supply and demand, we should observe mean reversion—a tendency for unusually high or low prices to be followed by prices nearer long-term trend prices.

However, supply response to a change in all crop prices simultaneously is smaller, because opportunities for substitution among crops are less. Some economists have argued that farmers increase output more in response to high prices than they reduce output in response to low prices, mainly because they have fixed assets committed that they tend to keep using despite low prices. The evidence, however, is mixed. Another special argument is the "cobweb" model, according to which this year's production is a function of last year's price. This is essentially a theory of simple-mindedness on the part of farmers, who are thought to expect that if this year's price is high, next year's price will be too (even though they must know all their neighbors will also be making adjustments on those same expectations and thereby collectively spoiling them). The theory's implication of a two-year cycle of high and low prices has not been borne out.

A series of papers following Jeffrey Williams and Brian Wright (1991) and Angus Deaton and Guy Laroque (1992) shows that commodity storage in pursuit of profits from year-to-year price gains typically generates a time series of price similar to that shown in Figure 5.1—infrequent price spikes followed by sustained periods of low prices—even if the only random events are serially uncorrelated supply shocks. Other analysts have focused on other properties of prices, such as the effects of interventions in commodity markets by governmental policies (tariffs, price supports, and other regulation), and on interrelationships among prices for different commodities as market conditions change. It is important to know as much as possible about the causes of price dynamics because low prices often trigger policy responses, and the policies that make most sense depend on addressing the cause efficiently. If recession is indeed the enemy, then macroeconomic policy, rather than commodity price regulation, may be the place to look for solutions. If market prices are mean reverting, governmental intervention to prevent prices from falling or rising will damp the economic response that producers and consumers would otherwise have made, and thus prolong the imbalance that led to low or high prices.

The extent to which different commodity prices change together is important, because if they do not, for example if one commodity's price increases in years when another commodity's price decreases, then farmers can reduce the economic risk they face by diversifying their crop mix. Figures 5.2 and 5.3 show time series for selected U.S. farm commodity prices. They generally move together, indicating that sectorwide as opposed to commodity-specific factors are important. But the correlations are not perfect. How much reduction of risk could a farmer achieve by selling several commodi-

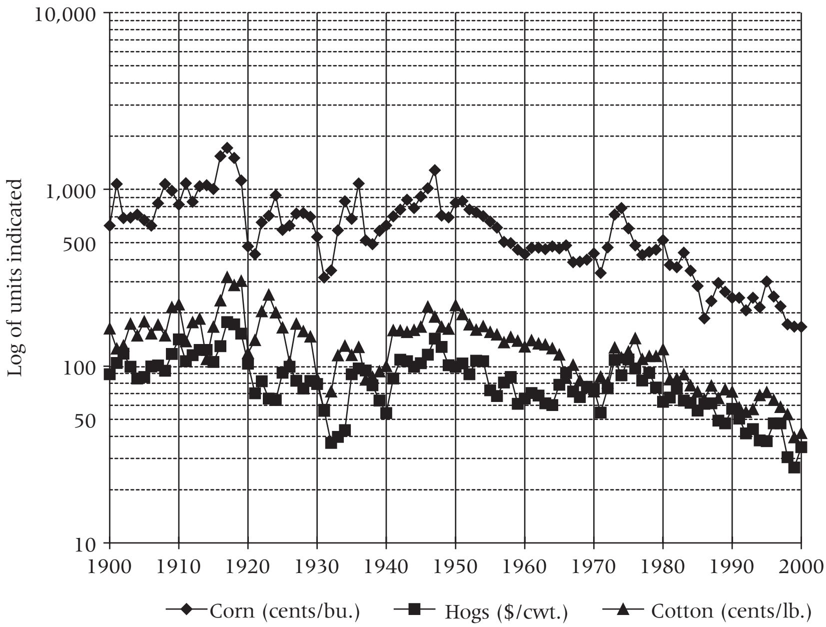

Figure 5.2 Real farm prices of corn, hogs, and cotton (1992 dollars). Cwt. = 100 lbs.; data from U.S. Department of Commerce (1975); U.S. Department of Agriculture, *Agricultural Statistics,* various years.

ties instead of specializing? Table 5.2 provides data that bear on this issue. The matrix shows correlation coefficients among the prices of fifteen commodities. Some are small, but only hay has a negative correlation with any other commodity price.

Thus it may be hard for farmers to reduce their market risks through diversification. The standard deviations shown in Table 5.2 indicate the gains from diversification. The value of .024 for hogs in 1911–1996 means that for a given quantity sold, farm revenue from hogs had a typical change from one year to the next of 2.4 percent. If fixed costs of inputs are two-thirds of average revenue, then the typical year-to-year change in net income for the farmer's labor and investment is 7.2 percent. This may not look terribly risky, but in eight years of the 1911–1996 period, revenue from hogs fell 25 percent or more from the preceding year, indicating that net income decline by 75 percent—an amount that would for most people require borrowing to maintain a subsistence consumption level. Corn is even riskier. But if a farmer combines hog and corn income in equal shares, the standard deviation of revenue change falls to .020 and revenue falls by 25 percent or more in only five years (1920, 1921, 1930, 1931, and 1937). Other diversified

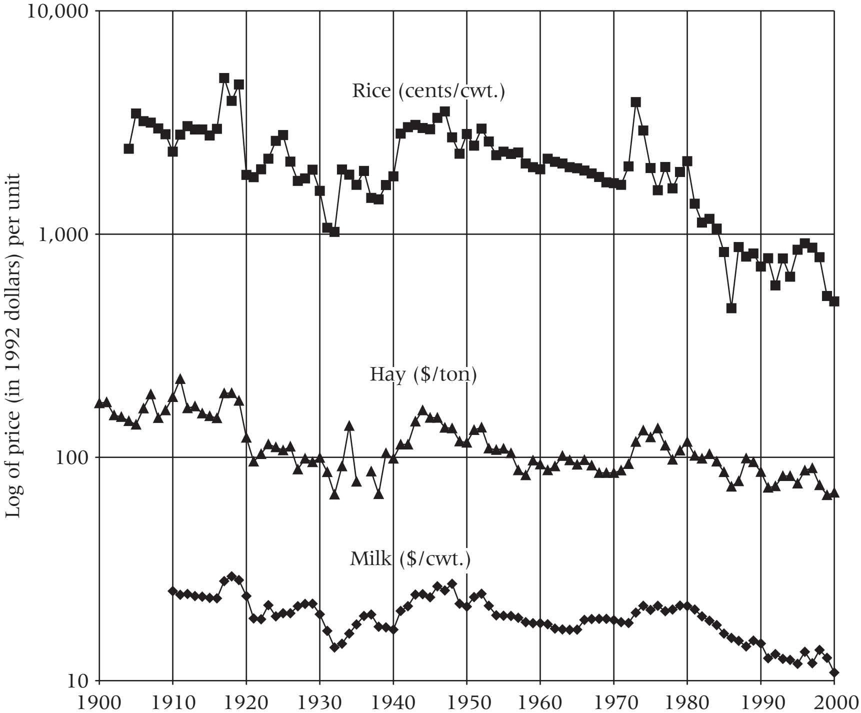

Figure 5.3 Real farm prices of milk, hay, and rice. Cwt. = 100 lbs.; data from U.S. Department of Commerce (1975) and U.S. Department of Agriculture, *Agricultural Statistics,* various years.

portfolios of commodities (milk, corn, and hay; wheat, corn, and soybeans; corn, apples, potatoes, and hay) provide similar reductions of risk. The last one listed is especially notable in that it combines four commodities with quite volatile prices into a portfolio that is much less risky than any of them individually.

In the message accompanying his veto of an early congressional attempt to support agricultural commodity prices, the first objection raised by President Calvin Coolidge was that the bill would discourage the time-honored methods of diversified agriculture and would "instead put a premium on one-crop farming" (1927, p. 4774). In the 1930s the New Deal enacted such legislation. As discussed in Chapter 3, commodity specialization by farmers has in fact increased a great deal since the 1930s, and that commodity support programs played a role in this is a hypothesis worth taking seriously.

Year-to-year variations in commodity prices decreased substantially under federal commodity programs, as indicated by the statistics in the bottom

Table 5.2 Correlation among farm commodity prices and variance of farmers' revenue, 1911–1996

Matrix of Correlation Coefficients, annual percentage changes in farm price

	Steers	Milk	Eggs	Corn	Hogs	Tob.	Cotton	Wheat	Potatoes	Sugar beets	Oats	Rice	Hay	Apples	Sweet potatoes
Steers	1.00														
Milk	0.67	1.00													
Eggs	0.51	0.65	1.00												
Corn	0.19	0.25	0.21	1.00											
Hogs	0.56	0.58	0.66	0.25	1.00										
Tobacco	0.23	0.41	0.28	0.58	0.33	1.00									
Cotton	0.24	0.35	0.17	0.51	0.22	0.65	1.00								
Wheat	0.41	0.48	0.43	0.64	0.41	0.39	0.40	1.00							
Potatoes	0.08	0.25	0.13	0.33	0.19	0.13	0.24	0.37	1.00						
Sugar beets	0.39	0.49	0.34	0.40	0.22	0.20	0.25	0.45	0.14	1.00					
Oats	0.13	0.41	0.19	0.71	0.23	0.40	0.37	0.69	0.36	0.34	1.00				
Rice	0.27	0.37	0.32	0.66	0.32	0.48	0.54	0.63	0.36	0.38	0.54	1.00			
Hay	0.33	0.27	0.15	−0.08	0.05	0.01	0.00	0.17	−0.13	0.12	0.10	0.12	1.00		
Apples	0.02	0.27	0.18	0.31	0.11	0.47	0.45	0.24	0.36	0.05	0.32	0.28	−0.15	1.00	
Sweet potatoes	0.19	0.41	0.38	0.40	0.18	0.23	0.18	0.43	0.49	0.17	0.48	0.43	0.05	0.29	1.00
Standard deviation of annual percentage price changes															
1911–1996	0.016	0.012	0.017	0.027	0.024	0.018	0.026	0.024	0.041	0.019	0.030	0.026	0.036	0.032	0.025
1911–1933	0.038	0.032	0.037	0.066	0.054	0.055	0.081	0.060	0.105	0.038	0.080	0.065	0.040	0.087	0.047
1986–1996	0.022	0.021	0.038	0.069	0.045	0.010	0.039	0.062	0.065	0.023	0.088	0.097	0.037	0.081	0.071

Standard deviation of diversified commodity prices

	Milk, corn, and hay	Hogs and corn	Wheat, corn, and soybeans	Corn, apples, potatoes, and hay
1911–1996	0.016	0.02	0.024	0.02
1911–1933	0.038	0.049		0.057
1986–1996	0.03	0.036	0.051	0.038

panels of Table 5.2 for 1911–1933 (before the programs) and 1986–1996 (after their price-stabilizing elements were largely eliminated). For all commodities but tobacco (which maintained its stabilization program in 1986–1996), the standard deviations of price changes are higher in these no-program periods than in 1934–1985 (despite this period's containing World War II and the 1970s commodity boom). However, most commodity prices remain quite volatile in all periods, and the portfolios of diversified commodities are far from stable.

Trends in Commodity Demand

Although sustained periods of low prices have been a central concern of U.S. farmers and of U.S. farm policy, no approach to supporting commodity prices can accomplish much for farmers over the longer term (without substantial economic waste) if there is no market for farmers' products at prices in the neighborhood of the cost of producing those products. And productivity gains that allow more output from given agricultural resources are a hollow achievement in the absence of demand for the products produced. We therefore need to examine twentieth-century trends in demand for U.S. farm output. That demand has two main components: consumers in the United States and foreign buyers of U.S. farm products.

DOMESTIC DEMAND

One of the first large-scale U.S. consumer expenditure surveys was undertaken in 1901 by the U.S. Bureau of Labor. It found an average annual income per person of $163, of which $67 (41 percent) was spent on food (U.S. Department of Commerce 1975, p. 321). By 1992 estimated food spending was $1,567 per person and income $13,398, so the share of spending on food was 12 percent (Smallwood et al. 1994, p. 1). After adjusting for inflation, real disposable income per capita in 1992 was 5.3 times its 1901 level (a rate of growth of 1.8 percent annually over ninety-one years). The decline in the share of income spent on food as income has risen is an instance of Engel's Law, which implies that a 1 percent increase in income leads to a food consumption increase of less than 1 percent. USDA's index of food consumption per capita, and calories per capita, are shown in Figure 5.4 (see Harp and Bunch 1989 for a description of the consumption index). Between 1909 and 1990 consumption grew at an average annual rate of 0.3 percent. With real income per person growing 2 percent per year, the implied income elasticity of demand is 0.15. This estimate assumes no changes in the price of food relative to other goods and does not account for changes in the

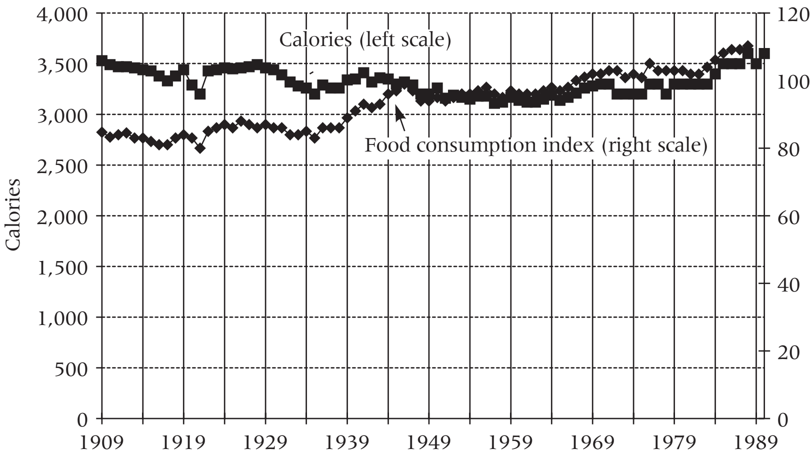

Figure 5.4 U.S. food consumption per person. Data from U.S. Department of Commerce (1975); U.S. Department of Agriculture 1999d; food consumption index from Harp and Bunch (1989).

age composition of the population—an older population later in the century—or changes in the distribution of income.

Figure 5.5 plots real food prices at retail in 1913–1996. The real price has a significant downward trend, −0.4 percent per year, adding up to a 35 percent decline over the period. This would be expected to have some effect on consumption, but not a large one, given the low responsiveness to price that is found in econometric studies of aggregate food demand. With an elasticity of demand of −0.2, which is on the more price-responsive end of estimated values, historical price declines would have generated about an 8 percent increase in demand over the century, which is less than a tenth of 1 percent per year.

The implication of the preceding calculations is that neither real income growth nor overall food price changes can plausibly have generated a large change in the demand for farm products over the last hundred years. A more important force behind changes in U.S. food demand is population growth. The U.S. population increased from 76 million in 1900 to 281 million in 2000. Consumption per capita, as measured by USDA's quantity index, has increased by 20 percent during the century. To feed the U.S. population in 2000, agriculture must produce roughly four times as much food as in 1900.

Beyond these aggregate effects, demographic trends have been responsible for notable changes in the demand for agricultural products. In 1900, 32 percent of the U.S. population was aged fourteen and under, and 4 percent

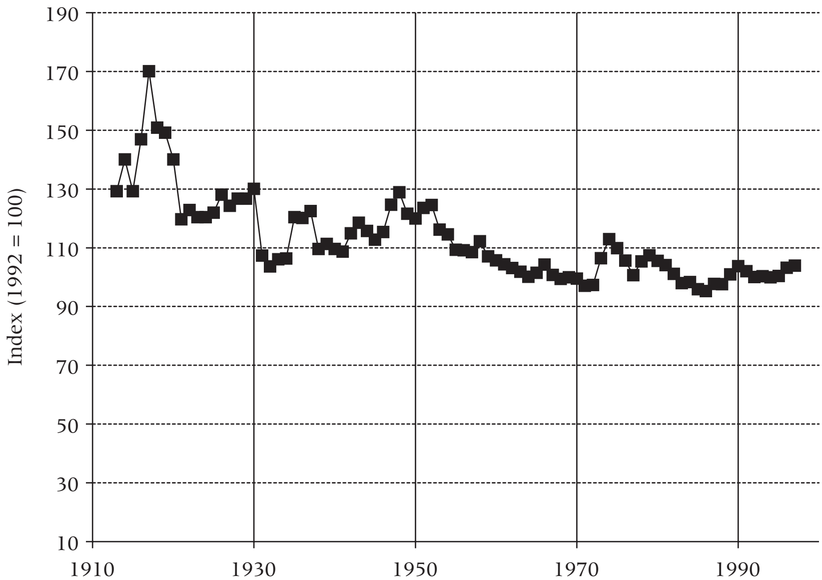

Figure 5.5 Real cost at retail of food for home consumption. Data for years before 1970 from U.S. Department of Commerce (1975); for years since 1970, Council of Economic Advisers (2000).

was sixty-five or older. In 1996, 20 percent was under fourteen, and 13 percent over sixty-five. The increasing age of the population since 1900 has altered the composition of food demand, as has growing incomes and increased ethnic diversity. For example, while USDA's index of food quantity has increased substantially between 1909 and 1989, their estimate of calories consumed per person is unchanged.

Household technology has been the locus of perhaps as many innovations as has farming, mainly through the development of labor-saving devices such as automated home heating, gas and electric cooking appliances, and improved home food storage equipment, not to mention more exotic kitchen gadgetry. At the same time, an increase in women's work outside the home has contributed to an increase in food consumption away from home and the increased use of food products brought home almost ready to eat. Food manufacturing and marketing have reflected and perhaps accelerated these changes, which are evident in the thousands of food products in today's supermarket, with hundreds of new products appearing (and most promptly disappearing) each year. Variety is such that most consumers also have the choice of buying at farmers' markets and organic food outlets that re-create much of the simpler menu of raw food product choices of a century ago.

For particular commodities there are risks of sudden demand shocks due to “food scares.” In a celebrated case in 1989, a public-interest watchdog group wanted to draw attention to a potential problem with apples treated with the chemical Alar, used to promote an appetizing red color. The group lined up air time on the morning TV news-chat shows and got the attention of network evening news shows, too. Soon mothers were urging that apples be removed from school-lunch programs, and demand generally collapsed. The U.S. Environmental Protection Agency had announced in August 1985 that it estimated the lifetime risk of consuming foods with Alar residues at an alarming rate of one cancer death per 10,000 people consuming these foods. The finding was contested, however, and Alar was never banned. Following the uproar of 1989, producers voluntarily ceased using it, and several supermarket chains announced chemical residue testing programs for their produce.

The reduction in sales of apples due to perceived risks of Alar contamination was estimated at 30 percent. E. O. van Ravenswaay and J. P. Hoehn (1991) estimated this loss on the basis of sales in the New York City/Newark, N.J. market. The U.S. average farm price of apples fell by nearly 20 percent between 1988 and 1989, costing producers of this billion-dollar crop about $200 million. Producers of the most affected varieties abandoned some of their orchards. But already in 1990 demand had fully recovered and by 1992 the U.S. apple industry was selling 15 percent more apples than in 1988 at a higher average price.

Similar episodes of sudden demand shocks due to a health scare, with large industry costs, followed by full recovery, have occurred in cranberries (a herbicide residue) and milk (strontium-90 fallout) in the 1950s, mercury in swordfish in the 1960s, saccharin in soft drinks in the 1970s, and bacterial contamination in fast-food hamburgers in the 1980s. For a review of studies analyzing many cases, see Ivar Strand (1999). In the last few years food irradiation to kill microorganisms that cause spoilage, and the use of genetically modified ingredients in foods—milk in the early 1990s and in grains most recently—have been the object of heavy protest and media hype, but so far have not influenced consumer demand in anything like the intensity of earlier episodes.

More lasting effects have resulted from longer-term health concerns, most notably moves away from high-fat foods and toward noncaloric sweeteners. With respect to health threats from food contamination, the sources of risk are similar throughout the century, most importantly bacteria and other pathogens. Salmonella causes deaths in the thousands each year. Recent overall estimates are an annual incidence of 3.6 to 7.1 million estimated cases of food-borne illness annually, resulting in 2,700 to 6,600 deaths in 1993 (Buzby and Roberts 1995; see also N. Fox 1997 for an effective potboiler on the subject).

Illustrating the uncertainty in such estimates, in September 1999 the U.S. Centers for Disease Control revised their estimates of 9,000 deaths annually from food-borne illness sharply downward to 5,000, but from a much larger estimated total of 76 million cases annually (*New York Times,* September 17, 1999). Data on incidence of food-borne illness and deaths therefrom remain sketchy at best. Actual cases of illness reported to public health authorities as food related average about 18,000 annually. Extrapolation to millions involves difficult assessments of underreporting and misdiagnosis (see Antle 2001; Council for Agricultural Science and Technology 1994). Illnesses or deaths due to currently feared contaminants such as pesticides, food irradiation, or genetically altered crops are even more conjectural. It is arguable that the incidence of deaths from these causes is near zero in the United States today.

The casualty rate from food poisoning was almost surely higher in earlier years, and has probably been generally decreasing since 1900. The effects on the demand for food are unclear. Former threats, notably botulism, have been tied primarily to home-processed foods. Such threats presumably increased the demand for industrially processed foods. But current consumer opinion seems to be that home preparation is safer.

Despite many changes, the most striking aspect of farm-level demand is how stable the use of commodities has been. Figure 5.6 shows the shares of crop production by value in 1900 and in 1995. Oats have disappeared from significance (less than 1 percent of aggregate crop value) and soybeans came from virtually nothing to 14 percent of crop output. And the collection of small-scale crops in “other” has increased in importance. But otherwise the major products of 1900 remain the major products today: corn, wheat, hay, and cotton are still the top four crops, accounting for about half of U.S. crop value. Similarly, livestock products accounted for about half the value of U.S. farm output in 1900, and still do today. Within livestock output, the rise of broilers parallels but is perhaps even more impressive than the rise of soybeans on the crop side. Still, these are not revolutionary changes in the larger picture of nutrition and taste.

Bigger changes have occurred in what processors do with farm commodities. They are increasingly the raw material for highly processed mixes of a variety of agricultural products and additives. The ascent of processed foods of incredible variety—a few hundred farm products end up as tens of

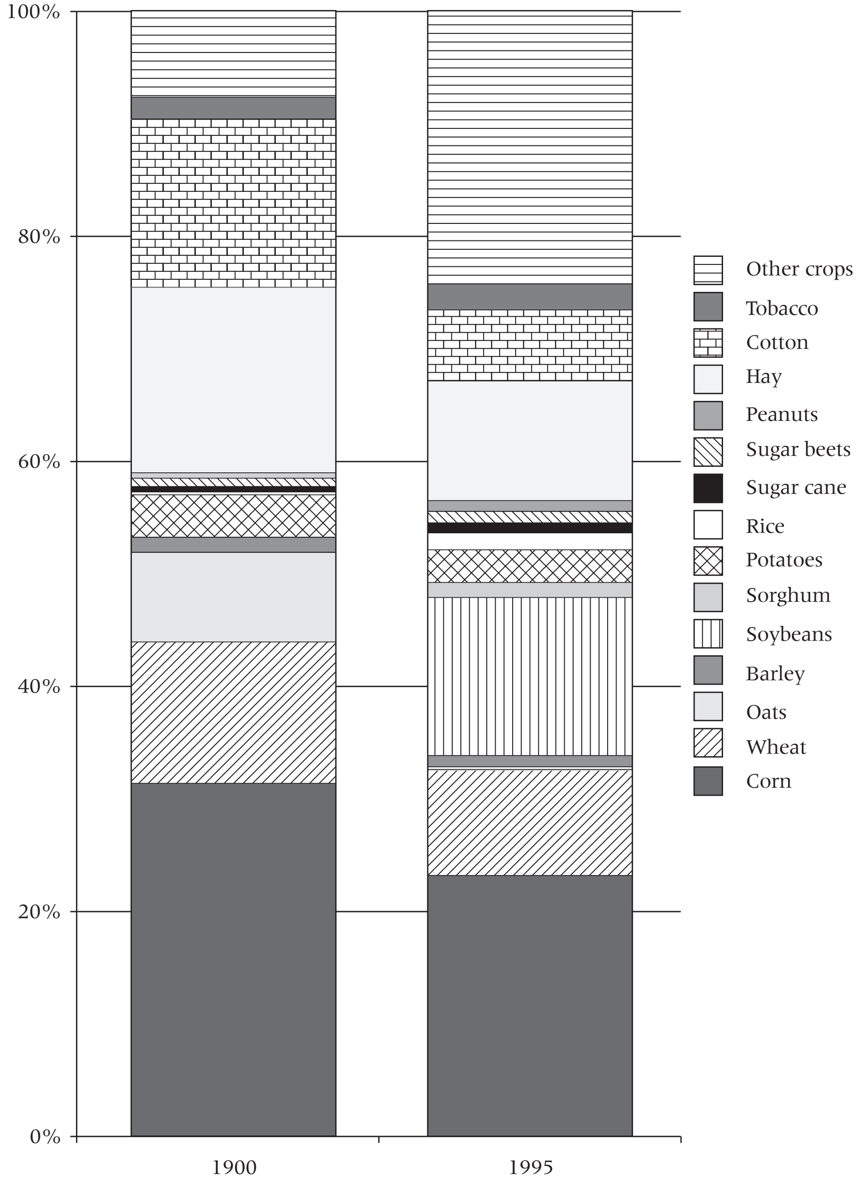

Figure 5.6 Crop shares in 1900 and 1995. Data from U.S. Department of Commerce (1975); U.S. Department of Agriculture, *Agricultural Statistics*, various years.

thousands of items on supermarket shelves—has triggered criticism on the grounds of these foods' nutrition, health risks, and cost. What are the consequences of increased processing for farm-level demand? Processing has not gone so far as to construct food products from nonagricultural raw materials—amino acids brewed in tanks, say—but foods such as soybeans and milk have shown a versatility in what can be done with them in processing that has substantially boosted their demand.

A recurrent refrain for many decades has been the promotion of uses for farm commodities in products other than food. Of course, textiles and fuel have been derived from agricultural products for thousands of years, and textiles retain their importance as the source of demand for U.S. cotton and wool. Industrial and agricultural interests have cooperated in the search for financially viable new uses of farm products. The use of corn-based ethanol (alcohol) for fuels has received the most attention and, since the energy crisis of the 1970s, has encouraged hopes for a vast new market for corn. In the 1990s the use of corn for fuel alcohol rose to 500 million bushels annually, but this is still only about 5 percent of the U.S. corn crop; and that level of use is achievable only with the help of subsidies amounting to hundreds of millions of dollars annually.

Other new uses, of corn and soybeans especially, continue to show promise in inks, solvents, biodegradable plastics (from corn starch), and other products. Optimism about such technologies goes back to George Washington Carver's famous work with peanuts. An example from the 1930s is found in Roger Burlingame's article "Rainbow over the Farm" in the December 1939 issue of *Harper's Magazine* (pp. 50–59). The "rainbow" is industrial uses of farm products. Nonetheless, over sixty years later large-scale commercial success sufficient to add significantly to farm-level demand remains elusive. And some of the most successful innovations involve one agricultural product's replacing another. The expansion of high-fructose corn syrup as a sweetener replacing sugar in soft drinks and bakery products in the 1970s is an example (triggered largely by government sugar policy, which has held the price of sugar in the United States at two to three times world price levels, while U.S. corn is the cheapest in the world).

A big economic force in substitution among agricultural raw materials is the inherent higher cost of livestock as compared with crop products, arising from the fact that livestock must process crops, before being processed themselves. Crop-based foods eliminate the intermediate processing. Continual advances in replacing more expensive animal products with cheaper crop-based materials have occurred, going back to the replacement of butter by oleomargarine made from vegetable oil, and on to soy-based "hamburger helper" and the like. But meat products and livestock remain almost as important in the agricultural economy now as they were in 1900.

REGIONAL PRICE DIFFERENCES AND CONSUMER PRICE STABILITY

The development of a market economy in agriculture has benefited consumers by making a wider range of commodities available in more geographically dispersed places at lower prices. The main underlying causes are technological improvements in transportation, storage, preservation, and information transmission. The extent of improvement is evident even in storable and relatively standardized commodities like corn. In 1912 the average price received by farmers in Iowa, where prices were lowest, was 35 cents per bushel; the highest price was $1.00, in Arizona. In 1950 the lowest price, in North Dakota, was $1.35; the highest price was $2.04, still in Arizona. In 1997 the lowest and highest prices, still in North Dakota and Arizona, respectively, were $2.30 and $3.30. Thus the ratio of highest to lowest state prices was reduced from 2.9 in 1912 to 1.5 in 1950 to 1.4 in 1997.[2] Figure 5.7 shows the range of state farm prices of corn in twenty-six states for which USDA has continuous data from 1928 to 1993. Each line plotted represents the price history of a state, but congestion precludes labeling them. The important fact is that state-level prices converge over time, and price variability from state to state is reduced. This reduction can be quantified by means of the coefficient of variation (standard deviation divided by the mean) of state prices. It fell from 0.24 in the 1920s to 0.10 in the 1980s and 1990s, with the reduction occurring most rapidly between 1930 and 1960.

For more perishable products, changes in the seasonal variability of prices are also important. Some of the most significant improvements involve products that were formerly not available except in a short growing season gradually becoming available, and at lower prices, over a greater part of each year and in more locations.

Improvements in marketing together with an enhanced role of processing have also resulted in greater food price stability. Figure 5.8 shows annual rates of change of food prices relative to the general price level. Food prices have always been considered especially volatile and thus are omitted from the "core" inflation data published by the U.S. Bureau of Labor Statistics. But as Figure 5.8 shows, this volatility has decreased markedly over time.

2. Calculations in this paragraph all use USDA's data on prices received by farmers as published in *Agricultural Statistics* and, before 1936, the *USDA Yearbook*. The data are available on the website of USDA's National Agricultural Statistics Service, at www.usda.gov/nass/.

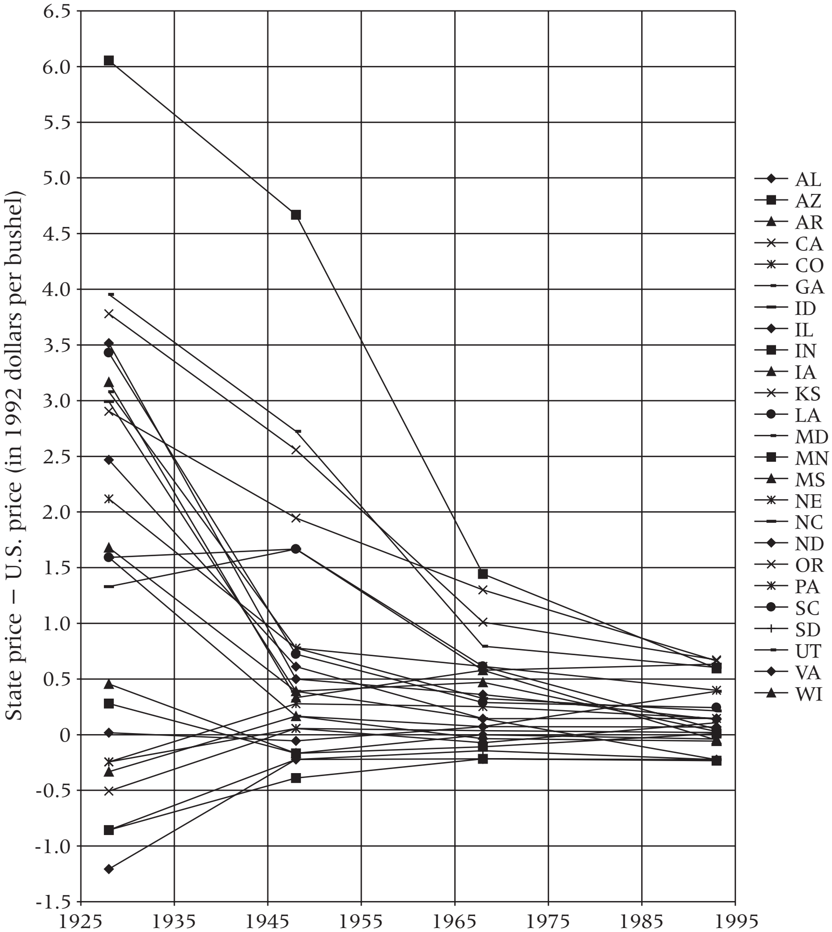

Figure 5.7 State corn price minus U.S. average price. Data for year-average price received by farmers for each state and the United States from U.S. Department of Agriculture, National Agricultural Statistics Service, unpublished data.

Since World War II there have been only two years in which the price of retail food changed more than 5 percent relative to the prices of other goods (1973 and 1974). But before 1950 there were eight such years.

INTERNATIONAL DEMAND AND SUPPLY

U.S. farmers, growers of cotton, tobacco, and grains especially, have traditionally seen themselves as participants in world commodity markets. In the

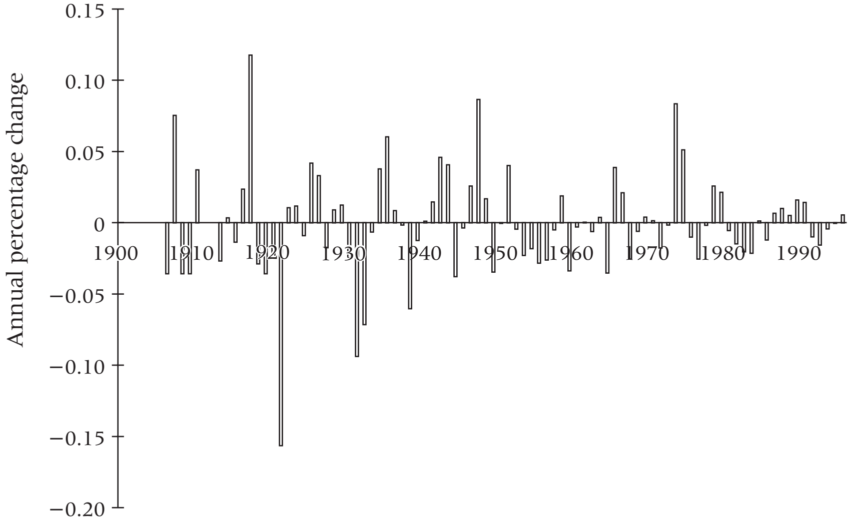

Figure 5.8 Percentage changes in food prices. Data from U.S. Department of Commerce (1975); Council of Economic Advisers (2000).

first decades of the twentieth century a large part of the news reported as influencing market prices for U.S. crops concerned events in European markets, especially Russia, and in South America. Discussions of U.S. farm-level wheat prices invoked their relationship to Chicago market quotations, and also to Liverpool.

Figure 5.9 shows the value of agricultural exports to average about $15 billion (1992 dollars) during most of 1900–1930, with about twice that amount in 1915–1920. Agricultural imports, however, mostly of crop products such as coffee, rubber, and tropical products not directly competitive with U.S. products, more than doubled in real value between 1900 and 1930. Thus agriculture went from being a contributor to a positive U.S. balance of merchandise trade in 1900–1920 to being a trade-deficit sector in 1925–1930.

After the general decline in trade that accompanied the Depression, agricultural exports rebounded to about $20 billion (1992 dollars) annually after World War II. Farmers saw the benefits of strong world markets vividly at this time, and responded to not only market-driven sources of demand but also the demand for U.S. products created by the Marshall Plan. When agricultural exports began to weaken in the 1950s, food aid and export subsidy programs were introduced to maintain and build foreign markets. In the 1960s agriculture again began to be seen as a significant contributor to a

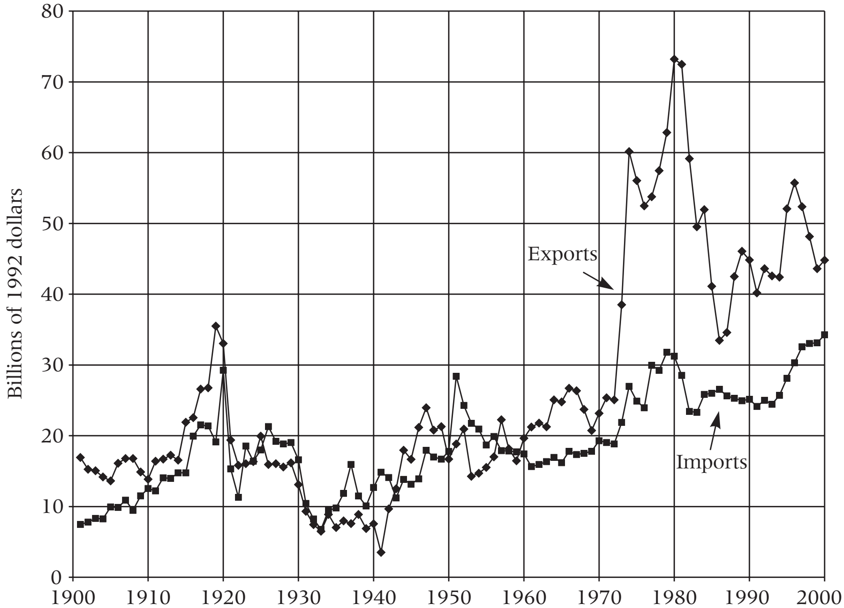

Figure 5.9 Agricultural exports and imports, value in 1992 dollars. Data from U.S. Department of Commerce (1975); U.S. Department of Agriculture, *Agricultural Statistics,* various years.

positive U.S. trade balance and source of economic benefits to the economy generally as well as to farmers.

The largest shock to U.S. agricultural exports occurred in the 1970s. It began when the Soviet Union unexpectedly bought a quantity of wheat equal to about one-sixth of the entire U.S. crop in 1972. U.S. grain exports doubled and grain prices soared, within a matter of weeks turning public discussion from chronic grain surpluses to shortages. Bakers testified before Congress that something had to be done to protect U.S. consumers from the "grain robbery" fostered by the Soviets.

Not only did the Soviets drive up grain prices, they did so with sufficient stealth that their purchases were completed before the major price increases occurred; and moreover the price the Soviets paid was further reduced because USDA continued paying export subsidies intended for an earlier period, when foreign demand was weak. Authors such as James Trager (1975) and Dan Morgan (1979) blamed the large international grain trading companies for profiteering and acting so as to prevent the farm-level price from reflecting the prices the Soviets were paying. The climate of shortage became sufficiently strong that in 1973, with grain stocks tight and soybeans now looking even scarcer (as the first widely noted El Niño event wiped out supplies of feed protein from the South American anchovy industry), the Nixon administration felt impelled to take drastic steps. For the first time in peacetime history, presidential authority was exercised to impose an embargo on exports of a farm commodity, soybeans. Two years later, when the Soviets again made a summertime raid on the grain markets, President Gerald Ford within two months halted further shipments of grain to the USSR while government-to-government negotiations were held to determine the level of grain sales that would be permitted. For the next five years the U.S. government became the regulator of U.S. grain exports, with quantitative restrictions imposed by Presidents Nixon, Ford, and Carter at various times. The agricultural community responded politically with such vigorous opposition to export controls that subsequently, to have a chance of election, any hopeful for national office who campaigned in the farm states had to give ironclad promises of no more embargoes.

An overall indicator of the importance of trade in the U.S. farm economy is the net agricultural trade balance (value of exports minus value of imports) as a percentage of the market value of all U.S. farm output. This "export intensity index" tells what fraction of the demand for U.S. farm products is accounted for by foreign markets. The index is shown in Figure 5.10.

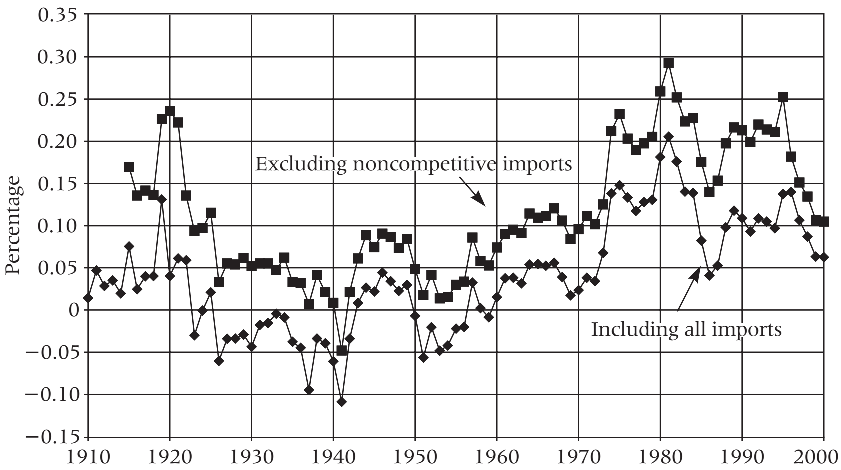

Figure 5.10 Real agricultural exports minus imports, as percentage of farm cash receipts (export intensity index). Data from U.S. Department of Commerce (1975); U.S. Department of Agriculture, *Agricultural Statistics,* various years; noncompetitive imports as defined in *Agricultural Statistics,* 1998.

What difference has the export market made for the U.S. farm economy? Econometric analysis of the relationships among exports, farm prices, and farm income is fraught with pitfalls. Prices and exports are mutually determined in ways that standard regression methods are unlikely to be able to cope with, because there is no stable underlying causal relationship between the two variables. Some changes in exports, like those generated by Soviet sales in the 1970s, are obvious shifters of the demand for U.S. farm products. But other changes, such as the sustained growth of U.S. broiler exports in the 1980s and 1990s, are most likely caused by U.S. supply-side changes that have increased exportable surplus production.

The most comprehensive economic analysis of exports as related to U.S. commodity markets and farm income in the 1990s is incorporated in the work of USDA economists in their medium- to long-term projection of the agricultural economy. They had to face the issue in practical terms when, primarily because of the economic problems of Asia, the outlook for U.S. agricultural exports was substantially reduced between 1996 and 1998. Their projections for net farm income were reduced by an average of $5.7 billion annually as a result of an average annual reduction of $13 billion in exports over a six-year period, indicating that each $1 of exports was worth $0.44 in farm income. (For details, see B. L. Gardner 2000a.) These estimates quantify the idea that the export market is important for the prosperity of U.S. agriculture.

This importance was underlined by a continued drop in export earnings from grains and cotton in 1998–2000, and the historically low U.S. commodity prices attributed to that decline. The decline appears within the range of recent variation in Figure 5.9, but a basis for longer-term worry can be seen in the top line of Figure 5.10, which excludes imports of "noncompetitive" products such as coffee and cocoa, not produced in the United States because of climatic constraints. An increasing share of the remaining strength in U.S. agricultural exports is accounted for by poultry and other livestock products, which in recent years have replaced grains as the most important export earners.

Market Power Facing Farmers

Entering the market economy means relying on sales of commodities to and purchases of inputs from businesses outside the immediate farm community. The power of business enterprises to set prices unfavorably for farmers has long been an object of farmers' suspicions. Economists have invoked theories of monopoly and monopsony that explain why farmers facing a single buyer of their products or supplier of inputs have good reason to be concerned. However, when there is more than one supplier or buyer for a product, even if only a few, matters are less clear. The case of just a few sellers/buyers is typical of economic relationships between farmers and the nonfarm businesses they deal with. In such cases it is particularly difficult to gauge whether and to what extent farmers are being exploited. This situation has led to many congressionally mandated studies and assessments, from the trust-busting Progressive Era preceding World War I, through the Federal Trade Commission's investigations of the 1930s and the 1960s (see, for example, U.S. Federal Trade Commission 1960), to antitrust inquiries into cereal makers and Archer-Daniel-Midlands in the 1990s, down to the 1999 Department of Justice requirement that Cargill Inc. divest itself of key grain-handling facilities before it could consummate its merger with Continental Grain.

What is the economic evidence of market power? Two principal kinds of data have been marshaled: first, data on prices, and particularly on margins between prices of raw agricultural commodities and prices of final products sold to consumers; and second, data on the profits and costs of agribusiness enterprises.

With respect to marketing margins in aggregate, the main relevant trend is that real farm product prices fell by about half during the twentieth century, from an index value of 200 in 1900 to less than 100 in 2000, while at the same time, real food prices paid by consumers fell a little less than half that percentage. The overall marketing margin, or farm–retail price spread, has therefore increased substantially. However, details of price movements are quite different for farm and food prices. As Figure 5.1 shows, the index of real prices of farm products remained about the same in 1950 as it was in 1900. The strong trend of farm price decline emerged only after 1950. (It is only now that the entirely transitory nature of the commodity price boom of the 1970s has come clearly into view.) In contrast, the declines in real food prices paid by consumers occurred almost entirely before 1960, with essentially no trend decline since (Figure 5.5).

The best overall indicators of what goes on economically between the farm and the consumer are the statistics calculated by USDA's Economic Research Service that measure the price spread between farm and retail, and the share of each dollar spent for food products accounted for by the cost of raw agricultural products. The price spread is calculated by subtracting from the retail price of a food item the farm value of the raw materials that go into the item. This is a more complicated matter than just subtracting the farm price of a pound of steer from the price of a pound of retail beef, because some of the steer never becomes beef. USDA estimates that on average it takes 2.4 pounds of steer to yield a pound of beef. So they subtract the cost of 2.4 pounds of steer from the price of a pound of beef. But in doing this it is also necessary to take into account the fact that the 1.4 pounds of steer that does not become a pound of beef is not just wasted. It goes into by-products such as hides and tallow. Therefore the value of by-products has to be added to the retail value to get an accurate picture.

The economic assumptions required for the USDA approach to be accurate can be seen from the algebra of their calculating method. Let *P* and *Q* be price and quantity, and *r, b, m,* and *a* stand for retail product, by-products, marketing services (including profits), and agricultural raw materials, respectively. Then the value of food products sold is accounted for by the costs they cover:

$$P_rQ_r + P_bQ_b = P_mQ_m + P_aQ_a$$

Now scale all quantities and prices to units of Q_r, for example, not the price of wheat per bushel but rather the price of the amount of wheat needed to produce a one-pound loaf of bread. This allows us to replace all *Q*'s by Q_r. To get the price of marketing services, then, we take P_aQ_a to the left-hand side and divide by Q_r. This gives $P_m = P_r + P_b - P_a$, which is the USDA formula. Thus the approach depends on there in fact being a fixed ratio between the quantity of the retail product and by-products, marketing services, and farm products. These ratios have, however, changed substantially over time for some products, and this creates a problem for the meaning of trends in the USDA price spread as a measure of P_m. It could go up, for example, not because the cost of marketing has gone up but because the quantity of farm products per unit of retail product has gone down, as a result of less spoilage during storage, say. This is important because it means the farm–retail price spread can go up without either farmers or consumers being economically harmed.

The farmer's share is more straightforward and more easily aggregated across commodities. USDA simply divides the farm value of all goods used domestically for food products by the retail value of food products, by convention including food consumed away from home in the retail value (which is not done in calculating price spreads—for example, retail beef for that calculation includes only cuts sold in stores, not steaks sold in restaurants). This means the trend toward more meals prepared in restaurants or other away-from-home locations will decrease the farmer's share. But again this says nothing about farmers' receipts or exploitation of farmers.

Figure 5.11 shows how both the price spread and the farmer's share of the food dollar have changed over time. The real price spread (deflated by the GDP deflator) declined until mid-century, although only at about 0.3 of 1

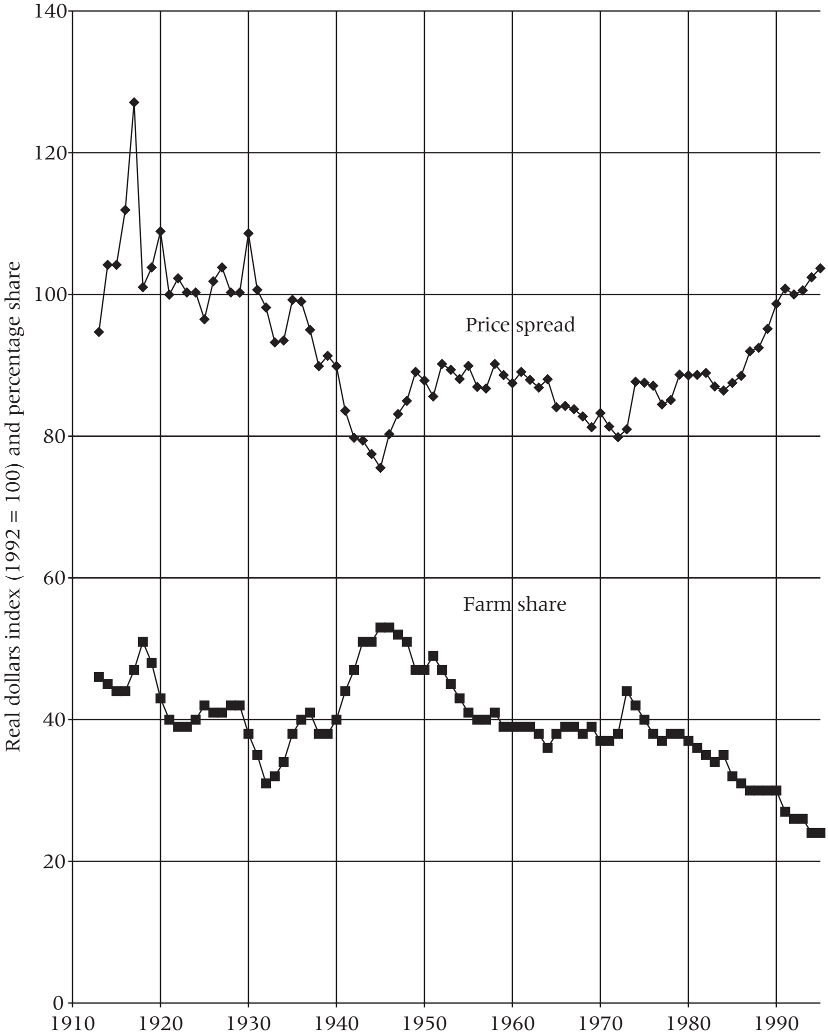

Figure 5.11 Farm-retail price spread and farmer's share of food dollar. Data from U.S. Department of Commerce (1975); Elitzak (1997).

percent per year; and the spread rose by about 15 percent between 1980 and 1995. Before World War I the farmer's share averaged about 45 percent; between 1920 and 1970 the share fluctuated around a mean of about 40 percent, and since 1970 the share declined rapidly to about 25 percent today. The price spread could decline between 1913 and 1950 while the farmer's share remained constant because the decline in retail relative to farm prices was offset by the use of less farm raw material per unit of retail food sold, probably because of less wastage and greater use of nonfarm ingredients in food products.

Possible explanations for a declining farm share of the food dollar include: (a) retail food is now more highly processed and packaged than earlier, and the costs of processing and packaging account for the decreased farm share; (b) the costs of labor, transportation, and other inputs used in marketing food have increased at a faster pace than the costs of farm inputs; (c) there has been less cost-reducing technical progress in marketing than in farm production; (d) the market power of farmers has declined relative to the food processing and retailing industry. This last is the politically charged explanation.

A useful step in investigating these explanations is to look at particular commodities. Eggs are a commodity that is essentially the same today as a hundred years ago. Processing and packaging changes are few, since the chickens do so much of the job so well. The farm production process has remained roughly the same over time, but the economic organization of the farm enterprises and of marketing channels has changed tremendously, as a few thousand specialized layer operations have replaced millions of small-scale chicken flocks. The real farm price of eggs has declined even faster than prices of other farm products. In the 1990s the average farm price of eggs was about 65 cents per dozen; in 1913–1915 the farm price (in 1992 dollars) was about $3.10 per dozen. What has happened to consumer prices and the farmer's share of the consumers' expenditures on eggs? Retail price surveys of 1910–1915 indicate an average of about $5.10 per dozen in 1992 dollars, compared with 95 cents in 1991–1993. Real consumer and farm prices have both declined about 2.0 percent annually over the last ninety years, and the farmer's share has stayed about the same at 62 to 65 percent of the retail price. This suggests very large real cost reductions in both egg production and marketing. It suggests that where processing is minimal, the farmer's share has held up quite well.

Consider next potatoes, another minimally processed product as sold in supermarkets. The U.S. Bureau of Labor Statistics has surveyed the retail prices of "white or Irish, excluding large baking types . . . in the quantities in which sales have customarily been made," on a consistent basis since 1900 (U.S. Department of Commerce 1975, p. 194). Unlike eggs, the potato had a slight upward trend in its retail price between 1900 and 1995. The farm price of potatoes, though not decreasing as rapidly as that of eggs, declined from about 16 cents per pound (in 1992 dollars) prior to World War I to about 7 cents per pound in the 1990s. The farmer's share has declined from about 60 percent to about 20 percent.

In pork and beef products real prices at retail have also increased over time, while real farm prices have been declining. Retail prices of pork chops, for example, were about 50 percent higher in the 1990s than in 1900, while the real farm price of hogs had fallen by about half over the same period. USDA estimated the farmer's share of meat products generally at about 35 percent in the mid-1990s; it was over 50 percent just thirty years ago.

Still another notable decline is in cereals and bakery products, where the farmer's share of retail spending is now about 7 percent. In a one-pound loaf of white bread that sold for 88 cents in 1996, for example, USDA estimates the farm value of wheat at 5.9 cents and other farm products (vegetable oils and sweeteners) at 0.9 cents, for a farm-value share of 6.8/88 = 7.7% (Elitzak 1997, p. 22).

There is no apparent single cause of the decline in the farmer's share of the retail food dollar. Some part of the decline is attributable to added services at the marketing level, not only because of more packaging and processing but also because consumption of highly processed and packaged foods, and of food eaten away from home, has increased over time.

Comparative rates of technological change at the farm and processing levels play a role. For example, the farmer's share in sugar has declined little while both real farm (sugar beets) and retail (refined sugar) prices have declined over the past 80 years, albeit at a slower rate (about 1 percent annually) than foods generally, and the most plausible underlying reason is technical progress both in beet production and in sugar recovery from beets. Indeed, the retail price has declined by a slightly larger percentage; but this is possibly a result of changes in import protection for both raw and refined sugar over time. For food processing overall, Matthew Shane, Terry Roe, and Munisamy Gopinath (1998) estimate an average annual rate of productivity growth of 0.4 percent in 1959–1991. This growth is significant, but far less than the 1.8 percent rate of growth of farm productivity in the post-1950 period. Other things equal, this would decrease the farmers' share of the food dollar over 1 percent per year.

Although reasons (a) and (c) get preliminary support in the data, this is not the case for (b), the idea that the prices of marketing inputs have risen faster than prices of farm inputs. Indeed, farm wage rates have risen slightly faster than nonfarm wage rates, and other input costs—energy, transportation services—have experienced about the same trends as farm inputs, which indeed are largely the same inputs except for fertilizers and seeds.

What about item (d), market power? One segment of agribusiness, the meatpacking industry, has been under scrutiny through almost the whole of the twentieth century. In 1903 the formation of the "beef trust," with the coast-to-coast cooperation of the three largest packers, collided with the trust-busting proclivities of Theodore Roosevelt. A drop in cattle prices set in motion a long-running series of investigations, the most extensive of which was conducted by the Federal Trade Commission (FTC) in 1917–1919. The commission concluded that “the five major packing companies were so extensively interconnected as to constitute a monopolistic combination which controlled about 80 percent of the total interstate slaughter of cattle and calves” (Benedict 1953, p. 150). More adventurous than today’s FTC, the commission recommended that the federal government take over the principal stockyards. Subsequent antitrust prosecution by the Justice Department led in 1920 to a consent decree under which the packers agreed to dispose of their holdings in stockyards, related railroads and terminals, retail meat, market newspapers, and certain other unrelated businesses (see Azzam and Anderson 1996). Thus the vertical integration of the meatpacking industry was reduced; but the degree of concentration in beef packing itself did not decline substantially until the 1950s. This eventual deconcentration probably owed more to changes in technology and the transportation infrastructure than to regulation.

The antibusiness spirit of the time (part of what made it the “progressive” era) animated a similarly intensive FTC investigation of the grain trade. In this case, the commission’s report ended up finding the business highly competitive. Commissioners were, however, suspicious of futures markets, as were (and are) many farmers.

The best possibilities for a preliminary overall consideration of the effects of imperfect competition are provided by associating differences in trends in the farmer’s share with the history of industrial concentration. In the case of cattle slaughtering, the share of the four largest firms decreased from 55 percent in 1918 to 21 percent in 1971. Then consolidation increased again until the four-firm concentration ratio was 59 percent in 1990 (Azzam and Anderson 1996, p. 22). A USDA study reported a similar concentration ratio, increasing from 28 percent in 1980 to 70 percent in 1997 (MacDonald et al. 2000, p. 8). These increases in concentration are large. Do we see a corresponding rise in price spreads? Figure 5.12 shows two indicative prices. The ratio of the two as a percentage price spread (farm as percentage of retail price) and the farmer’s share have generally declined, but appear to have declined most during the period 1920–1960, when concentration was declining; and there is no indication that the increasing concentration of recent years has reduced the farm share.

The preceding evidence is crude. Azzam and Anderson (1996) summarize the findings of thirty-five detailed econometric studies of concentration in meat marketing, all of them using rather short time series of various subperiods during 1959–1990. Results were mixed, but the studies tended to find significant though not quantitatively major negative effects of state-

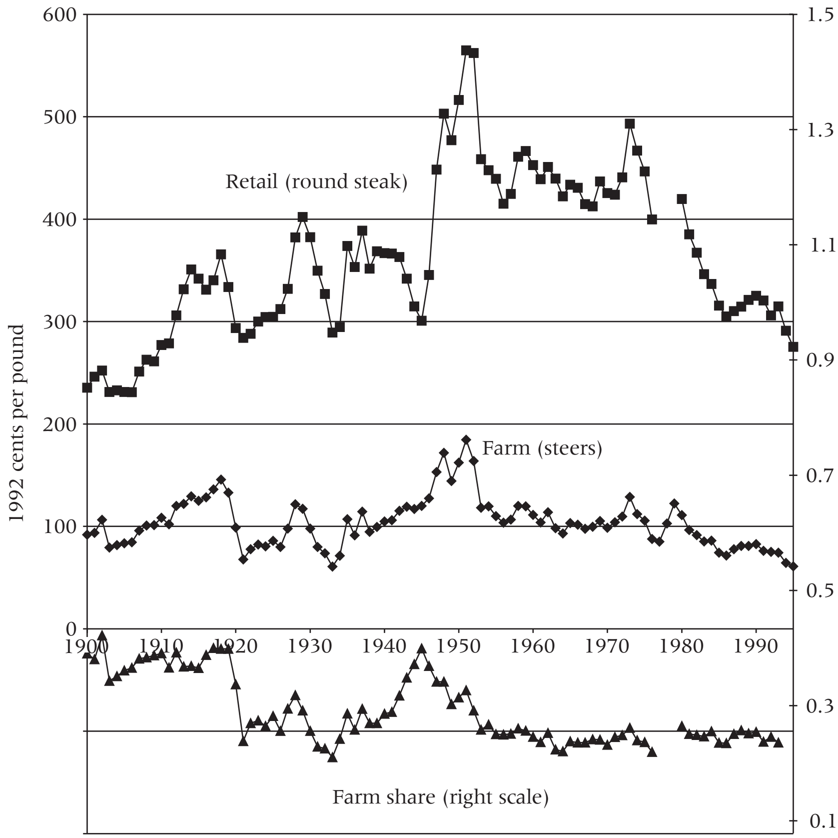

Figure 5.12 Farm steer and retail beef prices. Data from U.S. Department of Commerce (1975); Elitzak (1997).

level concentration of livestock buying on farm-level prices. USDA's analysts summarize the situation for recent decades: "Our evidence suggests that once new and extensive scale economies emerged in meatpacking, intense price competition led to the exit of high-cost small plants, their rapid replacement by larger and more efficient plants, and significant increases in market concentration" (MacDonald et al. 2000, p. 39). Overall, these findings encourage one to be skeptical that imperfect competition is an important explanatory factor in the evolution of farm prices, although not to rule it out.

The nexus of economics and politics as related to market power has generated especially contentious results in commodities where agricultural cooperatives have become large, notably in dairy products. With the help of the federal marketing order system (discussed in detail in Chapters 6 and 7), a cooperative can become a collective bargaining agent for all the producers of milk sold for drinking purposes (Class I milk) to buyers in an area. When a cooperative gets large, it can influence the volume of milk sold at different locations by shipments of its members' milk. In 1972 the Department of Justice brought an antitrust case against Associated Milk Producers, Inc. (AMPI), the largest and fastest-growing dairy cooperative of the time, alleging that AMPI shipped milk between marketing order areas in such a way (called "pool loading") as to raise the premium at which Class I milk sold as compared with milk sold for other purposes (for cheese, butter, and so on) and that these and related practices amounted to "the use of predatory and exclusionary practices to further their power" (Masson and Eisenstat 1980, p. 276). These allegations were never precisely explained in economic terms, still less tested against data. For a characteristic debate on the issue of AMPI market power, see Christ (1980), Masson and Eisenstat (1980), and the comments of Blakley (1980) and Manchester (1980). Although the evidence of AMPI market power presented by Masson and Eisenstat is not strong, the defense of dairy cooperatives by other authors is on the whole more egregious. The defenders assume that milk processors have monopsony power that cooperatives offset. Yet the cooperatives have a stronger hand than processors in one respect: they have the force of law behind them in marketing order legislation. So when Blakely states that "equating AMPI with Standard Oil or U.S. Steel is ridiculous," it is not actually clear which way the true inequality runs. Subsequent economic history has not been kind to either AMPI or U.S. Steel, but while probably neither of them had huge market power, AMPI might have had an edge in this respect. Notwithstanding economists' debates, in 1975 a consent judgment was reached in which AMPI agreed to stop certain of its practices.

With respect to food prices paid by consumers, a number of studies have examined imperfect competition in food retailing as related to industry profits and prices charged consumers. The National Commission on Food Marketing (1966a) found larger stores with larger market share earning higher profits. However, the rate of profit per dollar of sales was about 1 percent in the late 1930s and remained at that level in the 1950s and in 1988–1994; there is no apparent upward trend over time (ibid., p. 284; Elitzak 1997, p. 35). Because profits could reflect large-store efficiencies as well as monopoly pricing, better evidence of market power is provided by comparisons of food prices in cities that have more or fewer competing stores. The National Commission on Food Marketing and other studies have found that cities with less competition have higher prices.

Data on the profits of businesses in food manufacturing and farm input supply are also suggestive. Two thorough studies of food retailing and food manufacturing were arranged by the National Commission on Food Marketing (1966a,b). Both described numerous indicators of imperfect competition, but quantifying the effects reliably proved impossible. The most telling quantitative findings related industry concentration to profit rates of food manufacturing firms, grouped by the products produced, for example, bakery products, dairy products, edible oils. The data are primarily from a 1950 survey of large firms by the Federal Trade Commission. The study found a significantly higher profit rate in groups where there was less competition as measured by the percentage of product sales accounted for by the largest four firms. Indeed the most concentrated groups had a rate of profits as a percentage of net worth of 17 percent compared with about 7 percent for the least concentrated groups (National Commission on Food Marketing 1966b, p. 206).

The average profit rate appears to have been about 10 percent. If we suppose that the overall profit rate in food manufacturing was therefore about 3 percent above the competitive rate, indicated by the profits of the least concentrated group, this enables us to estimate that imperfect competition added 3 percent of the net worth of these firms to the U.S. food marketing bill. With a net worth of about $10 billion for all food manufacturing businesses in 1950 (based on ibid., p. 275, where total assets are given as $10.8 billion in 1947), this would add $300 million to the marketing bill. USDA estimates the total U.S. food marketing bill for 1952 at $30 billion, so imperfect competition in food manufacturing plausibly increased food costs by 1 percent. If there were similar imperfections of competition in food wholesaling and retailing, this could double the effect to 2 percent.

When food prices rose sharply in the 1970s, concerns about monopoly power in food focused on harm to consumers. Paul Scanlon (1972) provides an estimate that monopoly profits and excess costs due to imperfect competition cost consumers $2.1 billion in thirteen food industries. Hightower's (1976) popularization used this and other evidence to conclude: "It is reasonable to estimate that food would be at least 25 percent cheaper today if we were able to deal effectively with the various aspects of monopoly power in the food industry" (p. 76). Since U.S. consumers spent about $200 billion annually for food in the mid-1970s, the 25 percent figure amounts to $50 billion. Economists' more thorough estimates uniformly indicate smaller effects. Russell Parker and John Connor (1979) estimate the consumer loss from monopoly power in food manufacturing at between $10 and $15 billion annually in 1975. J. Bruce Bullock (1981) and A. D. O'Rourke and

W. S. Greig (1981) dispute this estimate as being too large. Their comments and Parker and Connor's (1981) reply provide a useful overview of the technical issues, but the scientific waters remain rather cloudy.

Looking at more recent data, and from different sources, USDA estimates that 4.5 percent of the retail value of food, about $24 billion, went to corporate profits of retail stores, food manufacturers, and other marketing firms in 1996 (Elitzak 1997, p. 34). Table 5.3 shows this together with other components of the "marketing bill" that accounts for all costs between the farm gate and retail purchase in grocery stores or restaurants. How much of this can be attributed to market power under imperfect competition? If one-third is "excess" profit, as the FTC results suggest it might be, we have $8 billion, about 2 percent, added to the marketing bill. But perhaps competitive forces have changed since 1950, so that more than one-third of food industry profits are owed to imperfect competition. The past fifty years have seen much consolidation but also many new domestic and foreign competitors. Concentration overall appears to have increased. But USDA's profit rates for food manufacturers and retailers indicate after-tax profits as a percentage of assets of 5 to 6 percent in the 1990s (Elitzak 1997, p. 35). This is no higher than the FTC estimates for the 1950s. It appears that food industry monopoly profits at a maximum would amount to perhaps 3 percent of the retail value of food.

The much larger estimates of consumer price effects cited above depend primarily on higher costs of marketing in more concentrated markets. Parker and Connor attribute almost $9 billion of the $12.5 billion total losses due to imperfect competition to factors other than monopoly profits (1979, p. 631). But these factors are particularly open to debate. Ronald

Table 5.3 Components of the marketing bill for domestically produced farm food products, 1996

	Billion dollars
Labor	206
Transportation (intercity)	23
Energy (fuels, heat, electric)	19
Advertising	21
Packaging	47
Profits	24
Taxes	20
Other	83
Total	424

Source: Elitzak (1997), p. 28.

Cotterill (1986) and Richard Sexton and Nathalie Lavoie (2001) provide analytical reviews, and they are reticent about estimating overall quantitative effects of imperfect competition.

It is striking that in the 1980s and 1990s government economists became more cautious in finding anticompetitive behavior in the retail food industry that might warrant a policy response. In the 1970s, the FTC examined charges that the three largest breakfast cereal manufacturers (Kellogg, General Foods, and General Mills) exercised predatory behavior through heavy television advertising and monopolizing store shelf space through a proliferation of brands. The three firms had over 80 percent of the U.S. market. After a ten-year investigation, the FTC dropped the case in 1982 and no action was taken.

With respect to supermarkets, a study by USDA's Economic Research Service (Kaufman and Handy 1989) found no significant effect of concentration on supermarket prices. And a critical review of literature carried out at the Federal Trade Commission (Anderson 1990) found no convincing evidence that concentration increases consumers' costs of food; the author claimed that studies that find higher prices or profits do not adequately consider quality or service improvements or lower costs that may accompany concentration—and concluded that there is no basis on which the FTC might act, for example, to discourage mergers of food chains. These publications precipitated a lively debate (in Cotterill 1993, part 5) that shows how difficult it is to establish the facts as well as their causes in food pricing. The outcome is that while it still seems plausible that having two supermarkets to choose from in your city will generate higher prices than if you had three, it is far from easy to establish from the data available that this is the case, or how much difference it makes.

This scientific uncertainty leaves a situation in which the policy balance is easily tipped by policymakers' general predispositions or, perhaps, the broader zeitgeist. In this respect it is noteworthy that in the 1960s government economists were more activist in promoting antitrust action against food retailers, while what skepticism there was came from academic economists. Daniel Sumner (1994) provides an example from a 1967 conference on competition in food marketing. At this time, when the FTC had obtained consent decrees that disallowed mergers by large retailers, an FTC economist (Willard Mueller) made the case that mergers in food retailing should be scrutinized and disciplined; the academic side of the debate (Roger Gray) counseled caution, not action. But by 1990 the FTC had disavowed activism, and the last consent decree had expired in the 1970s. It is worth noting that the side of caution now looks more appropriate. The principal offender in the FTC view in the 1960s was the A&P food chain. Although the government did nothing further to regulate A&P, and indeed mergers picked up and concentration increased from a four-firm concentration ratio of 50 percent in 1967 to 68.4 percent in 1987 (Connor and Schiek 1997, p. 325), market competition dealt firmly with A&P's profits and the company barely escaped bankruptcy.

Overall in the food industry John Connor and William Schiek (ibid., p. 311) estimate that there were 336,000 firms in 1992, down by 70,000 from the number thirty years earlier, but still seemingly plenty to ensure either actual or potential competition to exploit any opportunity that abnormally high profits might indicate. Competition that could readily be mobilized in any local market would be more limited, and some near-monopoly positions have been created for specialized branded products. In the early 1990s these ranged from the hegemony of General Foods in Jello-like products (87 percent of the market), Campbell's with 80 percent of canned soups, and Hershey's with 80 percent of cocoa, to Proctor and Gamble's 34 percent share in peanut butter and Unilever's 32 percent share in margarine (Connor and Schiek 1997, p. 345). However, we don't have evidence that there is more profit in Jello than in peanut butter, for example. An example of what happens when competitors sense profit can be seen in the case of Ben & Jerry's. They found a profitable niche with creatively blended, high-fat ice cream. We know it was profitable not only because the company's market value rose significantly in the stock market, but also because the business of selling this type of ice cream soon drew many competing brands. Ben & Jerry's market share and profits subsequently fell, without the necessity of antitrust action.

A further issue in food market power is its effect on farm-level prices. The monopoly profits that we have been discussing are typically said to be extracted from consumers in higher food prices. The costs may also be borne by farmers as raw material suppliers. Who actually pays the monopoly its profits? Monopoly works by restricting supplies to consumers, but this also means buying less from farmers and therefore causing farm-level prices to be lower. The key analytical fact is that the incidence of losses depends on the price responsiveness of consumers as compared with farmers. The more farmers respond to lower prices by producing less, the less farm prices will fall; and similarly, the more consumers respond to higher prices by buying less, the less consumer prices will rise. If farmers just keep producing no matter the price, they will get a lower price, and if consumers keep on buying regardless of the price, they will be charged a higher price. In seeking to maximize profit, monopolists are led, as by an invisible hand, to exploit the most exploitable.

Econometric evidence indicates that neither consumer food demand nor aggregate farm supply is price responsive, with elasticities of probably less than 0.2 in both cases (a 10 percent rise in price generating a 2 percent rise in supply or fall in demand). If the elasticities are equal, however small or large, half the monopoly returns will be borne by farmers and half by consumers. Inelasticity then increases the size of the losses that both farmers and consumers face.[3] If we use an estimate from the earlier discussion, it appears that market power of food agribusinesses could have reduced average farm-level revenues by about 1 percent during the period since 1950, with no apparent trend toward either smaller or larger losses over time.

Firm-level brand advertising is another indicator of imperfect competition, since if the firm did not have a market niche conveying pricing power there would be little reason to advertise beyond providing factual information to potential customers. Parker and Connor (1979) attribute consumer losses as much to excess advertising as to monopoly profits. Table 5.3 indicates food advertising expenditures of $21 billion in 1996. Between 1967 and 1996 food industry advertising about doubled in real terms and has increased from 4.0 percent to 4.9 percent of total marketing costs in that same period (Elitzak 1997, p. 28). However, advertising is not problematic for farm incomes in the way that monopoly profits are. Monopoly profits are extracted by firms' pricing their products higher than competitive firms would. This means companies sell less, and hence buy fewer raw materials, and this results in a lower price for farm products. Advertising, in contrast, is intended to increase sales of food products. If successful, it means increased demand for farm-level raw materials and a *higher* price for farm products.

Thus when branded products are sold by processors such as Perdue broilers or Omaha Steaks, farmers see direct benefits from the promotional efforts of these businesses. Indeed, farm producer organizations themselves finance the advertising of milk, eggs, orange juice, meats, and other products to the tune of almost $1 billion per year (Forker and Ward 1993, p. 101). Individual farmers do not command the scale of sales to justify a large advertising campaign, and each farmer has an incentive to hold back from voluntary collective promotional efforts for the generic products he or she produces. But some agricultural cooperatives have been able to brand products and promote their members' output through assessments, such as Ocean Spray in cranberries or Sun-Diamond Growers for walnuts and other specialty crops in California. In recent years an increasing amount of this ef-

3. A monopolist facing inelastic demand will raise price as long as the inelasticity persists, since by the definition of inelasticity a price rise increases total revenue, and producing less does not increase total costs. Since empirical demand functions find price inelasticity for most food products, it is unlikely that monopolies are selling them.

fort has been undertaken under the auspices of federally sanctioned assessment and promotion programs.

The experience of Ocean Spray illustrates problems that can occur when members of a cooperative arrive at conflicting opinions on marketing strategies (which may be surprisingly strongly held in view of growers' lack of comparative advantage in marketing relative to production). In the Ocean Spray case, a majority of members of the cooperative backed a move into cranberry juice products that made the cranberries go further by mixing their juice with other ingredients; a disgruntled minority withdrew from the cooperative and hitched their hopes to a "pure" cranberry juice product. Subsequent overproduction and marketing problems placed the existence of Ocean Spray in jeopardy (see *New York Times,* November 20, 1999).

The key to whether the activities of agribusiness firms harm or help farm income is the effect of these activities on the demand for farm products as raw materials. Market power by agribusiness firms tends to be detrimental, because in order to keep final product prices up and raw material costs down, these firms produce less output and hence reduce purchases from farmers; but advertising is helpful because it tends to increase sales and hence the demand for farm-level raw materials.

It is possible, however, that the most important long-term determinant of raw material demand is technological change in processing and marketing. When commodities can be transported, stored, and processed at less cost, this enables food to be sold at lower prices and hence increases the demand for farm as well as for retail products. Technical progress has reduced these costs. But technical progress in food processing has also reduced the quantities of farm raw materials needed for some products, and has enabled processors to substitute less expensive farm products for more expensive ones. Cigarette makers now use about half the tobacco per cigarette that they did twenty-five years ago. Hog slaughterhouses still use "everything but the squeal" of the pig, but lard has been replaced by vegetable fats in many uses and so the demand for hogs is lessened. Retailing eggs requires one on the farm for every one delivered to consumers. But even here fewer are now required to be laid on farms for every one delivered to consumers because of reduction in breakage and spoilage as handling and storage technology has improved.

Improvements in processing technology have also been turned to the advantage of farmers by the development of nontraditional uses of farm products. Corn starch, for example, has found many nonfood uses, as have soybean and other vegetable oils. The biodegradable properties of many of these products as compared with their petroleum-based alternatives have boosted demand for farm raw materials as environmental concerns have increased. Perhaps the most notable developments due purely to technology have driven the market for cotton. After being seriously threatened by synthetic fabrics, cotton staged a remarkable rebound when technology generated affordable, high-quality cotton materials that, with the help of a sustained advertising campaign, have been an outstanding marketing success.

From an economic viewpoint, the salience of changes in agribusiness demand for farm products has the corollary that attention traditionally paid to measures of the farmer's share of the food dollar or the profits of agribusiness firms is misplaced. Knowing that the price spread has declined or that profits have increased does not tell us what we most need to know, which is what has happened to the demand for farm products as a result of the evolution of competition in agribusiness. And we have to be able to sort out the effects of imperfect competition from the effects of changing technology in processing and marketing. These tasks have not been accomplished by research to date.

The Markets for Inputs in Agriculture

During the farm policy debates of the 1920s, the idea was established that the important thing about farm product prices was their relation to farm input prices. The ratio of farm product to farm input prices (times 100) became known as the "parity ratio," and was scaled to equal 100 or "parity" in the high-income period of 1910–1914. This concept draws attention to input markets as a determinant of farm income and the issue of market power in the farm-supply industry. Machinery manufacturers, chemical producers, and other input suppliers, like banks and railroads in earlier decades, have been accused of using market power to charge farmers too much for the goods and services farmers buy. In these instances the qualitative evidence and quantitative estimation of exploitation are even less definitive than in the more thoroughly documented areas already discussed. The shares of the four largest companies in the U.S. sales of several farm inputs have been measured as follows, using 1977 data: pesticides, 65 percent; nitrogen fertilizers, 28 percent; phosphate fertilizers, 49 percent; fencing materials, 46 percent; wheel tractors, 80 percent; plows, 69 percent; harvesting machinery, 79 percent (McBride 1986, pp. 22–23). Whether this concentration is sufficient to cause monopoly markups in sales to farmers is unclear. There is no apparent increase in real prices paid by farmers over time. Figure 5.13 shows an index of real prices paid by farmers for production items. There was a period of rising real prices of inputs in 1920–1950, but overall the

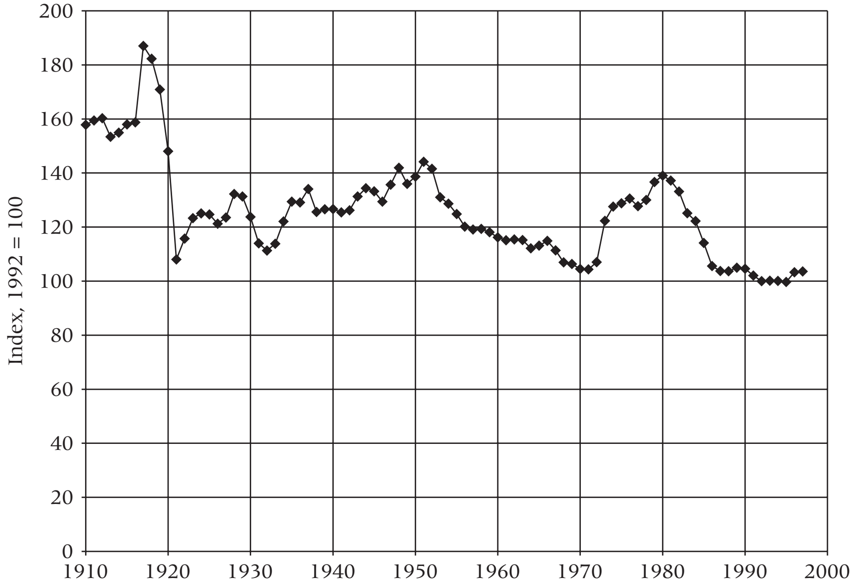

Figure 5.13 Index of real prices paid by farmers for production items. Data from U.S. Department of Commerce (1975); U.S. Department of Agriculture, *Agricultural Statistics,* various years.

long-term trend is for lower prices of these goods. As with food marketing issues, however, one would have to sort out the effects of technological change to draw conclusions from these data.

Farmer-owned purchasing cooperatives have emerged as an alternative way of buying farm inputs. Cooperatives through which farmers buy feed, fertilizer, and other farm supplies existed throughout the twentieth century, but before World War I they were unimportant. In 1915 there were 275 farm supply cooperatives with 59,000 members. Their business totaled $12 million, less than 1 percent of farmers' spending on purchased inputs. By 1936 the number of purchasing cooperatives had grown to over 2,000 and their business to $250 million, or 20 percent of the value of all farm purchases of feed, seed, and fertilizer; and by 1950 this fraction had grown to one-third. The importance of purchasing cooperatives retains roughly that level of importance today. Comparisons over time are tricky, however, because some cooperative sales increasingly go to people who are not farmers. In 1996, USDA estimates farm purchasing cooperatives sold $6.3 billion of petroleum products. But they also estimate that farmers' total purchases of these products from all sources came to only $5.7 billion (USDA, *Agricultural Statistics,* 1998, tables 9–43 and 10–16).

Farmer-owned cooperatives established for purposes of marketing farm products, often as a counter to the perceived market power of corporate buyers, have also remained important. Despite recurring suspicions about cooperatives' capabilities as business organizations, the research of Zvi Lerman and Claudia Parliament (1990) indicates that on average they perform as well as investor-owned firms. They have grown to take on more processing operations as well as wholesale assembly and delivery. Moreover, cooperatives in the 1990s are becoming more and more like investor-owned firms, raising member capital in ways similar to those of corporations and governing themselves by voting shares that are proportional to investment rather than the tradition of one vote for each member. Federal policies are important in the history and status of agricultural cooperatives, but discussion of this is postponed until the next chapter.

FARM CREDIT

Credit is not a farm input in the physical sense, but it greatly augments a farmer's capability to mobilize other inputs for production purposes. Thus the availability of credit and the terms on which it is available are important to all farmers who are not content with small-scale production or are not already wealthy. Because many of the technological improvements that caused U.S. agricultural productivity to grow so impressively have been embodied in expensive capital equipment, most efficiently used in large-scale operations, credit is a key ingredient in productivity growth. Yet many of the most heartbreaking episodes in the economic history of U.S. agriculture center on hard-working farm families who lose everything because of debts that, through no fault of their own, they have been unable to repay. Because it is the lender, typically a bank, that makes the decision that a loan is uncollectible, bankers tend to be villains in some political debate on the agricultural economy.

Banks also are heavies in some academic theories. It is said that "capital is necessary, thus, the companies that control this resource dominate those that do not" and that "bankers use the threat of withholding of funds to obtain domination" of farmers (Zey-Ferrell and McIntosh 1987, p. 187). This "bank hegemony theory" reflects long-held rural populist beliefs. The terminology comes from the rural sociology literature and has not been taken seriously in published work in agricultural economics.[4] The bank hegemony

4. The bank hegemony idea as expressed in Zey-Ferrell and McIntosh's paper has also been controversial within the ranks of rural sociologists, because of allegations that the authors plagiarized its expression. See *Chronicle of Higher Education*, November 5, 1999, p. A19.

theory is suspect because it leaves out competition in the lending business. In fact, the sources of farm credit are quite various, even in small communities. Table 5.4 shows the percentage of debt from several sources in 1950, 1970, and in 1985, the last date in the heart of the farm financial crisis of the 1980s. Banks are important but are far from a monopoly source of credit for farmers, even in the era before federal government involvement in lending (which will be discussed in Chapter 6).

Also important in credit markets is competition between banks. The major story in this respect is the consolidation of smaller rural banks and the expansion of branches of city banks into rural communities. The consolidation of banks has resulted in a smaller number of large banks serving some rural areas in states that fifty years ago had a larger number of small, independent banks. Yet each individual farmer may have had easy access to only one or two local banks fifty years ago, while today that farmer can deal with the branches of as many or more banks and has more alternative institutions for both depositing funds and borrowing.

Despite farm populists' traditional mistrust of eastern financiers, nineteenth-century evidence on interest rates and banks' rates of return indicates that in rural areas it was the local bankers who were extracting monopoly rents from farmers, while the national credit markets serving rural areas were competitive (Sylla 1969). John Brake and Emanuel Melichar (1977) provide an overall picture of rural bank organization in the twentieth century and review a substantial literature indicating that interest rates on commercial farm loans appear well integrated with rates in the overall economy. But local rates for depositors have tended to be lower, and rates paid by borrowers higher, in rural areas.

With respect to bank services to farmers as depositors, Paul Calem and

Table 5.4 Percentage of farm debt owed to each type of lender

	Banks	Life insurance	Individuals and other[a]	Federal Farm Credit System	Farmers Home Administration
1910[b]	17	8	75	0	0
1930[b]	26	13	58	4	0
1950	39	11	43	12	5
1970	28	11	31	24	6
1985	25	6	23	32	14

Sources: Tostlebe (1957), p. 156, for 1910 and 1930; USDA (1994) for 1950–1985.
Note: Consumer debt, such as credit card debt and car loans, excluded.
a. Relatives, input suppliers, and other individuals and nonfinancial businesses.
b. Mortgage debt only.

Leonard Nakamura (1998) find evidence that banks in states that do not restrict branch banking, and thus permit more competition, pay higher rates to nonmetropolitan depositors than do banks in states that do impose significant restrictions. Thus it appears likely that lack of local competition is crucial for the establishment of market power in providing financial services to farmers, and recent developments in bank deregulation have been procompetitive in that sense. With respect to lending, there is evidence that rural subsidiaries of large bank holding companies make a smaller percentage of their loans to farmers than do otherwise comparable independent rural banks (Gilbert and Belongia 1988). This could mean that independent local banks have a comparative advantage in serving farmers' credit needs; but it could also mean that that they are in a better position to exploit farmers. Brake and Melichar cite studies that find no significant beneficial effects for farmers as borrowers in areas where branch banking existed in the period up to 1970.

THE FARM LABOR MARKET

The most striking changes in labor markets were initiated by Depression-induced population movements of the kind immortalized in Steinbeck's *Grapes of Wrath,* culminating in the massive migration of labor that took place between 1940 and 1970. It is labor market forces that more than anything else led almost a million African American farmers out of southern agriculture in one of the greatest but perhaps least widely appreciated socioeconomic upheavals in twentieth-century U.S. history. The discussion of Chapter 4 suggests, moreover, that labor market forces are a cause of the rise in farm relative to nonfarm economic well-being of the past thirty years.

The idea of the self-sufficient family farm incorporates a view of labor being supplied primarily by the farm operator and family workers. As of 1910 there were over 10 million farm family workers, of whom almost 6 million were farm operators and about 4 million other family members. But there were also 3.5 million hired farmworkers, a quarter of the farm labor force. These were not only workers on large farms but also hired hands on smaller farms. Figure 5.14 shows that after 1930 the main trend was a rapid decline, paralleling what we have already seen in farm numbers, in both family and hired workers. The decline in hired workers started sooner, however, as the Depression years saw an increase in unsalaried farm employment. The relative importance of hired and family labor has not changed a great deal over the course of the last ninety years. The share of the farm labor force accounted for by hired workers stayed at about 25 percent until the 1970s,

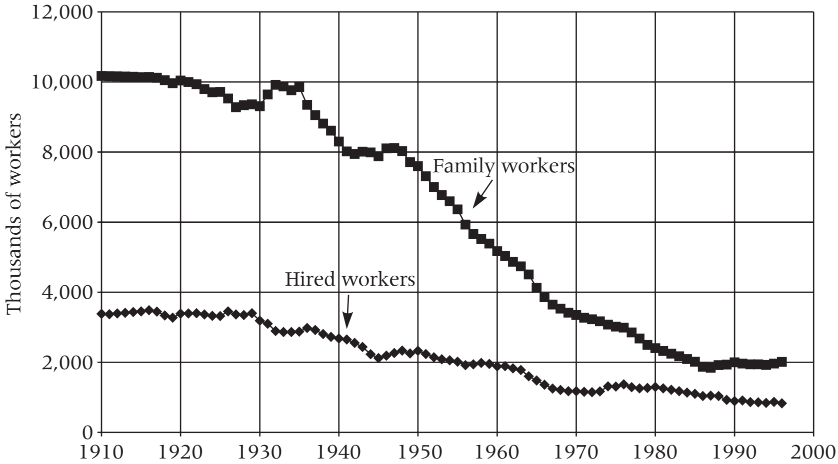

Figure 5.14 Family workers and hired workers on farms. Data from U.S. Department of Commerce (1975) and Council of Economic Advisers (2000).

and only then increased to a peak of 35 percent in the 1980s from which it fell back to 30 percent in the 1990s. We therefore cannot characterize the twentieth century as a period when workers paid in wages came to eclipse self-employed farmers in predominance in the farm labor force (although the trend toward production contracting reviewed in Chapter 3 indicates that farmers increasingly work under arrangements closer to being wage workers than had been the case earlier in the century).

Nonetheless, labor market events are fundamental to the history of U.S. agriculture in the century, not so much within farming as at the interface between farm and nonfarm employment. The main feature is increasing integration between farm and nonfarm labor markets. Figure 4.4 earlier has shown that the same broad trends of increase in real wage rates have occurred for workers in both agriculture and manufacturing. The relatively favorable results for farmworkers in the 1990s are notable, considering that low-income people generally lost out relative to higher-income people during the long economic expansion, and that the steady legal and illegal immigration of Mexican farmworkers might have been expected to depress farm wages even relative to wages of other low-income workers.

The evolution of wages and the labor force in agriculture has been strongly influenced by changes in the relationships between labor markets in different parts of the country. Regional integration is apparent in the convergence of farm wage rates in different states over time. In 1910, when the first state-level wage estimates were made by USDA, farm wages in the agricultural South (Alabama, Mississippi, Georgia, North and South Carolina) averaged $13 a month (with board) compared with $25 in the Northeast and $33 in the Pacific Coast states. Comparisons with wage rates of later periods are not exact because monthly wage-payment arrangements in the South became too little used for USDA to be confident of collecting accurate survey data. Today the predominant reporting of wage payments is hourly, without room and board, for workers in all parts of the country. In the October 1997 USDA survey, hired workers received on average $6.46 per hour in Alabama, Georgia, and South Carolina, compared with $7.40 in the Corn Belt and $7.25 in the Pacific Coast states. The ratio of southern to Pacific Coast wage rates rose from 0.39 in 1910 to 0.89 in 1997. A regional narrowing of differences clearly has taken place.

Figure 5.15 shows that the rise in real farm wages between 1910 and the period just after World War II (1948 is the year shown) was predominantly a Midwest phenomenon. The South still had quite low wages in 1948, and the spread between southern and northern wage rates had increased sub-

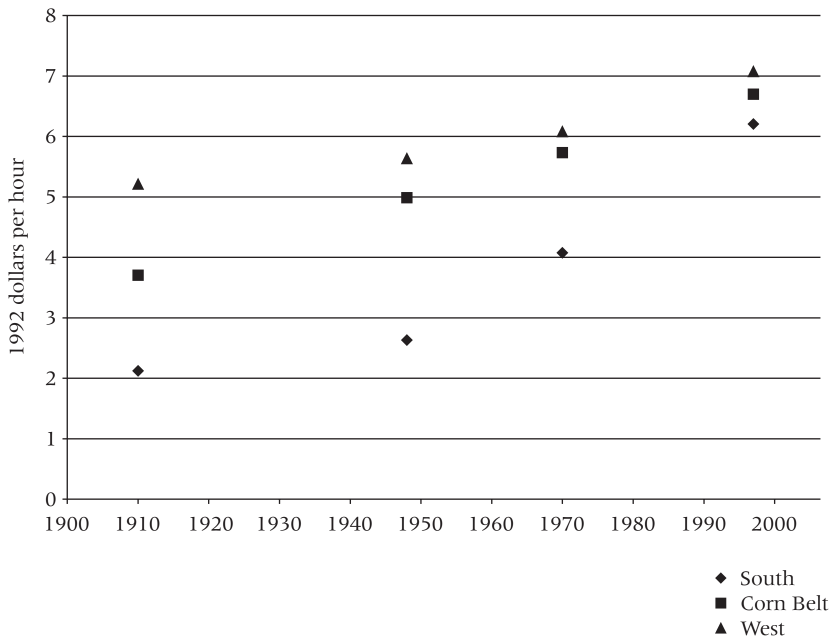

Figure 5.15 Real hired farm wage rates by region. Data from U.S. Department of Agriculture, *Agricultural Yearbook 1921* (1922) and *Agricultural Statistics*, various years.

stantially. By 1970, and even more so by 1997 (the last year shown), southern farm wage rates had closed rapidly on Corn Belt and Pacific Coast wages. Between 1910 and 1948, real farm wages grew at a rate of 0.6 percent annually in the South and 0.8 percent in the Corn Belt. Between 1948 and 1997 wage growth accelerated to a 1.8 percent annual rate in the South and slowed slightly to 0.6 percent in the Corn Belt. This history reflects the head start that midwestern agriculture got in adopting innovations in agricultural production in the 1930s and 1940s, and the ultimate integration of southern and northern labor markets.

Notwithstanding these adjustments, the earnings of farmworkers remain among the lowest of any industry. In 1998 the median weekly earnings of farmworkers was $260, compared with $456 for all U.S. wage and salary workers. Fifty percent of the families of hired farmworkers had annual incomes of less than $20,000, and farmwork generated the highest incidence of poverty of any major industry. For details of the socioeconomic characteristics of farmworkers and their families, and the source of the data cited here, see Runyan (2000). But as implied by the findings of Gisser and Dávila cited in Chapter 4, these workers could not now, in contrast with earlier decades, improve their well-being by migrating from agricultural to nonfarm employment, because the earnings of comparably skilled workers had become essentially equal in farm and nonfarm employment.

Summary

Although much has changed in agricultural markets in the last one hundred years, key elements of the situation as it affects farmers have remained unchanged to a surprising extent. International trade, domestic consumer demands, nonfood uses of farm products, and market power of businesses with which farmers deal have been important throughout, and in about the same ways. Despite awesome technical change in processing, information dissemination, retailing, and consumer products themselves, the farm products that provide raw materials to the industry are basically the same now as they were in 1900. A farmer of a century ago, seeing an American farm of today, would find few striking differences in the livestock and crops on view, though the technology being used would provide many surprises.

An attempt made in 1893 by Jeremiah Rusk, an early and eminent secretary of agriculture, to project one hundred years ahead suggests that a bigger surprise has been the capability of farm output to undergo a sustained expansion on a relatively fixed land base. Alongside some reasonably well grounded prognostications, Rusk averred that U.S. agriculture would produce enough to feed a growing population but that “long before a hundred years have rolled by we will have ceased to export food products to foreign countries" (1893, p. 262). This view reflects prevalent opinion of that time, much of which was even more pessimistic in foreseeing U.S. population growth requiring substantial imports of food products. What it missed was both the extent and the land-saving nature of technological change that was to occur in farming.

The extent of technological change in marketing was also hard to foresee. In the 1890s Rusk stated: "Our means of transportation have been so greatly increased during the past 25 years that it is very difficult to imagine their being carried much further" (1893, p. 179). Overall, technical and economic progress in marketing has paralleled that in farming and, in recent decades, has contributed perhaps as much as farming to America's status as the world's food superpower. Connor and Schiek (1997, p. 382) report estimates that indicate that multifactor productivity in food processing increased at an annual average rate of 0.7 percent in 1954–1992. An annual rate of 0.7 percent is, however, substantially less than USDA's estimate of 1.8 percent annual agricultural productivity growth over the same period, and is even less than the 1.2 percent rate Connor and Schiek report for all manufacturing. It should be noted that data problems for nonagricultural productivity growth measurement are even more daunting than those discussed in Chapter 2 for agricultural productivity, especially in the area of measuring the output of marketing firms. This output includes advertising, storage, information, and other services so evanescent as to impel farmers and others at times to question whether they are properly called output at all (and hence whether these services are worthy of the remuneration they receive). In any case, a productivity growth rate of 0.7 percent annually is enough to bring down the real cost of food processing by one-half since World War II.

Marketing developments have thus contributed to the continuing great bargain that agriculture has provided for U.S. consumers. For farmers, though, the gains are not so clear, although farm real incomes have undoubtedly increased. But might they have increased more? Populist mistrust of agribusiness has remained a constant, as has evidence of imperfect competition that works to the disadvantage of farmers as both sellers and buyers. The next two chapters consider the political fallout from these issues.

6

Government I: Public Investment and Regulation

In his annual message to Congress in 1796, George Washington stated: "It will not be doubted that with reference either to individual or national welfare agriculture is of primary importance . . . Institutions for promoting it grow up, supported by the public purse; and to what object can it be dedicated with greater propriety?" (Wanlass 1920). Government and U.S. agriculture have thus been intertwined from the beginning. In each of the preceding chapters issues have arisen that suggest, and have received, responses from the government: technology and infrastructure creation in Chapter 2; provision of services to and regulation of farming in Chapter 3; rural schooling, labor, and development policies in Chapter 4; and agricultural trade, agribusiness regulation, and food policies in Chapter 5. This chapter and the next expand upon the discussion of governmental activity with regard to agriculture.

Market Institutions, Public Investment, and Finance

A fundamental role of government is to certify and enforce individuals' property rights and to fix rules for the contractual transfer of goods and services. The institutions for achieving these ends are not just agricultural, of course, but in the United States, as in many societies, special problems of property rights and contracting have arisen for two agricultural resources: land and water. U.S. agricultural development in the twentieth century had the great benefit of having already resolved many contentious issues in these areas by 1900. The vast expanse of agricultural land had been largely distributed to individual private ownership by 1900, with the major exception of the West, where land in farms increased by a further 300 million acres between 1900 and 1960. Water rights were also stable even if varying from region to region; legislation of 1866, subsequently amended, formally acknowledged water rights "established under local customs and laws" (Benedict 1953, p. 125). Building on this relatively stable institutional base, investment in both physical and intangible infrastructure for commercial agriculture is an essential part of the twentieth-century story. That investment has been carried out by private individuals and associations as well as by governmental units, but this chapter focuses on the government role.

RURAL INFRASTRUCTURE

Irrigation. An early and large category of fixed capital for agricultural production is irrigation works. By 1900 almost 8 million acres (3 percent of U.S. cropland) had been irrigated by the actions of individual farmers and local districts. But as noted in the 1902 report of a federal commission, "since 1895 there have been comparatively few notable works of irrigation built, and development along this line may be said to have nearly ceased . . . the easily available waters are already utilized, and it has not been found profitable to store floods nor to construct large works by private enterprise, any more than it would be profitable for individuals to dredge harbors or build light-houses" (Bogart and Thompson 1916, p. 623).

Such considerations led to the Federal Reclamation Act of 1902, which set up a "revolving fund" mechanism to pay for large dams and irrigation projects by using the proceeds of sales of public lands in the West. The revolving fund had run dry by 1923, and borrowing was necessary to finance projects from then on. The program built huge undertakings such as the Salt River project in Arizona, the Hoover Dam, and the Shasta and Friant dams in California, along with associated channels and ditches for water distribution. Currently about one-fifth of the nation's irrigated acreage is irrigated by projects of the Bureau of Reclamation of the Interior Department (B. D. Gardner 1995, p. 294).

These projects are marvels of engineering and enabled much more productive agriculture to develop in the West than would have occurred under dryland farming or small-scale irrigation. But the projects cost far more than land-sale proceeds plus proceeds from power generation could cover. Water user fees were originally contemplated to cover the costs, but in fact have amounted to far less. The main departure from the requirement that projects cover their costs has been to permit zero interest to be charged for a loan repayment period initially set at 10 years, but which subsequent legislative adjustments increased to as long as 150 years for a few projects (for details, see Fuhriman 1949). Hence western irrigation of agriculture had from the start a large subsidy component.

The amount of the subsidy to agriculture is impossible to calculate with precision, because the projects produce joint products. The chief commercial product besides irrigation water is typically electricity. Generators and the electrical distribution grid are separable costs that can be charged to electricity users. But the costs of the dam itself can only be arbitrarily allocated. Attempts have been made to charge some of the dam-building costs, in addition to the costs of irrigation works, to water users. But this became a moot point as charges never covered even the construction costs of irrigation works, including interest on funds invested.

Joint products of dams include flood control and the recreational benefits of the lakes created. The Bureau of Reclamation of the Interior Department has undertaken benefit-cost accounting exercises that have not been fully satisfactory to economists. The idea that the overall benefits exceed the costs of typical irrigation projects because of unpriced benefits has recently lost credibility as harm to wildlife and wildlife habitat has received more attention. In 1999 plans were announced to dismantle several dams in order to revitalize populations of salmon and other fish whose lives had been seriously disrupted by them. Generally, the many disputed assessments of the economic value of hydrological projects, together with the political provenance of the projects, have meant that conflicts over whom to charge for water, how much to charge, and other regulations of water use have been resolved more by political than by economic argument.

With the help of federal programs, irrigated land in the West increased to 20 million acres by 1950, and half of all farms in the eleven western states had some irrigated acreage (Selby 1949). But privately financed irrigated acreage outside these large projects (mainly land irrigated with water pumped from wells, principally in the High Plains from Nebraska to Texas) increased even faster. Total irrigated area reached a maximum of 55 million acres in 1997. Table 6.1 provides some details.

An average acre of irrigated cropland in California was valued at about $1,400 more than unirrigated cropland in the 1980s, and rented for about $120 more (Bajwa, Crosswhite, and Hostetler 1987, p. 17). The fact that such gains result from access to subsidized water has created continual controversy. One contentious aspect of subsidized irrigation water is the extent to which it is and ought to be limited by size of farm. The 1902 Reclamation Act set a limit of 160 acres on an individual's land that was eligible for federal project water. Farmers found ways to gain access to larger amounts through separate farms for family members and through leasing arrangements. The Reclamation Reform Act of 1982 regularized the larger units with a 960-acre limitation, but it too has been subject to loopholes (Dawdy 1989).

More fundamentally contentious is the justification for any subsidy of water for irrigation. Earl Butz (1949), then an agricultural economist from Purdue University but later to be one of the more famous secretaries of agri-

Table 6.1 Acres of land in farms under irrigation (millions of acres)

	11 western states	6 Great Plains states	All other states	U.S. total
1900	7.5[a]		0.2	7.8
1910	11.3[a]		0.4	11.7
1920	13.9[a]		0.6	14.5
1930	14.1[a]		0.6	14.7
1940	15.7	1.5	0.7	18.0
1950	20.0	4.3	1.5	25.8
1959	21.9	8.9	2.4	33.2
1969	22.8	12.0	4.3	39.1
1982	25.9	15.4	7.7	49.0
1992	24.2	15.0	10.2	49.4
1997	26.7	15.4	12.9	55.1

Sources: U.S. Department of Commerce (1975); USDA, *Agricultural Statistics* (1998); U.S. Department of Commerce, *Census of Agriculture,* 1997.

a. All seventeen western states.

culture, stated the problem as: how do we justify subsidizing agricultural production in the West at the same time farm programs require the midwestern farmer to cut back output—output, moreover, that could be produced more efficiently and without subsidized water? For a more recent general discussion that makes a broader critique of western water policy, see Reisner (1986).

Drainage. Related to investments in irrigation, which requires the careful management of water flow to avoid waterlogging and salinization, are drainage projects. Beyond its use as a necessary adjunct to irrigation, drainage has long been a means of bringing new land into cultivation and improving the productivity of land that has limited natural drainage of surface water. For example, fields in the postglacial terrain that is common in the North have many areas in which water accumulates and can seriously reduce yields. Farm-level drainage works, both to bring new land into production and to improve existing fields, have not typically been an important area of policy, but rather have been a matter of private investment. Swamp Lands Acts in the nineteenth century facilitated drainage of what are now called wetlands by transferring federal ownership to the states. They could then distribute those lands by sale or grant to individuals.

Large public projects became important when the legal framework was established for drainage and levee districts with powers akin to those of local governments to assess fees upon beneficiaries. A well-documented early example is the Little River Drainage District in Missouri, containing 500,000 acres that needed drainage outlets into the Mississippi River to meet the great potential of the rich alluvial soils there. The district was legally incorporated in 1907 and constructed between 1914 and 1929. The $11 million cost was covered by sales of bonds, paid off by assessments on 436,000 acres (Beauchamp 1987). Federal government drainage projects got under way with the activities of the Civilian Conservation Corps in the 1930s, and were greatly expanded and regularized under the Flood Control Act of 1944 and the Watershed Protection and Flood Control Act of 1954, under which appropriations to the Army Corps of Engineers have funded many large projects—for example, levees and floodways along the Mississippi River to protect and facilitate drainage from the Little River Drainage District.

Postal service. Government investment in rural infrastructure had two other notable extensions prior to U.S. entry into World War I. The first was the establishment of rural free delivery by the U.S. Postal Service. This began in with a small appropriation by Congress in 1894 and was fully established as a permanent program in 1902 (Sorkin 1980, p. 6). Rural free delivery substantially reduced the costs of sending information and light objects to and from rural areas, especially remote areas. President William McKinley cited as benefits that the service "ameliorates the isolation of farm life, conduces to good roads, and quickens and extends the dissemination of general information" (Greathouse 1900). This service has had from its beginning an element of subsidy, since charging the same for a stamp on a letter carried a few city blocks as is charged for a letter carried from the city to a rural town, and thence to a mailbox on a farm several miles away, does not come near to charging a price equal to the marginal cost of rural delivery.

Roads. A second notable initiative was the Federal Post Roads Act of 1916, which began substantial federal appropriations for building highways in rural areas. During the following fifteen years, spending for roads constituted about one-third of USDA's budget. State and local farm-to-market roads also received sustained investment in this period, especially in the midwestern and Plains states. These investments supplemented earlier and continuing projects to maintain ports and navigable inland waterways, both used extensively to market agricultural products, especially grain for export. Development of the interstate highway system in the 1950s was a further significant step. These large physical capital projects provided an excellent transportation system, from which U.S. agriculture continues to benefit to the present.

Electricity and telephone service. Other infrastructure developments important to rural areas include federally subsidized rural electrification and telephone service in the 1930s and 1940s. The Rural Electrification Administration (REA) was established in 1935 by executive order. Its primary function, which persists to the present, is to make loans for the construction and improvement of electrical services in rural areas. It also provides technical and managerial assistance to rural electrical cooperatives and businesses, an especially important role in the 1930s and 1940s.

REA activities were vigorously debated in its early years, a key issue being how far it would go in the direction of becoming a public corporation like the Tennessee Valley Authority. REA, and its relative the Rural Telephone Bank, did not follow the TVA path. Both evolved to be parts of USDA's Rural Utilities Service, essentially a lending agency that is attractive to borrowers because it loans at subsidized rates. In recent years controversy has arisen over the use of subsidized credit to finance loans peripheral to agricultural purposes, such as development associated with vacation resorts in rural areas. Because of the facilitating role of infrastructure in the larger process of modernizing American agriculture, it is plausible that the returns to electricity, communication, and transportation infrastructure investment in 1920–1940 were high. But for neither the more recent USDA lending activity nor the earlier infrastructure investments do we have economic analyses that quantify the net social benefits of the public's investment expenditures.

INFORMATION, EDUCATION, AND RESEARCH

The early twentieth century saw new departures in intangible public capital that have arguably proved as important as physical infrastructure investments. Most notable are increases in federal support of research, education, and information dissemination.

Market information. Many problems of farmers lend themselves to governmental provision of information as a solution. Before 1900 this was mainly research and technical information. Early in the twentieth century demands for market information made themselves felt at the federal level as well. A Bureau of Markets was established in USDA with a congressional appropriation in 1915. Senator Hoke Smith of Georgia was a prime mover for this legislation, in response to a disastrous experience of Georgia peach growers "in attempting to market in a few weeks one of the largest crops which had ever been produced" (Sherman 1928, p. 162). Peaches had sold at less than freight charges, since New York and other usual markets were glutted. Too late came reports that satisfactory prices could have been obtained in cities further west. The idea was that a market news service could have prevented this situation and similar ones that occur almost every year for some crop.

From 1915 to the present, the provision of market data and economic analysis has remained a key function of USDA. In fiscal 1999 federal budget outlays of USDA's National Agricultural Statistics Service, Agricultural Marketing Service, and Economic Research Service were $102 million, $158 million, and $55 million, respectively. The bulk of the funds were to be used for the collection of crop and farm data, the collection and dissemination of market price data, and economic analysis and forecasting. An additional sum of almost $100 million from state government and other sources also went to support these agencies. The total spent was about $200 per U.S. farm. Although exact comparison is not possible, from USDA budget data of 1922 it appears that roughly $3 million was spent on analogous services at that time (USDA 1923, pp. 61–68). In terms of 1999 dollars this is about $31 million, roughly a tenth of what is spent today.

Extension education. Federal support of agricultural extension education, in cooperation with state extension services, was established in the Smith-Lever Act of 1914, and the scope of federal efforts in this area was expanded with the establishment of aid to vocational agriculture education under the Smith-Hughes Act of 1917. USDA's extension budget in 1922 was $3.2 million ($33 million in 1999 dollars) compared with the $280 million spent under the Smith-Lever Act and related provisions in 1999. So in extension as in information, real spending in 1999 was about ten times the 1922 level.

Research. Because of the central role of technology in the evolution of American farming, federal support of agricultural research is worthy of special attention. Federal involvement goes back to the Morrill Act of 1862, which founded the system of land-grant universities that persists to the present day. The Hatch Act of 1887 provided federal support for state agricultural experiment stations, which also operate in conjunction with land-grant universities. They, together with USDA's own research institutions, consolidated in the Agricultural Research Service since 1953, are the predominant governmental sources of technological innovation in agriculture.

Promoters of investment in research have long argued that funds spent on invention and technology development yield very high returns. An early calculation finds $35,000 spent on improved dairy cow testing methods generating productivity gains worth $10.5 million during 1920–1928 (McMillen 1929, p. 142). The same study cites a $20,000 project that found removing roosters from chicken flocks in the summer prevents spoilage of eggs (because fertilized eggs spoil more quickly), a finding that saved $4 million in losses per year. A later, more general study of publicly funded poultry research estimated high rates of return over a long period of time (Peterson 1967).

A key issue in this book is the connection between agricultural research and the accelerated growth of productivity that began to be evident in the late 1930s. It is not surprising that poultry research shows high returns because, as data reported in Chapter 2 indicate, productivity rose extraordinarily rapidly in that industry. To obtain convincing evidence about the returns to overall governmental activity in research, one has to count the projects that generated no useful new knowledge as well as the ones that did. We therefore first consider data on aggregate spending on research and then relate that spending, if possible, to aggregate productivity growth.

Figures 6.1a,b show the twentieth-century path of real spending on research, including state as well as federal contributions to agricultural experiment stations. Figure 6.1a indicates that real spending increased much faster after 1950, at a rate of about $40 million per year, compared with a rate of increase of about $10 million (1992 dollars) per year from 1900 to 1950. This chart provides no reason to expect the acceleration in productivity growth in the late 1930s, that we observed in the data of Chapter 2. But consider Figure 6.1b, which charts the natural log of spending, so that the slope is the percentage rate of growth. This chart shows a rapid rate of

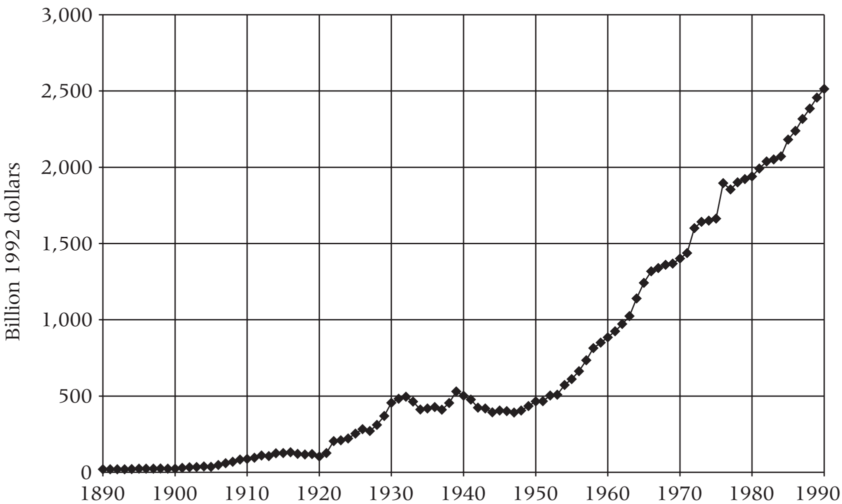

Figure 6.1a Real public spending on agricultural research. Data from Alston and Pardey (1996), pp. 77ff.; includes both federal and state spending.

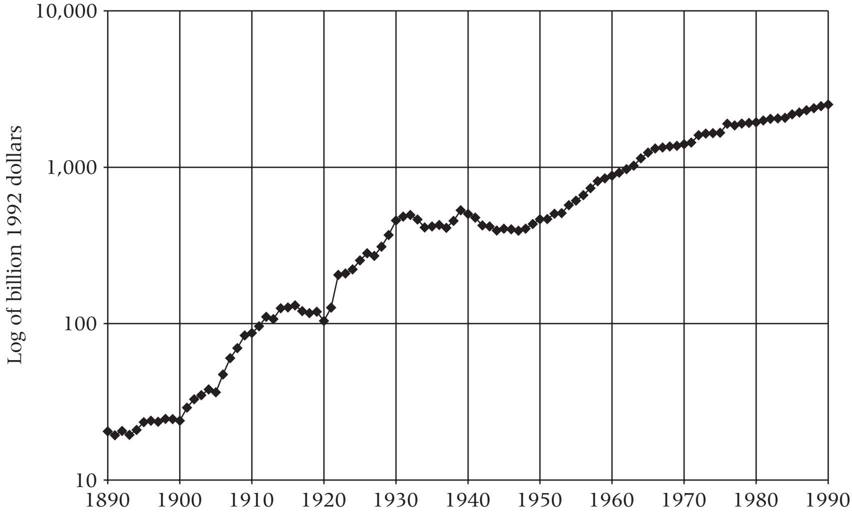

Figure 6.1b Real public spending on agricultural research (log scale). Data from Alston and Pardey (1996).

growth in 1900–1930, with substantially slower growth thereafter. The high rate of spending growth in 1900–1910 could have generated a faster rate of productivity growth beginning in the 1930s, if it is the case that research activity generates productivity results with roughly a thirty-year lag. Long lags are in fact not implausible, and have been found in econometric work on research as related to productivity by Wallace Huffman and Robert Evenson (1993) and other scholars.

Agricultural research is a variable for which the growth in real dollars is arguably a more reasonable productivity-influencing variable than the percentage rate of growth. In percentage terms, spending $1,000 meant a lot more in 1900 than in 1960, because the initial level was so low in 1900. But does that mean that $1,000 (in constant-value dollars) should be expected to have generated more scientific results in 1900? One could argue that a given level of research activity generates more at low levels of activity because of diminishing marginal returns to research effort. But it is not clear that argument applies when comparing the early 1900s with the 1950s. Assuming that Figure 6.1a is the more appropriate chart, we can see why post-1960 productivity growth is rapid and has been sustained at a rapid rate, but we do not have a contribution toward understanding why productivity growth accelerated after 1940. Assuming Figure 6.1b is more appropriate, we can with sufficient lagged effects explain a takeoff in the 1930s. But a consistently strong lag of sufficient length would indicate a significant decline in productivity growth after 1960, which did not occur.

The question of the payoff to agricultural research is the most intensively studied aspect of public investment in agriculture. Zvi Griliches created the analytical and econometric framework in studies of hybrid corn research (1958) and of the aggregate effects of agricultural research (1964a). In contrast to the less readily quantifiable and more questionable investments in large irrigation and drainage projects, a large body of work on agricultural production research has found very high social rates of return. Evenson (2001) summarizes results of fifty studies of both particular commodities and aggregate output, in many countries around the world. Almost without exception they find rates of return to public investment in research to be substantially greater than the rate of interest and thus to be socially profitable investments. Taken as a whole these studies indicate rates of return that if anything exceed the range of the 25 to 40 percent annual rate of return that Griliches originally estimated for both corn and U.S. aggregate farm output. These returns are extraordinarily high. An annual investment of $1.5 billion, about the average USDA/land-grant research budget in the 1980s, that generated an annual excess rate of return of 15 percent (25 percent minus a 10 percent assumed cost of capital), would at the end of thirty years have accumulated over $100 billion in profit.

Many difficulties stand in the way of confidence in such estimates. One is the rate of depreciation of the value of new knowledge. New varieties often do not retain their advantage over existing ones for long. P. Pardey and colleagues (1996) carried out a careful study of experimental yields of many wheat varieties at multiple locations. Comparing yields of new varieties during 1970–1993 with those already in production in 1970 indicated that without the new varieties, average U.S. wheat yields would have been 33 percent lower in 1993. Aggregate economic benefits over the period were estimated at $43 billion as of 1993, resulting from expenditures that are hard to pin down but were almost surely less than $3 billion. With 5 percent of federal agricultural research spending on wheat, and $40 billion cumulative spending in 1990–1993, $2 billion net economic gains would be attributed to wheat research.

Notwithstanding such findings, the USDA and land-grant university research program has come under extensive criticism, ranging from technical points about possible overstatement of returns estimated in various studies (for example, G. Fox 1985; Alston, Craig, and Pardey 1998) to broad concerns about aspects of agriculture that the studies typically leave out. The broad concerns were forcefully stated by Jim Hightower in *Hard Tomatoes, Hard Times* (1973). The complaint was not that public agricultural research was ineffective, but rather that the effects were large and undesirable—that the technology resulting from the research efforts advantaged large corporate farms and agribusiness enterprises and actually worsened the situation of family farmers while reducing the quality of the food consumers eat. The indictment echoes criticisms of technology and the farm economy discussed in Chapters 2 and 3, with the more specific indictment that agricultural research is to blame. Not only is "every aspect of rural America . . . crumbling" in a "protracted, violent revolution," but "the land grant university system has been the scientific and intellectual progenitor of that revolution" (Hightower 1973, pp. 1, 2).

In the particular case of the mechanical tomato harvester, part of the research effort at the University of California's agricultural experiment station that inspired Hightower's title, Andrew Schmitz and David Seckler (1970) brought the human costs of displaced workers into their accounting. Even after their adjustments, the annual rate of return they estimated was over 35 percent. That and other efforts to broaden benefit-cost analyses of research, most recently by bringing environmental elements into the picture, have made evaluations more complicated but also more complete. Those studies have not altered the conclusion that rates of return are high. However, such analyses do not address the distributional question of which farms and agribusinesses are helped most by agricultural research. Studies of product and factor markets are required for this purpose. The most definite conclusions about the incidence of technological change is that consumers of farm products are gainers, and on the supply side the most likely gainers are technologically astute farmers and owners of farmland, with individual farmers gaining proportionately to their entrepreneurial capacity and their ownership of land.

An additional complicating factor is the interaction between research and farm commodity support programs. As noted earlier, irrigation projects have been criticized for subsidizing production in arid regions while elsewhere commodity programs were required to keep acreage idle for purposes of supply control. Similarly, one could criticize research programs that seek ways to boost production while commodity programs simultaneously try to reduce production. Several studies by agricultural economists have indicated that in this situation research spending that would otherwise have a high rate of return becomes a waste of the taxpayers' dollars (see Alston, Edwards, and Freebairn 1988).

Rural Industrial Policy

World War I gave impetus to endeavors that today would be called industrial policy for agriculture. The first nationally chartered and regulated rural credit institution was introduced for farm mortgages under the Federal Farm Loan Board in 1916. The Food and Fuel Control Act of 1917 gave a

Food Administration (headed by president-to-be Herbert Hoover) new powers to regulate foreign and domestic trade in agricultural products, with the objectives of limiting margins and profits, eliminating "unnecessary distribution functions," and preventing waste and hoarding (Benedict 1953, p. 163). Subsidies were offered on fertilizer imports, and plans began to be implemented for federal action to develop nitrate production capacity in a huge project at Muscle Shoals, Alabama (later to become primarily a power project at the heart of the Tennessee Valley Authority). These interventions built upon the predilection for governmental activism that was characteristic of the Progressive Era. That activism took a variety of forms throughout the twentieth century.

SUBSIDIES

Incentives and subsidies have been applied in many ways. Some of the earliest and most long-lasting involve soil conservation practices. The costliest to taxpayers have been payments to farmers that subsidize production of the major crops—a subject large enough to warrant a detailed treatment in Chapter 7.

A subsidy that received particular attention in the 1980s and 1990s offers about 50 cents per gallon of fuel ethanol (alcohol) made from corn to ethanol producers. The policy has been successful in expanding corn use in ethanol from a small niche to a billion-dollar market. The question, as often in industrial policy, is whether the public benefits of this accomplishment exceed the costs (about $500 million annually in subsidies in the ethanol case). In the case of ethanol, the social gains (as distinct from the gains of corn growers and ethanol producers) are cleaner air from using ethanol-based gasoline additives and a security benefit gained from being less dependent on imported oil. Although the size of these benefits is not precisely quantifiable, it is doubtful that they amount at the margin to 50 cents per gallon of ethanol, which suggests that the subsidy is too large.

MARKETING ASSISTANCE

Policies aimed at marketing farm products more profitably for producers have been another key element of industrial policy for agriculture. Legislation encouraging agricultural marketing cooperatives go back to the first decades of the century. Further support for collective marketing efforts began in the 1930s.

Various commodity promotion schemes since the 1930s have been enacted whereby producers can organize and conduct votes which, if favorable, permit a producer organization to deduct a small percentage of all producers' revenues to be placed in a fund to be used for promotional purposes. The rationale for government involvement is that if a substantial group of producers banded together voluntarily to hire advertising services, there would be difficulties in dividing up the costs, and any individual would have an incentive to remain outside the group and be a free rider on the group's efforts. As of 1999, federal marketing assistance programs were in place for twelve commodities (apart from marketing order programs) and were assessing producers of these commodities, and in some cases importers of them, $660 million annually. The largest of the advertising campaigns so funded have been for milk, beef, cotton, and pork, with significant programs also for eggs, soybeans, potatoes, watermelon, popcorn, mushrooms, and honey. Generic and producer-specific programs have also been undertaken by some producer groups without government-sponsored referenda or assessments.

These programs have from their inception had opponents, both among consumers who see them as government-sponsored efforts to raise the prices they pay and among producers who don't believe the programs generate additional returns to producers that justify the costs to them. A large number of studies have been carried out by agricultural economists, many of which conclude that promotion programs do generate net benefits for producers. But these findings have received some reasonable criticisms. Authors have found relationships between advertising and commodity purchases that meet tests of statistical significance but too often change from significant to insignificant with the addition of new data or other variables (see Kinnucan and Nichols 1999; Kinnucan et al. 1997). These authors focus on livestock product promotions and find grave difficulties in separating the effects of advertising campaigns from other factors that also influence consumers' purchases. They are particularly troubled by the lack of robustness in estimates of advertising effects due to simultaneous changes in nutritional labeling and health concerns. Their overall conclusion is that "about all that can be said about generic advertising programs for beef, pork, and fish in the United States is that their effects are uncertain" (Kinnucan et al. 1997, p. 22).

Moreover, assessments of these programs have been largely limited to effects upon the aggregate of all producers' incomes. In 2000, a producer vote on continuing the pork promotion program was hotly contested by smaller-scale producers, who claimed the program was benefiting larger-scale contract hog production at the expense of traditional family farms. Note also that the producer benefits are generated by higher commodity prices. The issue of consumer benefits, or quite possibly costs, has not been sufficiently addressed, as it should be if government assistance in implementing these programs is to be justified as a public good.

Beyond statistical studies of benefits and costs, the largest promotion programs have been attacked for extravagant and wasteful spending. News stories in 1999 pointed to "a $450,000 party at the Metropolitan Museum of Art and entertainment expenses such as strip bars and golfing fees" as uses of the $60 million spent annually by Cotton, Inc. (*Washington Post,* December 16, 1999). Such allegations do not go down well with contributing farmers, even if they make business sense, and some promotion programs have been voted out by disgruntled producers. The programs that remain in place contain dissatisfied producers who have been out-voted. Attempts to meet their concerns have focused on legislative provisions under which a producer can opt out of a promotion program and obtain a refund of assessments that have been paid. But of course if opting out or obtaining a refund is made too easy, the free-rider problem that called for government action in the first place will reappear. A USDA task force recently recommended better auditing of program expenditures and having a producer referendum every five years on whether to continue each program, among other reforms (USDA 2001c).

TAXATION OF FARMING

Tax policy can be seen as an instrument to guide agriculture as an industry, but the political agenda has been dominated by demands from farmers for tax relief. Farmers' first area of intense interest in taxes in the twentieth century was the property tax, the base for the majority of local and state government finances. In 1902, 67 percent of all local and state revenues came from property taxes. As rural areas began to have increasing numbers of townfolk sharing a township or county with farmers, land-based taxation was seen to be placing a substantially greater per capita burden on farmers. In the 1920s farmers in many states organized and made a case for property tax relief. (Their efforts are reviewed in Taylor 1952, chap. 35.) The farmers' case met with long-term success in that by 1950 the share of local and state revenues from property taxes had declined to 35 percent, and by 1990 to 19 percent. The main change was at the state level, where property taxes have been almost totally phased out. For an analysis of this phenomenon, see Wallis (2000). Moreover, farmers' relative burden from property taxes has been reduced in almost every tax jurisdiction by assessments that value agricultural land at its use in farming even if its market value is much higher.

Nonetheless, property taxes have increased as a fraction of farm income, and perhaps more surprisingly, farmers' relative contribution to property taxes has increased as well. In 1913 total nonfarm property taxes were $1,075 million, 3.2 percent of the value of national nonfarm output. Farm property taxes were $257 million, 5 percent of farm value added, which is the sectoral equivalent of GDP. So it is true agriculture was harder hit in economic terms. By 1950 this percentage had been cut to 4.6 percent for farming, but it had been reduced even more for the nonfarm economy, to 2.4 percent. And by 1995 farm property taxes had almost doubled as a fraction of farm value added, to 8.4 percent, while nonfarm property taxes had increased only to 2.8 percent. So for the whole period of 1913 to 1995, the farm property tax burden relative to the nonfarm property tax burden increased. In 1913 the difference between the farm and the nonfarm property tax rate as calculated here was 1.8 percent, and in 1995 the difference was 5.6 percent. Moreover, in an important respect these percentage understate the difference between tax burdens. Farm property taxes reported above are those of farm operators and exclude those paid by nonfarm landlords, but rents received by nonfarm landlords are included in agricultural value added.

A proper comparison of tax burdens across population groups is tricky, and a difference in rates as calculated here does not necessarily indicate an inequity. Farmers would be expected to have a higher percentage of their incomes paid out in property taxes, because they get more of the income from property than the nonfarm public. For a fuller accounting we should also consider taxes on earnings, notably the income tax. Early in the century, income taxes were negligible, and as late as 1936 were only a fifth as important as property taxes in the sum of local, state, and federal finances. But by 1970 the individual income tax yielded three times as much revenue as property taxes. In the federal income tax system, which most state income taxes are tied to, farmers have benefited from liberal rules for counting capital investment costs as current expenses, exemption from capital gains taxation on breeding livestock, and income averaging (going so far in 1998 legislation as to let farmers use current losses to claim refunds on taxes paid up to five years earlier). For most of the post–World War II period, it was easy for nonfarm investors in agricultural enterprises to take advantage of these provisions, and to write off losses against other income, but these opportunities were greatly reduced in the tax reform legislation of 1986.

Because most farmers obtain income from several sources, it is not possible to calculate the income tax revenues paid specifically on farm net income. What one can do is add up farm profits as reported on schedule F of the personal income tax form (1040), which the Internal Revenue Service has helpfully done. This income multiplied by the tax rate of each filer gives an estimate of the income taxes paid on farm earnings. But what is the appropriate tax rate? Is it the filer's marginal rate—the rate at which the last dollar earned is taxed—or is it the average rate, that is, total taxes paid divided by income? Using the marginal rate, which is higher than the average rate in a progressive tax system, would treat farm income as an add-on to everything else the farmer does to earn income. Because there is no good reason to do this, it makes most sense to use the taxpayer's average rate on all income.

Income reported on Schedule F is not the whole of farm income upon which taxes are paid. In response to a request from Senator Bob Kerrey of Nebraska, the U.S. General Accounting Office (1993) attempted a reconciliation of the USDA and Internal Revenue Service farm income data. The General Accounting Office focused on 1989, when reported Schedule F income totaled a loss of $0.2 billion. To this GAO added $2.4 billion reported to IRS as income from rental of farms and $2.0 billion estimated as farm net income of partnerships and corporations, which would not be reported on Schedule F. Including all the ways in which farm income may be reported to the IRS, the total reported income of $4.2 billion is still far less than the $49.9 billion that USDA estimated as net farm income in 1989. It appears that the income tax rate paid by farmers is at most 10 percent of the rate that they would have paid if all income were taxed.

Why is so little of farm income taxed? The IRS attributed $8.2 billion of the difference between anticipated and reported farm income in 1989 to underreporting of income by farmers. As part of a systematic investigation of underreporting on federal income tax returns, the IRS estimated that between 30 and 35 percent of farm income was unreported in 1985, 1988, and 1992 (IRS 1996, tables 3 and 7). The percentage underreported was virtually the same for farm income and for nonfarm proprietor (noncorporate business) income.

This estimate of underreporting is consistent with the findings of one of the very few earlier studies done of farmers' tax compliance, that of W. D. Gardner (1960). In the late 1950s he surveyed about 500 Wisconsin farmers, from which he estimated that the farmers reported about 65 percent of their true net income. While they understated their deductible expenses, they understated their receipts even more. Notably, they reported 80 to 90 percent of their receipts of dairy and grain sales, their main products, but reported only about 50 percent of poultry and egg sales, a sideline for most farmers in the 1950s that generated a small amount of mostly cash sales. Today, as the commercialization and specialization of farming continues, more of farm receipts are of the better documented type that is less likely to be underreported. Nonetheless, the IRS investigation indicates that a serious problem still exists.

The bottom line is that in the years 1994–1996, Schedule F farm income reported to IRS averaged a *loss* of $1 to $2 billion, suggesting that the federal government might increase its revenues by declaring agriculture an untaxed activity.

Notwithstanding their getting a break on individual income taxes, farmers actually face an overall tax burden similar to that of the nonfarm population. Farm households pay sales taxes on consumption items and social insurance taxes similar to the public generally. Much of farm households' income is from off-farm wages and salaries, as noted earlier, and on this income they face the same tax schedules as everyone else. Moreover, farmers pay about 2 percent of all estate taxes and are about 2 percent of the population. With all these taxes on a roughly equal basis for farm and nonfarm taxpayers, the relative tax burden on agriculture as an economic activity is mainly a matter of property and income taxes. For 1995, property taxes of farm operators were $6 billion, and even if income taxes are zero, this $6 billion amounts to 14 percent of farm net income. Nonfarm property plus federal and state income taxes in 1995 were $800 billion, which is 13 percent of nonfarm personal income. In this rough sense, the tax burdens on farm and nonfarm incomes are about the same.

FEDERAL RESOURCE MANAGEMENT

An inevitable area of industrial policy is management of resources the government owns. The most valuable and most contentious such resources are mineral deposits on federal lands, and national forests. The latter are administered by USDA, and indeed the Forest Service accounts for about one-third of USDA's employees, but this activity is peripheral to farming. An important agricultural resource that the federal government manages is grass growing on federal lands, which cattle or sheep can profitably consume. Grazing rights have been leased to ranchers since 1906, eventually under rules established in the Taylor Grazing Act of 1934 and fees recently calculated using a formula in the Public Rangelands Improvement Act of 1978. As of 1996, fees were charged for grazing livestock on 95 million acres of Forest Service land and 167 million acres of lands managed by the Bureau of Land Management of the Interior Department (Cody 1996). Like assessments on farmers for irrigation water, the level of grazing fees charged has been a major bone of contention. The rates charged are estimated to be only a fraction of market rates for comparable private grazing contracts (although exactly what counts as a comparable private grazing contract is itself disputed). This subsidy is not only a matter of income redistribution between taxpayers and ranchers; it is also alleged that low grazing fees and ranchers' lack of incentive to avoid damage to rangeland they do not own have encouraged overgrazing and the consequent deterioration of public lands. Attempts to raise grazing fees and impose environmental requirements on lessees were regularly defeated by western agricultural interests in the 1980s and 1990s. In 1999 the Agricultural Appropriations Act incorporated the requirement that an environmental review of all grazing leases be made as they come up for renewal. It remains to be seen, however, what this amounts to in practice.

Regulation of Private-Sector Activities

Closely related to government management of public assets are policies to regulate private-sector activities. Indeed public resource management and regulation of the private sector are sometimes different aspects of a single policy initiative and are difficult to disentangle.

LAND USE

A good example of blending public resource management and regulation of the private sector is land-use policy. In recent decades, agricultural land in private hands has come to be seen as a public resource. Governmental efforts in the regulation of privately held farmland have impinged upon two important aspects of twentieth-century farmland management: soil conservation and conversion of cropland to nonfarm uses.

Before 1900, the purpose of soil conservation that received the most attention was the prevention of soil exhaustion, the depletion of soil nutrients through repeated cultivation and harvesting of crops. The refinement of fertilization and tilth maintenance techniques has defeated that problem, with government involvement limited to research and dissemination of technical information. New in the twentieth century was an overriding concern with soil erosion. As with other natural resource issues, it was President Theodore Roosevelt who placed the issue on the national political agenda. But no legislation addressing the issue was enacted in his term or in that of President Woodrow Wilson, who shared a strong interest in the issue.

Farmers themselves have an interest in preserving the value of their land assets, which is arguably sufficient to make regulatory intervention unnecessary. Nonetheless, concerns about observed soil erosion, evidence of its severity, and knowledge of how to control it were developed and promoted steadily through the 1920s by land-grant colleges and government agencies. Then the dust storms of the 1930s placed wind erosion firmly in the public's attention.

Events since that time, as discussed in Chapter 4, indicate marked improvement in soil management by U.S. farmers, some of which is attributable to federal programs subsidizing investment in soil-conserving structures and practices, as well as to continuing research and extension efforts. The subsidy programs were introduced in the 1930s, most notably in the Soil Conservation and Domestic Allotment Act of 1936. Politically, the subsidy programs became intertwined with the farm income support measures of the New Deal, and soil erosion incentives continue to be regarded as closely related to commodity policy.

Conversion of cropland to nonfarm use became a national policy issue in the post–World War II period. Its high-water mark in congressional attention came in the Agriculture and Food Act of 1981, stimulated by the commodity price increases of the 1970s and associated concerns about future food scarcity. The 1981 act stated a finding that continued decline in farmland could threaten U.S. agriculture's ability to produce, and required a report from the secretary of agriculture on the federal role in the issue. The requirement dovetailed with the National Agricultural Lands Study (NALS) undertaken by USDA and the President's Council on Environmental Quality during the Carter administration in 1979, with its final report issued in January 1981. Its finding that received the most attention was that conversion of farmland had accelerated to 3 million acres annually between 1967 and 1975, from an average of about 1 million acres per year before that time, and that this was an imminent threat to U.S. agricultural production capabilities.

An unusual sequel to the report of the National Agricultural Lands Study was sharp criticism of its alarming findings not only by outside experts but by the research director and staff of the study itself (Brewer and Boxley 1981; Baden 1984). Their allegation was that the estimate of 3 million acres lost annually, the projected acceleration of loss, and the conclusion of substantial threat to U.S. crop production capabilities were vastly overstated.

Pronouncements by officials of the incoming Reagan administration and media presentation of the issue indicated acceptance of a pessimistic reading of the outlook (see Baden 1984), and a political seal of approval was awarded in the 1981 Farm Act's Farmland Preservation section. Yet caution is evident in the 1981 act's failure to do anything substantive to regulate the conversion of cropland to nonfarm residential and commercial uses (unlike conversion of wetlands, which has been strongly regulated since the 1970s).

Twenty years later, the uncertainties that underlay congressional refusal to act persisted. Events so far have proved the critics of the NALS correct. Land in farms has declined at a slightly slower rate since 1980 than before; and while cropland harvested was about 20 million acres less in 1999 than in 1980, the trend over the long term is quite slow (see Figure 3.2). The most telling observation is the failure of any indications of food scarcity to emerge over the last two decades. Problems of commodity surpluses and low farm prices continue to be the predominant issue.

Uses of private land remain firmly on the public policy agenda, but with a broader focus. Recent policy discussion concerning agricultural land use rests on the perception that farming creates benefits for both farm and nonfarm residents in the form of attractive open space, but the action here has been almost entirely at the state and local level. The 1990 Farm Act included "a national farmland protection effort to preserve our vital farmland resources for future generations" (104 Stat. 3616), but it applied only to the state of Vermont and accomplished little. State and local jurisdictions have implemented more substantive farmland preservation policies, typically involving paying farmers to cede their right to sell the farm for development. Some areas have also imposed agricultural zoning that limits the kind and density of residential or business development that is permitted. And in all fifty states "right to farm" legislation has been enacted to protect farmers against nuisance actions that might otherwise be brought by nonfarm residents unhappy with farm odors, noises, or other emissions (see Hand 1984).

CORPORATE FARMING

Political debate is rich in expressions of support for family farms and expressions of regret about corporate farming. Antipathy to the largest and most industrialized farms has led to limitations on the size of payments that any farm may receive in several federal programs, although rather large loopholes are characteristic of those limits. Direct regulatory policy in this area has been undertaken by several states, going back to the early 1930s when Kansas and North Dakota enacted statutes banning all corporations from engaging in farming. Strong restrictions on corporate farming have since been adopted in seven additional states (Oklahoma, Wisconsin, Minnesota, Nebraska, South Dakota, Missouri, and Iowa). The laws have been legally challenged and amended, and in Nebraska's case solidified with a 1982 amendment to the state's constitution banning corporations from farm production or owning farmland. Although it appears that the purpose of these bans is to strengthen the position of family farms, comparisons with the situation of family farms in states where no bans have been enacted leave it inconclusive whether this goal has been accomplished (see Krause 1983; Knoeber 1997).

Farmland protection and regulation of corporate farming are issues that may be characterized as rural industrial policy in a broad sense, on issues that are complex and about which the information base is insufficient for even well-informed people to make confident judgments regarding the consequences of alternative regulatory actions. Congress, in confronting such issues, especially where there are politically active proponents of some particular remedy, has largely refrained from enacting substantive legislation, but as a substitute has often required the executive branch to undertake a study and report on the issue. The resulting federal efforts can be viewed as planning for rural industrial policy. Questions have been raised about the value of such studies and reports. Michael Brewer and Robert Boxley (1981) argue against them as being inherently difficult to separate from political as opposed to scientific considerations. Even so, studies may be low cost as compared to acting without studies. Nonetheless, the executive branch has objected to the costs of an accumulation of large numbers of congressionally mandated studies and reports. The 1990 Farm Act called for approximately one hundred studies and reports, but also contained a section (2515, "Scarce Federal Resources") stating that the secretary of agriculture and the congressional Agriculture Committees may rank the studies and reports to determine which shall be completed, and that "the Secretary shall complete at least 12."

FARM CREDIT POLICY

The most extensive and determined federal ventures into rural industrial policy are in the area of credit. Government action originated as a legacy of economic crises of the nineteenth century, resulting in a perceived dual role for government: to alleviate the human costs of financial emergencies that have occurred, and, more fundamentally, to put policies in place that will prevent crises from occurring and automatically minimize their adverse consequences when they do. A focus on financial crises links agriculture with the overall American economy through the business cycle, as discussed in Chapter 5.

Issues of farm credit are on the agenda both as a response to crises and as a means of helping farmers to improve their long-term economic prospects. Reporting in 1908, Theodore Roosevelt's Country Life Commission pointed to "a lack of any adequate system of agricultural credit" (Benedict 1953, p. 145). The main defect perceived was in mortgages on farmland, which were only available for short-term loans and, particularly in the West, at high interest rates. Following debate on solutions ranging from facilitation of private banks to European-style credit cooperatives to making direct loans to farmers from the U.S. Treasury , the Farm Credit Act of 1916 authorized a system of twelve cooperative federal land banks to provide mortgage loans to farmers. These banks, supervised by a Federal Farm Loan Board, after a slow start became a significant source of credit for farmers. The system was enhanced by intermediate credit in legislation of 1923, which provided wholesale discounting of agricultural notes from country banks, a means by which country banks obtained improved access to funds for loans to farmers, and was further enlarged in the Farm Credit Act of 1933 to include Production Credit Associations, which provide short-term loans to farmers.

The Farm Credit Acts of 1971 and 1987 established the Farm Credit System as it currently exists, a network of cooperative agricultural credit associations and merged Federal Land Banks and Intermediate Credit Banks. The Farm Credit System gets no appropriated funds from the federal government. It raises most of its capital from sales of securities to the public. The member institutions are supervised by a government agency, the Farm Credit Administration, and their debt has government-agency status. The federal government does not guarantee this debt, but the debt gets favorable interest rates because of a "perception of implied government backing if the system experiences severe financial difficulties" (Barry 1995, p. 73).

The implied government backing received a rigorous test in the farm crisis of the 1980s, the latest of the sharp and drawn-out low-income periods that have periodically plagued farmers. The crisis had two components: low income and financial stress. The low-income problem resulted from reductions in commodity prices after their high levels of the 1970s. Real net farm income fell to well below the levels that prevailed in the 1960s. What made this a crisis was the even larger losses in farmers' equity. Prices of farm assets had been bid up to unsustainable levels in the late 1970s. USDA estimated the average value of U.S. farmland at $823 per acre as of January 1, 1981. Five years later it was $640.[1] Many farmers had borrowed heavily to buy land in the 1970s when commodity prices were high and real interest rates were low (even negative, in some years, in the sense that nominal interest rates paid were less than the rate of inflation). Between 1970 and 1979 farm debt more than tripled, from $53 billion to $162 billion. When prices fell in the 1980s, many farm borrowers found themselves with insufficient net cash flow to keep up interest payments (and recall that 1980–81 was the peak of interest rates, when mortgages went at rates of 15 to 18 percent) and, because land prices declined, with net worth too low to be in any position to borrow more.

The farm crisis of the 1980s was the last occasion in the century when

1. Referring to the figures as estimates of "value," rather than price, follows USDA usage. This reflects the fact that the data are derived from farmers' valuations of what their property is worth, rather than from data on transactions in which farmland is actually sold.

U.S. agriculture made sustained national news. A front-page article in the *Washington Post* on January 27, 1985, reported that at least 40 percent of the farmers in the north central region were headed for insolvency, and in February *Newsweek* had a five-page story with similar estimates. At a congressional hearing three actresses, each of whom had starred in a movie in which the farmer's plight was central, "decried the farm policies of the Reagan Administration as uncaring and insensitive to rural America's anguish" (*Washington Post,* May 7, 1985; see also Harl 1990).

The Farm Credit System found itself caught up in these events. A few regional land banks were themselves on the brink of insolvency. A report of the General Accounting Office was cited in the *Wall Street Journal* as stating that if the system were to raise its loan-loss reserves to the levels maintained by commercial banks, it would wipe out the net worth of the entire system (Harl 1990, p. 129). Ultimately Congress in 1988 approved a mechanism through which $4 billion in federal assistance could be provided to the system in conjunction with reforms to be carried out, mostly specified in the Farm Credit Act of 1987. Thus the implied government backing mentioned above eventually materialized, and indeed the downsized and reformed Farm Credit System survived without having to draw upon the $4 billion or imposing other large costs upon taxpayers. Subsequent streamlining is evident in that mortgage debt owed by farmers to the system was $26.5 billion in 1995, down from its maximum of $49 billion in 1984, the number of banks reduced from 37 to 6, and local credit associations reduced in number from over 1,000 to about 200.

A more controversial aspect of farm credit policy is loans provided to farmers who do not qualify for lending from commercial sources or the Farm Credit System. USDA "lender of last resort" loans were initiated in the 1930s for subsistence, rehabilitation, resettlement, and other needs related to the Depression. These programs of direct lending by the government were consolidated in the Farmers Home Administration (FmHA) in 1946. Loans are made to young people to start farms, to tenants to buy farms, and to established farmers in times of emergency. In the late 1970s emergency loans expanded rapidly. The Carter administration instituted a new Economic Emergency Loan Program to help farmers in trouble restructure their debts. By the end of 1981, loans outstanding under emergency loan programs totaled $15 billion. These loans were made at subsidized interest rates. In contrast to traditional FmHA lending, which was targeted at young, small, and beginning farmers with low incomes and wealth, much of the economic emergency lending went to farmers with large wealth and income potential, but with high debt loads. Farmers proved unable to repay many of these loans, and FmHA loans worth $14 billion were written off during 1987–1992, at taxpayers' expense (Barry 1995, p. 61). During these same years, commercial banks and the Farm Credit System each wrote off a total of less than $1 billion. Earlier in the 1980s FmHA had refinanced many problem loans of these institutions, and this, rather than direct federal assistance, constituted the real bailout provided by taxpayers to the Farm Credit System.

USDA's lending activities can be seen as a decision by the government to encourage investment in farming, and as special encouragement for young farmers and limited-resource or minority farmers (each category of which has had special loan programs). Why do this? One argument is that federal lending is a remedy for a market failure resulting from informational imperfection. For example, it can be argued that inexperienced, low-income farmers do not have access to credit even when a loan would permit many such farmers to make investments that would be profitable for both borrower and lender. Lenders hesitate to make such loans because some farmers are ineffective managers and run a high risk of default, making them unpromising loan recipients; and in the absence of a track record for young farmers, the lenders cannot accurately distinguish the good prospects from the bad. Furthermore the farmers know their characteristics more accurately than lenders do. Too many bad risks end up getting loans on the same terms as the good risks, and if the lender raises interest rates to compensate for bad loans, the good risks may drop out. Under these circumstances a well-functioning private market for loans to young farmers is difficult to maintain.

If a governmental lending program is to improve the allocation of capital to farmers, the government must have a mechanism for uncovering at least some of the information that private lenders lack. Lending experience over the last sixty years provides little indication that the government has a way to get better information. More importantly, experience has proved that political forces often make it difficult for the government to act upon the information it has, for example, by foreclosing on bad loans or refusing further loans to especially risky clients. As of the end of 2000, 4 percent of USDA's loan portfolio was delinquent in not making payments for 180 days or longer. And because delinquent loans cannot be carried indefinitely even by a tolerant lending agency, 2 percent of USDA's loans were in the process of foreclosure—higher rates of nonperformance by both measures than on private sector farm loans.

Congress at times has explicitly required USDA to take commercially dubious lending risks and not to foreclose on nonperforming loans. Returning to the distinction between the two main purposes of credit policy, helping farmers in economic crisis and raising farmers' (and the agricultural sector's) long-term economic prospects, we find that the two objectives are mutually incompatible to an extent that has made it questionable whether net long-term economic benefits of U.S. farm credit policy exist. And as a welfare program, subsidized loans that keep farmers who are destined ultimately to fail solvent for a while longer are difficult to see as a favor to anyone. The New Deal of the 1930s was more realistic about this dilemma with its resettlement and relocation assistance, but its approach was seen as an unacceptable counsel of despair in the 1980s.

In the 1990s direct government lending was increasingly replaced by private-sector loans carrying a government guarantee of repayment to the lender. Problems can arise with guaranteed loans, because the lender may no longer be sufficiently prudent in lending. Moral hazard problems on the borrower side arise even in purely private lending, particularly because bankruptcy law provides ways for borrowers to default on loans while still retaining assets that could conceivably be used to pay off the loan. The Family Farmer Bankruptcy Act of 1986 created a new "Chapter 12" section in the bankruptcy code, specifically designed to give farmers new capabilities to fend off lenders who wish to foreclose. The idea is to permit insolvent farmers to keep farming while writing down a portion of debt and paying off the rest (according to mutual agreement between farmer and lender). The law permits farmers who bought land that subsequently declined in value to write down mortgage debt to the depreciated level of the land. The farmer can submit a reorganization plan, with write-down or reduced interest features, directly to the bankruptcy court, with no review by the lender. The 1986 act thus strengthens the bargaining position of the heavily indebted farmer significantly. This is a benefit to farmers but is also likely to have resulted in greater caution on the part of lenders about whom they lend to than was formerly the case.

Chapter 12 was enacted as a temporary measure to deal with the farm crisis of the mid-1980s, legislated to expire after five years. But it subsequently has been extended several times, most recently in October 1999, and appears to have become a permanent feature of bankruptcy law for farmers. Chapter 12 not only decreases lenders' expected recovery of bad loans but also increases the costs of bankruptcy proceedings. It is estimated that as a result, average interest rates charged to farm borrowers have been raised 0.25 to 1.0 percent per annum (Collender 1993; Stam 1997).

In earlier decades, regulation aimed at staving off bankruptcy was most vigorous at the state level. In 1932–1934, twenty-five states passed mortgage debt relief legislation, which prevented lenders from foreclosing for periods of three months to four years. R. R. Rucker and L. J. Alston (1987) estimated that these moratoria prevented the failure of 41,000 to 120,000 farms in 1933–1939, although the ultimate economic fate of their owners is not known. The short-term benefits of the moratoria to those protected were undoubtedly positive. But there were also costs, as lenders adjusted by rationing credit and raising interest rates for borrowers perceived as having substantial default risk. See Alston (1984) for details and analysis of these state actions, including discussion of why the other twenty-three states did not enact such legislation and the likely benefits and costs.

The existence of net benefits from credit legislation and regulation is in doubt, although benefits and costs have not been precisely quantified. The most comprehensive recent study by USDA "failed to uncover any evidence that serious market failures are either endemic to or epidemic in rural areas," and with respect to various proposals for expanding the role of the Farm Credit System, concluded: "Implementing any of these proposals, however, would be costly from the perspective of the Federal Government while both social and economic benefits are likely to be small" (USDA 1997a, p. 33).

The study did not address the benefits and costs of dismantling or reducing the role of the current Farm Credit System, or of bankruptcy and foreclosure regulation, but its arguments and data suggest that there would be a net gain from a smaller governmental role. The study was prepared under a congressional mandate in the 1996 FAIR Act "for the purpose of ensuring that Congress had current and comprehensive information as it deliberates on the credit needs of rural America" (USDA 1997a, p. ii) and reflects the input of several executive branch departments besides USDA. The general tone of appreciation for private-sector approaches and the recognition of the difficulty of improving upon social and economic flaws in the situation through governmental efforts are very different from governmental reports on similar issues from the 1920s through the 1960s. This shift illustrates a remarkable sea change in the tenor of policy discussion in recent decades.

REGULATION OF MARKETS

The regulatory agenda expanded notably in the Theodore Roosevelt administration and through the early 1920s. Beginning in 1908 a series of laws regulated grading, standards, and shipping of perishable commodities. Examples are the Standard Containers Act of 1916 and a series of laws culminating in the Perishable Agricultural Commodities Act of 1930. A law regulating the sale of insecticides and fungicides, aimed at mislabeled or adulterated products, was enacted in 1910 (36 U.S. Stat. 331). Regulations to protect the interests of farmers who owned commodities held by brokers, elevators, or buyers who had not yet paid for them became law in the U.S. Warehouse Act of 1916 (see Benedict 1953, pp. 154–155).

These and further protections for sellers of livestock were enacted in the Packers and Stockyards Act of 1921 and subsequent amendments. Further steps to assist farmers in dealing with nonfarm businesses involved legislation to strengthen farmers' bargaining power through cooperatives and other associations and the regulation of commodity futures markets in the 1920s and 1930s. Chapter 5 reviewed the history of federal antitrust action against meatpackers and other concentrated agricultural processors.

The Food and Drug Act of 1906 opened the door to retail-level regulation, and congressional strengthening of USDA meat inspection authorities in that same year placed increased controls on meatpacking (see Benedict 1953, p. 133). Adulteration of foods, sometimes in ways dangerous to consumers, was recognized as a problem warranting regulatory intervention. The issue was couched in terms essentially the same as used in today's food safety debates, primarily the threat posed by bacterial contamination of foods. Although more esoteric worries like risks from food irradiation (to control microorganisms), genetically altered food plants and animals, or pesticide residues now get predominant media attention, it is traditional bacterial contamination that still in the 1990s killed thousands of people annually, as discussed in Chapter 5. In 1997 the federal government introduced the Hazard Analysis and Critical Control Point (HACCP) program, under which meat and poultry slaughtering plants must adopt new procedures intended to reduce the incidence of foodborne illness. Elise Golan and colleagues (2000) estimate the costs of HAACP at $1.1 billion over twenty years, and the corresponding benefits of reduced disability and death at $13.3 billion. But the possibilities for error in both costs and benefits are enormous.

The pre–World War I Progressive Era generated new departures in U.S. policy responses to farmers' distrust of middlemen. Antitrust legislation had already built up a head of steam in the late nineteenth century, and was broadened and strengthened early in the twentieth. Similarly increased was regulation of the prices charged by middlemen for farm services, notably in transportation. Farmers received favorable treatment in the regulation of rail freight rates and inland water transportation via barges, and then in interstate trucking too as that industry developed as a shipper of commodities. Similar approaches prevailed later in the regulation of energy and other inputs. Farmers received priority allocation and favorable rates for natural gas and also received exemption from federal and most state gasoline taxes. Electricity for farmers was subsidized. Agriculture was exempt from minimum wage and overtime provisions of the Fair Labor Standards Act of 1938, and even after being brought under some of its provisions in 1966, farms that hired less than 500 days of labor in the peak quarter of labor use (as was true of most farms) remained exempt. These preferences generally persisted until the wave of deregulation in the 1980s, after which rails, trucking, and natural gas were no longer subject to federal rate setting. The exception is in the area of hired labor, where farms became subject to increased worker protection legislation in payment, working conditions, and safety.

COOPERATIVES

Before World War I producers of several agricultural commodities had organized cooperative marketing associations, most notably for milk. The perishability of raw milk led to recurrent problems, not only with perceptions that local processing plants were exploiting the necessity of the farmer's "selling or smelling" his milk but with the question of which milk gets access to the market when demand is low or when for other reasons the plant can handle less milk than farmers have to sell that day. Collective marketing through a cooperative promises a way of increasing farmers' bargaining power and of allocating the plant's demand among the producers in an area. Similar situations exist for other farm commodities. USDA's survey of marketing cooperatives counted 592 of them in 1915, selling $642 million of farm products, 8 percent of the value of all farm sales.

In his annual report to Congress in 1922, Secretary of Agriculture Henry C. Wallace noted the helpfulness of cooperatives in "regulating the amount marketed to what the demands of the consumers will absorb at a fair price" (USDA 1923, p. 9). Because such regulation is a clear case of a business combination in restraint of trade, it could legally occur only if legislatively exempted from the Sherman and Clayton acts. After much debate, this exemption was granted in what has been called the *magna carta* of agricultural cooperatives, the Capper-Volstead Act of 1922.

Although the sales and membership of cooperatives grew under the Capper-Volstead Act, it soon became evident that exemption from antitrust was not sufficient to confer decisive market power upon agricultural producers. They could not force their members to follow the cooperative's marketing plan or prevent free riding by nonmembers who could sell at prices achieved by the cooperative. Subsequent legislation strengthened the powers of marketing cooperatives, culminating in the Agricultural Marketing Agreement Act of 1937. This act established rules for creating marketing orders. New ones could, and still can, be initiated by petition of a grower group to the secretary of agriculture. Once the order is formally established by a vote of producers, its provisions are binding on all producers and handlers of the product in the area covered. The producers involved need not be organized as a cooperative, but they often are. The provisions of a marketing order may be limited to grades, standards, or promotional activities, but can extend to regulation of quantity sold in a designated period of time, or to quantity produced. However, only a few marketing orders have had production controls, and those that once had such controls (hops, spearmint) no longer do. "Flow to market" regulations, which limit the amount producers can sell week by week, were important until the 1990s for oranges and lemons. They had disappeared by the end of the century (although the approach was resurrected for cranberries in 2000). In 1996 there were thirty-seven marketing order programs in place for fruits, vegetables, and tree nuts, the largest of which was one governing the $1 billion output of 8,000 California almond growers.

The most complex set of marketing orders are those for milk. Milk producers were among the strongest supporters of marketing order legislation, and they have used the provisions to greatly strengthen the economic position of dairy cooperatives. Dairy marketing orders today do not attempt to regulate their members' output, although some of them have done so in the past. The economic benefits of marketing orders to producers are achieved through classified pricing, the essential feature of which is fixing a higher price for "Class I" milk marketed in fluid form, as compared with milk used in butter, cheese, nonfat dry milk, or other manufactured dairy products. Classified pricing increases the revenue generated by any given quantity of milk produced, because the demand for fluid milk is less elastic than the demand for milk to be used in manufactured products. (The same principle allows airlines to increase the revenue from a given number of seats on an airplane by charging higher prices to business travelers and lower ones to tourists.)

The details of milk classification have varied over time, as has the Class I price differential. In 1996 the U.S. average price for Class I milk was 16.2 cents per pound and for manufacturing milk, 13.4 cents per pound. The differential also varies across regions. In centers of milk production, notably Wisconsin and Minnesota, milk use is predominantly for manufactured products and the differential is small. In peripheral areas the differential is large, and because the manufacturing milk price is fairly uniform across the country, the average price received by farmers is substantially higher in the peripheral areas. In 1996 the average producer price of milk in Florida was 22 percent higher than in Wisconsin.

Estimates for the 1959–1980 period indicate that marketing orders increased the average producer price of milk about 2 to 4 percent (AAEA

1986). A study of the marketing order system as of 1990 estimated that it raised the U.S. average price of fluid milk by 13 percent and reduced the price of manufacturing milk by 6 percent, for an overall price effect of about a 6 percent increase (Helmberger and Chen 1994). The net gain to U.S. farmers was estimated to be $50 to $100 million annually as of the 1970s (U.S. Department of Justice 1977, p. 105). Consumers lost about twice this amount, the remainder being deadweight losses—costs to consumers for which there is no offsetting gain to producers. Deadweight losses to the U.S. economy, including $30 to $35 million annually as the costs of operating the marketing order system, range from $60 million to $180 million annually in three major studies of the 1970s (Dahlgran 1980).

Consumer costs gained attention in the 1970s when farmers were perceived as being enriched by the worldwide commodity boom while consumers were burdened by double-digit food price inflation. The Justice Department investigated milk marketing and issued a report that was critical of the marketing order system and large cooperatives in milk marketing. It recommended deregulation (see U.S. Department of Justice 1977). But the Department of Agriculture vigorously objected to the Justice Department's findings and analysis. In the end, this reform effort, like subsequent efforts, had little effect.

Legislation of 1990 and 1996 mandated studies followed by changes in milk marketing orders, the 1996 FAIR Act requiring a reduction in the number of milk marketing orders from thirty-two to not more than fifteen or less than ten, and reconsideration of classified pricing differentials. USDA, after two years of consideration, recommended reducing the number of orders to eleven and reducing Class I differentials slightly. But in 1999 Congress largely undid this modest reform legislatively. The *Washington Post,* in its last editorial on agricultural policy of the twentieth century, called this outcome "a fitting testament to the instincts of a Congress that, from the standpoint of the public interest, can't go home soon enough" (November 17, 1999, p. A30).

REGULATION OF BUSINESS PRACTICES AND FARMS

Throughout the twentieth century, interest groups sought to bend regulation to their economic purposes. A classic example dating from the late nineteenth century was regulation of oleomargarine, sought by dairy interests. By 1890 all but eight states had passed antimargarine legislation, as had the federal government. But many of the laws failed to pass constitutional muster in the courts, and while on the books they proved difficult to enforce. In 1902 a federal tax of 10 cents a pound was enacted on colored oleomargarine that essentially eliminated it as a competitor of butter (whose retail price at the time was 28 cents per pound). Uncolored margarine was taxed at only ¼ cent per pound. Consumers could then buy a packet of coloring to make it yellow like butter (except that New Hampshire required all margarine to be colored pink). The federal tax was finally repealed in 1950, after a protracted debate in which two of the main adversaries remain well known today (but not for this): for repeal of the tax, Senator J. W. Fulbright of Arkansas; against repeal, Senator Hubert Humphrey of Minnesota. Some state taxes on margarine remain in place to the present. (For more on historical details, see R. A. Lee 1973.)

Similar political responses to a competitive threat, but on behalf of a different interest group, propelled regulatory efforts to protect small, independent grocery stores from larger-scale commercial development in food retailing. Building on local successes in food retailing in eastern states, the Great Atlantic & Pacific Tea Company (A&P) was incorporated in 1900. In 1913, A&P introduced the idea of self-service, offering economies as compared to the traditional approach in which clerks filled orders much as pharmacists still do. By 1919 the share of such "chain stores" had risen to about a quarter of the U.S. grocery market and was expanding rapidly (see Ross 1986). These chains were able through mass buying and reliance on self-service to offer groceries at lower prices than traditional stores, which found it increasingly difficult to compete. Complaints of unfair competition first yielded political fruit in state legislatures, notably in 1927 when Georgia, Maryland, and North Carolina all passed anti–chain store legislation. Maryland's law was an outright prohibition on having more than a prescribed number of stores under a single management, but this approach was found unconstitutional (M. W. Lee 1939, p. 11). The predominant legislative approach was taxes levied on chain stores. North Carolina began with a tax of $50 for each store on any chain operating six or more stores in the state. It was quickly found unconstitutional in a decision stating the practice was arbitrary in taxing chains with six stores but not five (Ross 1986). By 1937 half the states had chain store taxes, and in 1938 Congress considered the most sweeping policy of all, a tax that would have put the national chains out of business (A&P's projected tax bill was estimated to be fifty times its earnings). This bill was debated for two years, but was never enacted.

The late 1930s proved to be a turning point in public opinion on the chain store issue, and ultimately the state taxes were repealed. In the 1960s the National Commission on Food Marketing reviewed chain stores and other issues related to alleged unfair competition or "predatory pricing" (such as the use of "green stamps," redeemable for merchandise, and similar means of price competition). While still reflecting popular suspicions of large corporations in food retailing, the commission's work led to no recommendations for regulatory action.

A similar story of regulation favoring small businesses threatened by economic change is regulation protecting local banks from the inroads of outside competitors, particularly an established bank in one community setting up a branch in another. The National Bank Act of 1863 established a rule for national banks of only one office location per bank, and delegated authority to the states to regulate banking in their states. As of 1930, twenty-seven states had "unit bank" laws, prohibiting any bank from having more than one office, and only eight states permitted statewide branch offices. Restrictions on branch banking are particularly limiting in rural areas, leaving farm depositors and borrowers facing only a single bank in some agricultural communities. But it has also been argued that local lenders are best suited to manage loans to farm customers they know, particularly in hard times when they can provide risk-sharing services that a branch of an out-of-town bank would lack sufficient information to provide efficiently. Agricultural economists have expressed mixed views about the benefits and costs of branch banking (see Brake and Melichar 1977, pp. 468–470).

The principal benefit of branch banking that overcame reluctance to embrace it was the risk of bank failure for small agricultural banks when the local agricultural economy went sour. The salience of this point first became apparent in the 1920s, when many rural banks failed in the post–World War I period of low commodity prices, and even more strongly in the 1930s Depression. By the end of 1935, twenty-two states had relaxed their restrictions on branch banking, largely in response to failures of local banks (see Wheelock 1992; Abrams and Settle 1993; Mason 1997; Rose 1997). Still, in 1985, twenty-eight states were classified by Calem and Nakamura (1998, p. 605) as having significant restrictions on branch banking. The continuing political pressure for such regulation came from local banks, of course. Over time their political clout was eroded, and the development of multibank holding companies allowed an increasing amount of regional competition to emerge. Regulatory restrictions on multibank holding companies have not been stringent, and restrictions on branch banking progressively disappeared during the 1980s and 1990s. A final move to the liberalization of branch banking across state lines was accomplished at the federal level in the Interstate Banking and Branching Efficiency Act of 1994, and by 1995, forty-seven states had enacted statewide branch banking statutes (LaDue and Duncan 1996; Rose 1997).

Evidence on the effects of the most recent relaxation of branch banking restrictions is not yet available. Results of earlier studies are mixed. Paul Calem and Leonard Nakamura (1998) find a significant procompetitive effect benefiting depositors in states where such restrictions are absent. This supports a widespread presumption in economic studies that bank regulation is primarily a political struggle between financial interest groups rather than being aimed at public-interest goals, and that deregulation is socially beneficial (see Kroszner and Strahan 1999). But the earlier work discussed by John Brake and Emanuel Melichar (1977) casts doubt on the extent of gains to farmers as borrowers from the spread of branch banking.

The regulatory activity discussed so far has been designed to control agribusiness rather than farms, and has often had, among other political reasons, the purpose of assisting farmers' interests. Other regulation has aimed to control farmers' actions. Three areas of such regulation are especially noteworthy: food safety and health regulation, environmental regulation, and regulation to assist marketing cooperatives.

Sellers of livestock cannot ship diseased or contaminated animals. Cattle treated with hormones or antibiotics, for example, must go without these products for a period of time sufficient to eliminate residues of the chemicals before they are sold. Dairy farms have been subject to inspection by departments of health ever since human illnesses have been traced to bacterial contamination of milk. Pasteurization, which practically all jurisdictions require, essentially removes these risks. Other contaminants such as antibiotics are detected by testing milk rather than by inspecting farms. In addition, most cities employ inspectors who periodically check milk houses for sanitation.

Fruit and vegetable growers are subject to compliance with federal grade and quality standards, albeit ones which the growers themselves have a hand in establishing. In one of the first major U.S. regulatory initiatives of the twenty-first century, USDA in March 2000 announced national standards for organic food. The initial proposed standards had been contentious, with 275,000 comments from the public logged by USDA, and had been gestating for almost ten years since the 1990 legislation requiring them was enacted. The organic label has ended up being a haven for consumers who are suspicious of technology in many forms, so the organic standard disallows not only farm products treated with chemical fertilizers or pesticides but also the irradiation of products (often used to kill organisms that spoil stored food), genetically engineered seeds, and the use of sewage sludge as fertilizer (a fall from grace for products such as Milorganite—from Milwaukee's sewage treatment plants—earlier seen as an admirable way of recycling organic waste materials). Although farmers regularly have complaints about this and similar regulations, on the whole they are seen as beneficial in maintaining consumer confidence in food products.

The story is quite different with respect to the regulation of farm practices.

The 1958 "Delaney" amendment to the Food, Drug, and Cosmetics Act forbade the use of any substance in a processed food product that had been found to cause cancer when ingested by humans or laboratory animals. The "zero tolerance" implied by this language would have kept some unprocessed farm products off the market, but they were not regulated by the act.

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) was modified in the 1970s (from FIFRA's original 1947 purpose of ensuring that pesticides were effective as advertised) to focus on the protection of humans and wildlife from harm from pesticides. FIFRA also addresses the health and safety of farmworkers, who are at risk of more intensive and sustained exposure to toxic chemicals than are consumers. The Environmental Protection Agency (EPA) is charged with reviewing pesticides for both consumer and worker safety, and in the 1990s moved to ban the use of some economically important ones and to closely regulate the exposure of farmworkers to others. Actions taken so far have undoubtedly increased farmers' costs, particularly in fruits and vegetables, and pending actions may cost more. But there is not good evidence of quantitatively significant economic effects.

Chemical bans have also been triggered by international agreements. The Montreal Protocol on ozone-depleting gases requires a phaseout of methyl bromide, used in gaseous form to kill insects in stored grain and hard-to-control nematodes in soil, among other applications. USDA reports estimates that farm costs will be increased by $450 to $800 million annually by this action, just from the loss of preplanting soil fumigation uses (Osteen and Caswell 1999). These estimates are very uncertain, depending as they do upon the availability of substitute chemicals, some of which are under FIFRA review, and upon how much lower farmers' yields will be under alternative methods of pest control. Moreover, the incidence of the farm cost increases is not obvious. If all production gets more costly, consumers can be expected to pay much of the price, just as consumers get much of the benefits from cost-reducing technology. But if production is affected in only certain areas, as is the case for some of the products on which methyl bromide is used, then farmers in those areas will bear a large part of the costs.

Regulation potentially costly to farmers has been promulgated under the Federal Water Pollution Control Act ("Clean Water Act") of 1972 and the Endangered Species Act of 1973. Implementation has been slow to develop under both acts. One area in which both have begun to affect farming is through their provisions regarding the protection of wetlands. The Clean Water Act requires anyone who intends to drain a wetland (the definition of which has itself been a highly contentious issue in the administration of the act) to obtain a permit from the Army Corps of Engineers. The Endangered Species Act gives the EPA wide powers to regulate what people do that affects the habitat of plants and animals determined to be threatened (more than 700 species in the United States at present), and these acts can include draining swamps or the use of pesticides as well as killing what farmers consider pests but are part of the food chain of an endangered species. The most widely discussed case of economic disruption in the 1990s has been logging bans to protect the habitat of the Northern Spotted Owl in the West. Until 2000 the effects on agriculture were negligible, but the wide regulatory powers given to the EPA and the explicit bypassing of benefit-cost analysis in the legislation—which sets criteria for listing a species as endangered strictly on the basis of prospects for the species, not of costs to people—has created unease among agricultural interests.

The Clean Water Act also initiated regulation of concentrated animal-feeding operations (CAFOs) by listing them as sources of pollution subject to permit requirements. These have been administered by the states, recently to implement the EPA's National Pollutant Discharge Elimination System, which requires no-discharge permit requirements to keep manure from streams or other surface-water bodies. Costly manure-handling investments have influenced the design and location of large dairy, beef cattle, hog, and poultry CAFOs in many states. Incidents such as a large manure spill in North Carolina, resulting from a 1999 hurricane, have led to levying fines for waste discharges and calls for tighter regulation. As of 2000, North Carolina required a nondischarge permit for swine operations of more than 250 hogs, while the federal EPA defines a swine CAFO as having 2,500 or more hogs. National rules for effluent emissions have only recently been proposed by the EPA (U.S. EPA 2001).

The pollutants that concern human health most directly are bacteria and other microorganisms in animal waste. Other prominent water quality problems arise from nitrogen and phosphorus in manure and inorganic fertilizers that run off fields or leach into groundwater. These problems have been addressed by the states as they appeared. Elevated levels of nitrate in wells led Iowa to impose a fee on nitrogen in fertilizer, the proceeds of which are used to develop and implement production practices designed to reduce leaching. In rivers leading to the Chesapeake Bay in Maryland, a 1997 outbreak of *Pfiesteria* microorganisms that kill fish and cause health problems for people led to state legislation regulating the use of chicken manure on fields. Phosphorus and nitrogen from such fields were believed to be implicated in the outbreaks. In Florida, dairy farms whose land drains into Lake Okeechobee have been required to install manure treatment plants. For an overall review of current policy tools and their application, see USDA (2001a). Generally, mandatory regulation of practices has not been imposed at the national level. Instead, farm legislation has incorporated titles that provide incentives for producers to undertake recommended practices.

Farm legislation since the 1930s has included resource and environmental titles, at first focusing on soil erosion. Soil erosion is not just a problem of the farmers' own capital depreciation, because soil leaving a farm silts up streams, rivers, and lakes and can carry harmful chemical residues. In the 1980s and 1990s various programs attempted to thread a path between environmental protection and economic costs to agriculture. Under the Food Security Act of 1985, farmers had to develop and implement soil conservation plans in order to qualify for price support payments and other farm program benefits, with special attention paid to newly planted acreage that might be erodible or a wetland ("sodbuster" and "swampbuster" provisions). But the main approach to winning farm interests' assent is to go slowly on requirements imposed on production practices, and to pay farmers for the costly activities they must undertake in response.

The most extensive such program is the Conservation Reserve Program, also begun in 1985. By 1990 this program had enrolled 34 million acres of land under ten- (and some fifteen-) year contracts. In exchange for annual payments averaging $50 per acre, plus cost-sharing assistance for certain soil-conserving investments such as tree planting, the farmer agreed to grow only soil-conserving crops such as grasses and not to harvest hay or graze the land except in limited circumstances. This program was criticized for costing too much, about $1.8 billion annually, for the conservation benefits achieved. However, other environmental benefits, most notably ones related to improved wildlife habitat, have been reckoned in the hundreds of million dollars annually (Feather, Hellerstein, and Hansen 1999).

Despite criticism from both right and left (see Cook 1994), the program was sufficiently popular with farmers that upon expiration of most of the ten-year contracts between 1996 and 1999, new ones were established. In addition to an enhanced Conservation Reserve Program, legislation since 1985 has also established a Wetlands Reserve Program to pay farmers for "conservation easements" to restore wetlands on over a half million acres of low-lying land that had formerly been converted to agriculture; an Environmental Quality Incentive Program, to pay farmers for developing and adopting environmentally benign practices; and refinements of "conservation compliance" requirements for receipt of commodity program benefits.

Political Overview

The major agricultural policy developments of the twentieth century show how far public sentiment and political realities were from the dominance of laissez-faire throughout the period. In part this activist agenda reflects the desire for a public role in managing federally owned lands, in developing agricultural production and marketing infrastructure, and in creating property rights and rules for voluntary collective action (as in cooperatives). These activities, continuing through the legislative efforts of the 1980s and 1990s to establish national and international property rights in biotechnology innovations and other intellectual assets, are the fundamentals of an industrial policy for agriculture.

A closely related aspect of this policy is the incentive and regulatory agenda. The main incentives are subsidies—of farm credit, of crop insurance, of farm product marketing, of conservation practices, and of farmland preservation. Regulation of farmers has been imposed in pursuit of health and food safety, farmworker protection, and environmental quality. Regulation of agribusiness has been undertaken in pursuit of some of the same objectives, but also to protect farmers against exploitation by agribusinesses with superior market power—or what is believed by farmers to be so. Examples include antitrust action against meatpackers and grain-buying companies, outlawing the trading of commodity options, moratoria on foreclosures by banks, farmer-friendly bankruptcy laws, and bans on corporate farming.

Many of these policies have objectives that in principle make them acceptable to all the main interest groups; but political forces have generated subsidies and regulations that do not look good in benefit-cost terms. The next chapter focuses on an even more nakedly political area of agricultural policy, the commodity programs.

7

Government II: Commodity and Trade Policy

Although the roots of U.S. governmental action in agriculture go back to the foundation of the Republic, commodity-based farm programs have more recent origins. These policies are aimed at stabilizing and supporting farm commodity markets, principally with the economic interests of farmers in mind. In the intense lobbying for these programs, both their benefits and their costs have been thoroughly questioned. Agricultural economists have been split over their worth, with recent opinion generally running against, although reasonable arguments have been put forward that U.S. commodity support policies have been an important contributor to the growth of agricultural productivity.

A Brief History of Commodity Programs

Decisive efforts to get the U.S. government directly involved in farm commodity markets began in the early 1920s and culminated in the New Deal farm programs of the 1930s. The programs survive to the present day in their basic premise that it is the responsibility of the federal government to place a floor under farm incomes. Practical difficulties with a succession of commodity programs have chipped away at support for them over the years, however, and the Agricultural Market Transition Act of 1996 raised the possibility of an end to price support activities as a means of farm income support.

The series of traumatic events that led to sixty-five years (and counting) of federal involvement in farm commodity markets began with the plunge in commodity prices of 1919–1920. In May 1921 the House of Representatives, and in June the Senate, passed a resolution establishing a commission to investigate the causes of the "agricultural crisis." The Commission of Agricultural Inquiry's report (U.S. Congress 1921) did not issue definitive findings but noted that the price declines were worldwide and not confined to the United States, and among factors within the United States the commission members laid considerable emphasis on high freight rates, rigid marketing charges, and generally pointed to the lack of farmer bargaining power. Thus the commission's first recommendation was to legalize cooperative selling of commodities by farmers (which might otherwise be prevented by antitrust law). Other recommendations were calls for improved statistics and economic intelligence in USDA, a system of agricultural attachés in foreign countries, improved provision of credit (through "adaptation of the private banking system"), and improved grades and standards for agricultural products. But the commission made no mention of direct intervention in commodity markets to support prices.

Farmers tended to see the issues as ones of harm visited upon them by powerful interests beyond their control rather than being the consequences of impersonal market forces. The recently established Federal Reserve System was accused of strangling farmers with high interest rates, in collusion with banking and financial interests. Sharp declines in the price of grain were blamed on speculators in futures markets. Middlemen were castigated for increasing their share of the consumer's food bill by maintaining retail prices while raw commodity prices fell.

It is possible that a less conspiratorial view might have led sooner to direct measures to support commodity prices through government action. But instead legislation of the early 1920s focused on regulating warehouses and stockyards, placing ceilings on freight rates, promoting farmer cooperatives, easing credit conditions, and taxing or banning futures and other derivatives (as they are called today). The legislation that survived constitutional challenge—which the early futures legislation, in particular, did not—redistributed income to farmers only marginally and indirectly.

At the same time agricultural leaders, both in government and in the private sector, came forth with ideas for the management of the commodity markets by the government. A proposal initiated by George Peek and Hugh Johnson of the Moline Plow Company in 1922 was vigorously debated in Congress and in political campaigns. The basic idea was that tariffs should be set at levels that would allow farm products into the United States at "fair exchange value," that farm output should be sold onto the domestic market only in quantities necessary to meet domestic demand at the fair exchange prices, and that any surplus U.S. production that could not be sold at these prices would be sold abroad at world market prices (see Fite 1954).

The first legislative version was introduced in 1924 by Senator Charles McNary and Representative Gilbert Haugen. The bill defined the fair price as one that would place farm commodity prices in the same ratio to the general price level (the all-commodity wholesale price index of the Bureau of Labor Statistics) as had been the case just before the war. Since the price index was

50 percent above the prewar level in 1924, the price of wheat, which had been $1.00 per bushel before the war, would now be established at $1.50. The mechanism for achieving this result would be a government agency that would buy wheat whenever the price fell below $1.50 and stand ready to sell to all comers at that price. The government's losses on surplus wheat sold abroad were to be covered by a complex scheme in which some of farmers' returns on the high domestic price would be retained by the government (see Benedict 1953, pp. 212–214, for details). If it had been enacted and made to work, the approach would have had the economic effects of an amalgam of two currently existing policy regimes that today's U.S. farmers detest—the Common Agricultural Policy of the European Union (reviled for its high tariff protection and export dumping) and the Canadian Wheat Board (disliked for its centralized export sales and farmer financing of strategically low-priced exports).

After legislative defeats in their first three outings, in 1924, 1925, and 1926, McNary-Haugen bills were passed by Congress in 1927 and 1928, only to be vetoed by President Coolidge. In light of the terms of the debate over economic policy in recent years, it is worth noting that opponents did not base their case primarily on the virtues of the market and the vices of government. The proponents were Republicans from the Midwest and West and the opponents mainly Democrats from the East and South, and the terms of debate were more practical and sectional than ideological. Coolidge in his veto messages did object to price fixing on principle, but the bulk of his case involved operational difficulties and commodity inequities in the legislation (see Benedict 1953, pp. 211–229; Coolidge's veto message of 1927 is reprinted in McGovern 1967, pp. 126–134).

The first large-scale commodity market intervention by the federal government was that of the Federal Farm Board, which was established under the Agricultural Marketing Act of 1929. The board set up complicated public/private sector operations for supporting commodity prices, notably for wheat, under a Grain Stabilization Corporation established in 1930 for the purpose of buying and storing grain (Benedict 1955, p. 102). In its grandest price-supporting effort, the board bought 250 million bushels of wheat during 1930, equal to about one-third of the previous year's U.S. production. This action undoubtedly kept wheat prices higher than they otherwise would have been in 1930. Unfortunately, the wholesale price of wheat dropped from an average of 90 cents per bushel in 1930 to 61 cents in 1931 and 49 cents in 1932. The board gave up its attempts to support the price of wheat in mid-1931 and liquidated its remaining stocks in 1932–33, mainly through sales abroad. The board ended up buying high and selling low and thus accomplished no real stabilization. Benedict (1955, p. 112) estimated the overall fiscal loss on the wheat stabilization operation at $144 million (in 1932 dollars). The board's price support efforts on behalf of cotton, and (through strengthened farmer cooperative efforts) wool, butter, and grapes, appear also to have been ineffective. Deflationary forces as the nation entered the Depression were too strong to combat.

The century's most decisive steps in federal regulation of commodity markets occurred in the Roosevelt administration. The Agricultural Adjustment Act (AAA) became law in May 1933, as one of the initial pieces of New Deal legislation in Roosevelt's first hundred days in office. The thought behind the AAA, common to many elements of the New Deal, was to get money circulating in the economy and to counter deflation by getting prices up. Payments were made to farmers, but not just as handouts or entitlements. The idea was rather to pay for actions that would result in higher commodity prices and thus boost farm income well beyond the sums spent. With prices received by farmers for both crops and livestock averaging less than half of their levels of 1929, consumer food-cost concerns were not an issue. The emphasis was on supply management, including idling of acreage (even plowing up some crops already planted) and delivery of breeding and young livestock for slaughter to reduce future supplies. The Supreme Court in 1936 ruled out a tax on processors of farm products that financed supply management efforts.

After 1936 supply management for grains focused on soil conservation, the idea being to save soil by not growing row crops, and cropland retirement under conservation programs remains in law to the present. Figure 7.1 shows acreage idled under government programs over time. The absence of idled acreage between 1938 and 1953 does not imply the abandonment of supply management ideas. In cotton, wheat, tobacco, and peanuts, acreage allotments placed limits on farmers' plantings while permitting other crops to be grown without restriction. Commodity booms associated with World War II and to a lesser extent with the Korean War lessened the salience of controlling production until 1952. In 1953 and 1954 government-held grain stocks accumulated rapidly as export demand waned, leading Congress and the Eisenhower administration to move more intensively to supply management with the Soil Bank Program and other acreage idling that equaled the scale of the New Deal programs by the mid-1950s. In the early 1960s idled acreage reached unprecedented levels as "set-aside" programs were introduced, according to which the secretary of agriculture each year made determinations about the diversion of crop acreage.

The most-used supply management approach through the twenty-five years after 1963 was a "mandatory" set-aside in which farmers had to idle a percentage of their crop acreage that the secretary determined annually in order to be eligible for price support programs. The use of this approach peaked in the mid-1980s, with over 75 million acres—almost a fourth of the

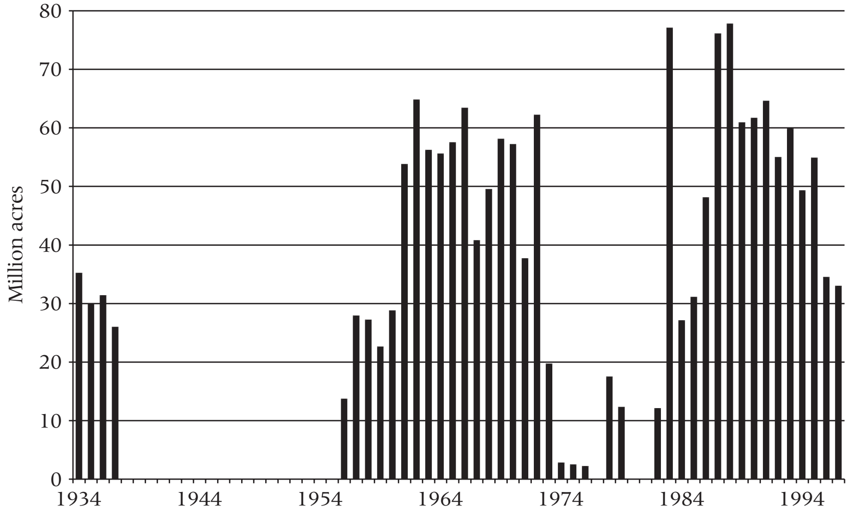

Figure 7.1 Acreage idled under government programs. Data from U.S. Department of Commerce (1975); U.S. Department of Agriculture, *Agricultural Statistics*, various years.

acreage used in the major crops—idled in 1983, 1987, and 1988. By the end of the 1980s an anti–supply control view that some economists and farm groups had been putting forward for years became politically dominant—namely, the belief that reductions in U.S. production did not have nearly the price-enhancing effect farm interests hoped for, and that in fact the main long-run effect of U.S. production control was to encourage other countries to expand their production to fill the gap in world supplies that U.S. acreage reductions opened up. Consequently, supply management programs were greatly reduced in the 1990s, and the Federal Agricultural Improvement and Reform (FAIR) Act of 1996 revoked the secretary's authority to conduct annual acreage reduction programs.

Nonetheless, in 2000 about 8 percent of all U.S. cropland, 36 million acres, remained idled under long-term (mostly ten-year) contracts under the Conservation Reserve Program discussed in the previous chapter. The spirit of supply management survived to some extent in this program. It still existed explicitly in the individual farm production quotas that remained the foundation of policy for tobacco and peanuts, and was reenergized in 2000 in a program under which sugar beet growers were paid to plow up their crop.

After a hiatus owing to the failure of the Federal Farm Board in 1930–1932, the idea of stockpiling commodities to support and stabilize commodity prices was revived in the New Deal. The Commodity Credit Corporation was created by executive order in 1933 and received legislative approval as a government-owned enterprise in the CCC Charter Act of 1936. It made loans to farmers after their crops were harvested, paying them the "loan rate," a price for the amount of product they placed as collateral "under loan" on the farm or in certified commercial storage. CCC loans were "nonrecourse," meaning the CCC was obligated to accept pledged commodities as repayment in full including interest. The loan rate thus gives the farmer a free put option, that is, an option to sell at a prespecified price. If the market price rises above the loan rate sufficiently to cover interest and other costs, the farmer pays off the loan and redeems the commodity for commercial sale; if the market price is below that level, the farmer lets the CCC keep the commodity. Moreover, with sufficient participation, the loan program places a marketwide floor under the price, so even nonparticipants in the program reap its rewards. The main commodities supported by CCC action have been the grains, cotton, and storable dairy products (the last supported by CCC purchases of butter, powdered milk, and cheese).

Like supply management, those CCC support mechanisms have been almost phased out as a significant part of farm policy. Figure 7.2 shows

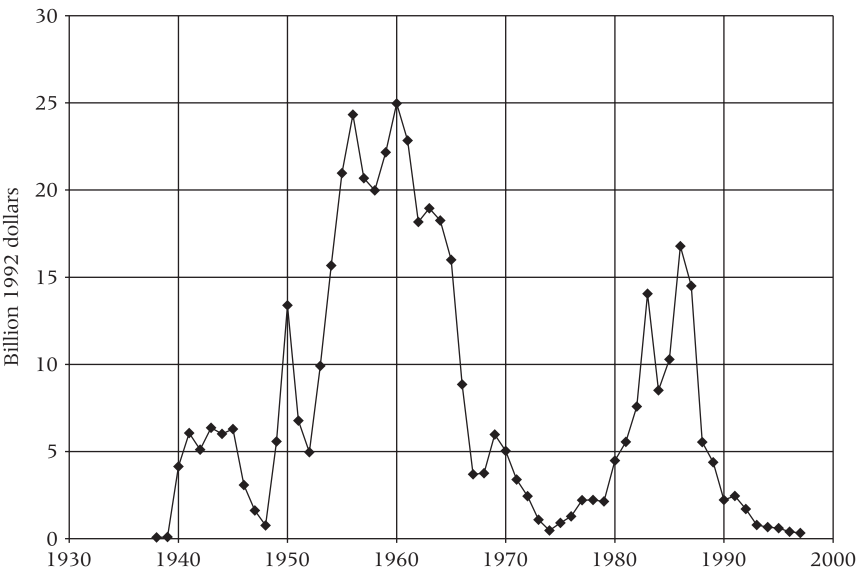

Figure 7.2 Value of Commodity Credit Corporation inventories (1992 dollars). Data from U.S. Department of Commerce (1975); U.S. Department of Agriculture, *Agricultural Statistics,* various years. Value at end of fiscal year, at support prices.

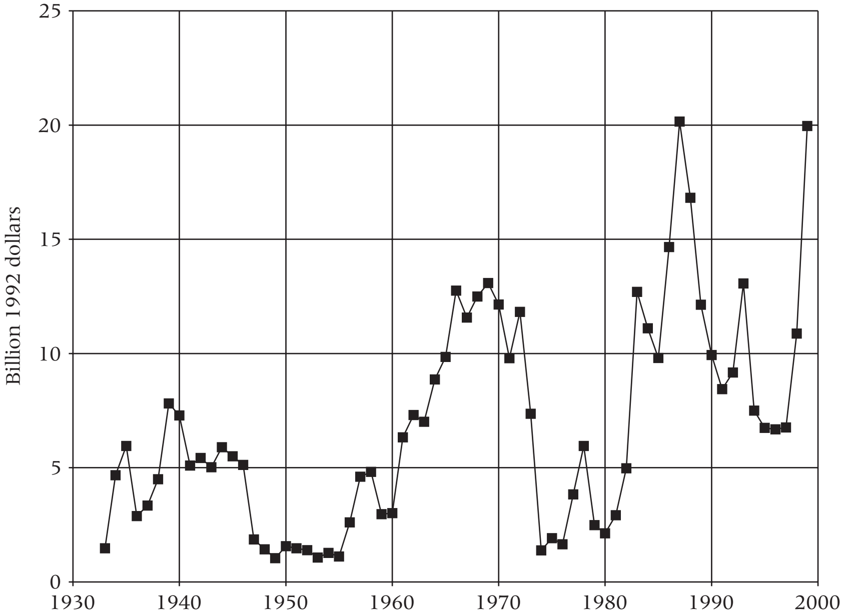

Figure 7.3 Government payments to farmers. Data from U.S. Department of Agriculture, *Agricultural Statistics,* various years; and U.S. Department of Agriculture, Economic Research Service website, <http://www.ers.usda.gov/>.

the evolution of stocks held. After the huge stock build-up of the 1980s, political pressures from farmers and budgetary concerns converged to a view that government support of market prices through inventory management should be largely abandoned. Even in the extended low-price period of 1998–2000, the government assiduously avoided acquiring commodity stocks.

The approach to farm income support that has recently gained predominance in the policy menu is direct payments to producers to compensate them for low prices. For an overall historical perspective, Figure 7.3 shows government payments to producers from 1934 to 1999. In 1963 the Kennedy administration asked growers whether they preferred to continue supply management, with resulting higher market prices, or to be freer to plant more, with lower market prices. After the most publicized and contentious grassroots debate in the history of commodity programs, they chose the latter (see Saloutos 1982).

Nonetheless the political clout of farmers was such that Congress could not leave farm incomes at the mercy of lower prices, and out of that situation the system evolved of payments tied to annual acreage set-asides. The approach crystallized in the Agricultural and Consumer Protection Act of 1973 in the form of "deficiency payments" to make up the difference between the market price and a "target price" legislated by Congress for the major field crops except soybeans (wheat, corn, cotton, rice, grain sorghum, barley, and later, oats). Target prices were well above market prices in most years during 1975–1995. To forestall farm output expansion in response to these prices, after 1980 increasingly stringent limits were placed on the quantity of production on which each farmer could receive payments. Each farm had a "payment acreage" and "payment yield" that were hard for a farmer to change.

Between 1965 and 1990 government payments to farmers averaged about $10 billion (in 1997 dollars). In the mid-1980s these payments plus the costs of the CCC programs resulted in an increase in the federal budget for farm income stabilization to over $25 billion—over $12,000 per U.S. farm. In order to control budget outlays, payment acreages were reduced, and by the mid-1990s payments were being made on only about 60 percent of actual U.S. production of grains.

The "freedom to farm" program of the FAIR Act of 1996 was intended to lock in fixed payments until 2002. Including both "market transition payments" and Conservation Reserve Program payments, the Office of Management and Budget's broader indicator of farm income stabilization outlays was about $7 billion in 1997. But in 1998 and 1999 weakened export demand led to marked reductions in the prices of the main farm crops. This, together with crop failures in some parts of the country (but not sufficient to prevent record-high yields of wheat, corn, and soybeans), triggered Congress to appropriate about $6 billion in additional payments to farmers in 1998, $9 billion in 1999, and $10 billion in 2000. Total payments received by farmers in 2000, $23 billion, had been exceeded only in 1986.

Trade Policy

Tariffs on agricultural imports go back to the earliest days of the Republic, as a federal revenue-raising measure. The McKinley Tariff of 1890 doubled tariffs on meats and increased tariffs on other staple commodities to practically prohibitive levels, in consequence converting farmers from the free-trade position that characterized the South earlier to "staunch advocates of protection" (Benedict 1953, p. 58). Congress's granting of further tariff protection to agriculture in the 1920s led H. L. Mencken to comment, "One might almost argue that the chief, and perhaps even only, aim of legislation is to succor and secure the farmer" (Mencken 1958 [1922], p. 160).

A putative sign that the political climate for agricultural policy had truly changed in the 1990s was President Bill Clinton's welcome of congressional action to phase out the wool program, which made subsidy payments to U.S. wool producers entirely financed by tariff receipts levied on imported wool. In his statement on the bill, President Clinton began by saying: "Today, in signing S. 1548, something unusual will happen: a Federal program is being abolished" (November 8, 1993). But in 1999, in response to low prices attributed to imports, his administration imposed tariffs on lamb meat that cost consumers as much as the Wool Act had formerly cost taxpayers—about $100 million annually. Similarly, the honey price support program was ended in the early 1990s but was soon replaced by import restrictions aimed principally at Chinese honey. (And the honey support program itself was reinstated by the end of the century.)

After World War II, it became apparent that export demand was capable of creating farm prosperity to an extent and with far less cost and turmoil than a decade of intensive effort by the federal government had been able to deliver in the 1930s. Under the Marshall Plan U.S. exports of foodstuffs amounted to 19 million tons annually in 1947–1950, four times the level of prewar exports. The general view that increased trade would be beneficial to the U.S. economy motivated the establishment of the General Agreement on Tariffs and Trade (GATT) in 1947. GATT member countries mutually agreed to reduce barriers to imports. Two aspects of the situation in U.S. agriculture and farm policy, however, were obstacles to free-trade ideas in agriculture. First, Marshall Plan and subsequent agricultural exports were in large part financed by subsidies paid to exporting companies. Second, U.S. commodity policy held some domestic commodity prices above world levels, so that import restrictions were vital to these policies (otherwise the program would have to support the world price and not just the U.S. price).

Section 22 of the Agricultural Adjustment Act of 1933 required import quotas to be imposed if imports threatened the effectiveness of a price support program. This situation led the United States to join Europe in pressing for a waiver of agricultural products from agreements of GATT members to reduce export subsidies or provide increased import access to their markets. Some experts argued vigorously for changing U.S. farm programs to make them compatible with liberal trade (see D. Gale Johnson 1950, and several papers in Jesness 1949). But U.S. policy did not favor negotiating about agriculture in the GATT until the 1960s. By then European farm policy had decisively taken a protectionist path in agricultural policy that precluded any significant agricultural trade liberalization.

In the Agricultural Trade and Development Act of 1954 (P.L. 480), U.S. policy institutionalized the idea of using food aid to foreign countries as a mechanism for surplus disposal. During 1956–1964 about one-fourth of U.S. agricultural exports were shipped under this program. P.L. 480 exports have varying degrees of concessionary pricing, depending on the status of the importing country, but overall they include a substantial subsidy element. Since the 1970s the program has on average shipped just under $1 billion in commodities annually. In addition, going back to 1935, government-provided export credit and guarantees of repayment to private-sector lenders have been used to stimulate foreign demand for U.S. commodities. Variants of these programs continue to the present, along with grants to commercial enterprises for the purpose of informational and sales efforts abroad.

More explicit export subsidies were also paid through most of the post–World War II period, most notably in wheat, where their role was negotiated under the International Wheat Agreement starting in 1949. In the 1960s more than 85 percent of U.S. wheat exports were assisted by subsidies. During 1968–1971, export subsidies for all agricultural commodities averaged $147 million annually, of which one-half was for wheat exports (Ackerman and Smith 1990).

During the grain price boom of the 1970s export subsidies were no longer needed, and it appeared that the days of commodity surplus might be replaced by commodity scarcity. But the worldwide collapse in commodity prices of the 1980s provided the stimulus for even further expansion of export promotion programs. The European Community intensified its longstanding practice of export subsidies on wheat. The United States reestablished export subsidies in retaliation in the early 1980s, and regularized this approach in the Export Enhancement Program (EEP), placed in law in the Food Security Act of 1985.

The EEP, like the pre-1970s export subsidies, was first and foremost a wheat program. It began as low-price government sales of CCC wheat stocks to North Africa in 1983. The mechanism was complicated, using a payment-in-kind approach. USDA would determine particular countries and commodities for which it believed export subsidies would be helpful in selling U.S. products. Exporters would then negotiate a deal with a foreign buyer at a price discounted from going world trading prices. The exporter would then apply to USDA for a payment sufficient to make up the difference between the market price and the negotiated discount price. USDA, if it approved the sale, would give the exporter sufficient wheat from CCC stocks to cover the payment, called the export "bonus." The exporter could then use the bonus commodity stock in its business or sell it. By the late 1980s the bonuses were adding up to a billion dollars annually, with over 80 percent of EEP commodities accounted for by wheat in 1985–1989. The program was widened and generalized so that CCC wheat stocks could be used to subsidize exports of other commodities, and in 1990, when CCC wheat stocks were exhausted (apart from an international emergency reserve), in-kind bonuses were replaced by cash.

The effectiveness and desirability of U.S. export programs have been challenged throughout their history. One question about the EEP, and other export promotion programs, is how much they really add to shipments (as opposed to just selling products at a lower price that would have been sold anyway). Karen Ackerman and Mark Smith (1990) report estimates of quite low "additionality," the work of economists generally supporting estimates that each ton of EEP wheat exports adds 0.1 to 0.3 ton to added total wheat exports. Such estimates imply that the $800 million spent on wheat EEP subsidies annually in the late 1980s benefited wheat growers by only $120 to $360 million and generated a loss to the U.S. economy overall of $110 to $570 million (B. L. Gardner 1996, p. 321). The main source of the U.S. loss was a transfer from U.S. taxpayers to foreign buyers (often well-connected operators in that country who would then sell at higher going prices to the final consumers in the buying country).

The preceding analysis takes the policies of other countries as given. In reality, the export subsidy policies of the European Community, the United States, and Canada have reacted to one another and, taken together, they substantially exacerbated and prolonged the period of low world grain prices in the 1980s. The United States reacted to EC subsidies in establishing the EEP. Canada met the subsidy competition, where feasible, through the pricing policies of the Canadian Wheat Board, the sole marketing agent for Canada's wheat exports. The EC then had to boost its subsidies further to meet the competition of the United States and Canada. This "export-subsidy arms race" cost the governments involved billions of dollars, harmed farmers in developing countries who had to compete with the subsidized exports, and did little to solve what in the United States became the farm crisis of the 1980s discussed earlier. (See USDA 1986 for a skeptical view of what U.S. policies could accomplish, and the World Bank 1986 for an even more pessimistic global perspective.)

Not only were agricultural exports from developing countries harmed, but so were those of Australia and New Zealand, who followed more nearly free-market policies in grains. General discontent with the international evolution of grain price support policies in the industrial countries ultimately had the effect of making liberalized agricultural trade possible. The context was the Uruguay Round of GATT negotiations, which began in 1986. At the initial urging of the United States and later the "Cairns Group" of fourteen other agricultural exporting countries, an agricultural agreement was finally added to GATT. Under the Uruguay Round Agricultural Agreement, all GATT (since renamed the World Trade Organization) members committed to discipline their trade-distorting activities in four areas: export subsidies, market access, domestic support policies that influence markets, and health- and safety-related regulation of imports. Domestic support policies are included because it is national policies that, by maintaining domestic prices at levels above those prevailing in world trade, underlie both border protection for imported products and export subsidies for exported products.

The agreement went into effect in 1995, but with sufficient looseness in its required disciplines that little actual liberalization was needed before the end of the six-year period it covered. Nevertheless, the agreement changed the atmosphere in which agricultural policy was made around the world, forestalling further increases in protection that might otherwise have occurred, and improved the prospects for long-term U.S. export expansion.

The favorable prospect can be summarized by saying that America has a comparative advantage in agricultural products, and therefore the freer are markets, the better the economic position of U.S. agriculture. But some U.S. commodities were expected to become less profitable with increased foreign competition, namely the ones for which domestic production did not meet demand and were already imported, like sugar and winter season fruits and vegetables. This possibility made liberalized agricultural trade politically difficult to accept in Congress. Nonetheless, in GATT as in the North American Free Trade Agreement (NAFTA) that went into effect in 1994, it was possible to introduce sufficient protections for producers of imported commodities that Congress voted favorably on both agreements (see Orden 1996). USDA estimated that as a result of the Uruguay Round agreement, U.S. agricultural exports would be 3 to 8 percent larger than they would have been with no agreement (Sumner 1995, p. 39). This effect looks small, but a 5 percent export increase amounts to about $3 billion in additional exports in 2000, and according to USDA estimates this increase would translate to an increase in net farm income of over $1 billion (for details see B. L. Gardner 2000a).

Stabilization Policies

One of the least-clear distinctions in agricultural policy discussion is between price support and price stabilization. It is common for statements of legislative intent to refer to the stabilization of prices as a primary reason for a commodity program. A purely stabilizing program, however, would reduce the incidence of both low and high prices, leaving the mean price unchanged. An example of such a program is government stockpiling of grain. Every bushel placed in stocks will have a price-increasing effect that will be offset by a roughly equal price-decreasing effect when that bushel is removed from stocks. The "ever-normal granary" of the Agricultural Marketing Act of 1929 and of the Commodity Credit Corporation in the 1930s was a buffer stock of this kind.

The same price-stabilization ends can be achieved by subsidies to private stockholding, which encourage farmers and merchants to store even more than they otherwise would at low prices. The purest form of this approach was the Farmer-Owned Reserve Program of the late 1970s and 1980s. As with the Export Enhancement Program, "additionality" became an issue. How much stored grain receiving subsidy would have been held in stocks even without subsidy payments?

Storage programs were ultimately unsatisfactory politically because of their inability to raise the average level of farm prices. And the limited stabilization they achieved came at great cost. Because of the unrealistically high prices at which the CCC acquired commodities, the government over and over again found itself with huge stocks that could not be disposed of without depressing already low prices, and too large to have any expectation of eventually selling at future high prices. From the 1930s on this situation prompted a desperate search for foreign markets into which to dump surplus commodities, as well as the more defensible but also more limited exploration of the possibilities for domestic surplus disposal in food assistance programs. The recurring difficulties finally led to a determined effort in the 1980s to get the federal government out of the commodity storage business, as mentioned earlier and shown in Figure 7.2. Moreover, with respect to subsidies of private stockholding, farmers' complaints of the potential future price-depressing effect of stored commodity supplies appear to have been the main reason the Farmer-Owned Reserve was ended in the 1990 Farm Act.

A line of argument going back to the 1930s is that acreage-idling programs should also be viewed as stabilization measures. The government manages the markets by requiring (in set-aside programs) or paying (in voluntary diversion programs) farmers not to plant crops on certain cropland acres in low-price periods, but letting this acreage be planted in high-price periods. Note, however, that the knowledge required to operate such a stabilization program is more demanding than for a commodity storage program. With storage, the government simply holds stocks until a shortage appears, and does not need to forecast in advance which years those will be. In acreage idling, the government has to know before the planting season that a shortage will occur. This can work when the previous year had high prices and signals are strong that high prices will continue, as in 1973 and 1974. But it is too easy for the government to get caught with idled acreage when a drought or export demand surge occurs, as in 1972. And politics can get in the way, as in the fall of 1972 when set-aside requirements were kept in place for planting winter wheat even though it was clear export demand was creating shortages. USDA was widely criticized for this "great food fumble" (Schnittker 1973; Sanderson 1975).

Managerial debates on set-asides took place within the executive branch, typically with USDA on one side, arguing for larger set-asides (referred to as Acreage Reduction Program, or ARP, requirements, after the 1981 Farm Act) in order to maintain higher farm prices, and, on the other side, other Cabinet agencies and sometimes the White House, where consumer interests in lower commodity prices carried some weight. Congressional legislation almost never tied down farm program provisions tightly, leaving plenty of discretionary room for administering programs even when different political parties controlled the Congress and the White House. The latest such debate was in 1995, when 6.1 million acres of wheat and 13 million acres of feed grains were idled in set-asides, only to see a major surge in export demand cause a big price increase after the shortened crop was harvested. There have been no set-asides since, and the 1996 FAIR Act expressly forbids the secretary of agriculture from imposing them.

Private-market means of farm price stabilization are available through futures markets and forward sales. Selling futures provides the farmer with what is effectively a side bet that wins when prices fall (because futures are bought back at the lower price), in precisely the situations when a loss is incurred on the farmer's main bet, in committing resources to grow the commodity without knowing what the price will be. The joint position in futures and the commodity constitutes a hedge. In grains, local elevators make it easy for farmers to undertake hedging by offering farmers a forward price for future delivery of grain (the risk of which the elevator hedges by selling futures at the same time the forward price to the farmer is agreed upon). In vegetables and fruits for processing, canners often offer growers a marketing contract with a price, subject to quality requirements, fixed in advance. In broilers, processors or other businesses often pay growers according to a fee schedule determined in advance. Nonetheless, the fact that most farmers, for most commodities, do not engage in transactions to lock in a price in advance calls into question the real value of pure price stabilization to them.

One reason for the limited value of forward pricing to farmers is the complication caused by output risk. A seller of futures who has less grain to deliver than the quantity sold forward will have to buy back the contracts anyway. And if prices have risen, as is likely when crops are short, the farmer will take a loss on futures contracts for which there is no offsetting gain from the commodity itself. It is in fact possible for producers facing output risks that are highly correlated with overall marketed output to destabilize their revenues with a forward sale. One remedy is to hedge not with futures but with put options, which give their holder the right, but not the responsibility, to sell at a prespecified "strike" price. This provides the farmer with price insurance; but of course this means the farmer must pay a premium for the put option. Premiums on put options for the major crop and livestock commodities are listed every business day in the *Wall Street Journal* and other business media. Farmers typically think, though, that these premia, which tend to be 8 to 10 percent of the market price for strike prices near expected market prices, are too high for the value of the protection they provide.

Farm legislation beginning in 1985 introduced pilot programs that have subsidized the purchase of exchange-traded put options for selected crops. But neither in these pilot programs nor more broadly since 1996 has there been widespread interest among farmers in buying these options. Among the reasons may be the rather rigid specifications of the options—5,000 bushel units (the output of 125 acres of wheat at U.S. average yields) and expiration dates and specifications tied to futures contracts. But probably the main impediment is the perception mentioned earlier that the premium the farmer has to pay is too high. Farmers are averse to risk, but not *that* averse.

Another approach to dealing with farmers' output risks is crop insurance. This risk management tool has a longer and a more reputable pedigree (put options on agricultural commodities were actually banned by federal law between 1936 and 1974). Insurance contracts for Minnesota wheat crops were recorded in 1899, and other private companies marketed varieties of crop insurance products before 1920 (see Gardner and Kramer 1986). Congressional hearings addressed crop insurance issues in 1922, but no program was enacted until the establishment of the Federal Crop Insurance Corporation (FCIC) in the Agricultural Adjustment Act of 1938. Participation rose to 371,000 farms by 1941, but this was low, considering that the insurance was subsidized. The continuation of a substantial excess of indemnity payments above premiums led to the suspension of the program in 1942. After World War II the program resumed on a relatively small and experimental scale, with continued underpricing of the risks assumed by the FCIC.

The Agriculture and Consumer Protection Act of 1973 introduced the Disaster Payments Program. It provided payments for prevented planting as well as for low yields (below 60 percent of normal for grains) of the major grains and cotton. It charged no premiums and was available even in areas so risky that federal crop insurance was not sold. During 1974–1980 a total of $3.4 billion in disaster payments were provided to farmers under this program. It was criticized for encouraging planting on marginal land, where in some counties the expected indemnity payment was equal to 20 percent of the rental value of the land. It was also criticized for paying for avoidable losses. The General Accounting Office found that cotton growers in Texas whose crops were damaged by drifting chemicals from neighbors' fields, and who had legal recourse against them, instead just collected disaster payments. This reduces the incentive to take due care in spraying chemicals. Similarly, wheat acreage planted expanded sharply in the riskiest counties in Colorado and Texas after the Disaster Payments Program was introduced (a 30 percent increase between 1974 and 1978 in these counties, while all U.S. acreage increased 6 percent).[1] These and related problems, such as the encouragement to plant more intensively on environmentally fragile land, led to the demise of this program in 1981.

The Crop Insurance Act of 1980 inaugurated a new push to expand crop insurance that farmers would pay for, and to do so with more private-sector involvement than in the FCIC programs. A series of experiments in insurance offerings continued through the 1980s and 1990s. Under the Federal Crop Insurance Act of 1994, USDA's Risk Management Agency has subsumed the former FCIC responsibilities and operates mainly as a regulatory and support agency for private providers of insurance and for farmers who buy such insurance. The 1994 act increased premium subsidies from about 25 percent of premiums paid to an average of 50 percent. Because of increased sales of insurance, federal outlays for premium subsidies increased even more, from about $250 million to $900 million annually. But the 1994 act also tightened indemnity procedures so that the ratio of indemnities to premiums declined. Still, crop insurance programs paid out $1.77 in indemnities for each $1 received in premiums from farmers during 1995–1998, a sharp contrast to homeowners' or other normal commercial insurance where the buyer pays for risk reduction rather than earning an expected profit. (For the data in this paragraph, and other program details, see Schnepf and Heifner 1999.)

Given that crop insurance is a good deal for so many farmers, it is perhaps surprising that only 65 percent of major field crop acreage was insured in 1998, and the biggest share of that was covered only by the "catastrophic"

1. See U.S. General Accounting Office (1976), Miller and Walter (1977), and Gardner and Kramer (1986) for details of these and other effects of both FCIC and Disaster Payment programs.

coverage that USDA gave away with no premium charge (but a small processing fee). One reason may be that in every year between 1988 and 1994, and again in 1998 and 1999, the federal government has enacted ad hoc disaster relief payments to producers in areas where yields were low. Federal outlays for these payments totaled $4 billion in FY1992–1996 and $1.9 billion in FY1999. As USDA analysts have asked: "Why pay a premium for something that you would likely get for free?" (Schnepf and Heifner 1999, p. 18). In order not to discourage the purchase of insurance, the 1999 disaster bill made payments even to farmers who had their yield losses covered by crop insurance; so these producers could well end up better off with disaster than if they had a normal crop—a sure invitation to moral hazard.

Food Programs

The extent of hunger and malnutrition in the United States has long been a contentious area of investigation. In the 1930s food deprivation was undoubtedly widespread but not well documented statistically. The persistence of a hunger problem during the generally increasing prosperity of the 1950s and 1960s, especially in rural areas of the South, came to be seen as a scandal and in desperate need of a policy solution.

In a program begun, like so many others, as part of the New Deal, Section 32 of the 1935 Farm Act provided for the use by USDA of import tariff receipts for the purpose of buying surplus commodities and distributing them to people in need. This program spent about $40 million annually in 1936–1939 and distributed products to state-level relief agencies and to schools. Schoolchildren were an especially suitable, and politically popular, target for efforts to ensure an adequate diet and nutrition. Under the National School Lunch Act, commodity distribution to schools predominated in food programs starting in World War II.

The school lunch program was expanded to cover school breakfasts in 1967, and by 1971 school feeding programs were spending $600 million annually. But the groundwork for the major expansion of food programs began with the introduction by President John F. Kennedy of a pilot food stamp program in 1961, following up on experiments and legislative proposals that had been discussed since the late 1930s. The idea is to give the recipients of food assistance more options in obtaining products they want rather than having to take what the government determines to be in surplus. This approach was made permanent with the Food Stamp Act of 1964, although direct distribution of surplus food continued. The Temporary Emergency Food Assistance Program (TEFAP) of 1985, for example, was used to dispose of huge government stocks of dairy products, mainly cheese, that had been accumulated in the early 1980s.

Outlays under all the food assistance programs reached $1 billion in 1970. After that their growth became explosive. The Special Supplemental Program for Women, Infants, and Children (WIC) and other nutritional programs, along with food stamps, received a quadrupling of spending in real terms between 1970 and 1980, finally reaching an apparent plateau in the 1990s of about $35 billion annually (in 1992 dollars). The growth of food assistance spending, with spending on farm income support for comparison, is shown in Figure 7.4. As late as the 1960s the federal government spent

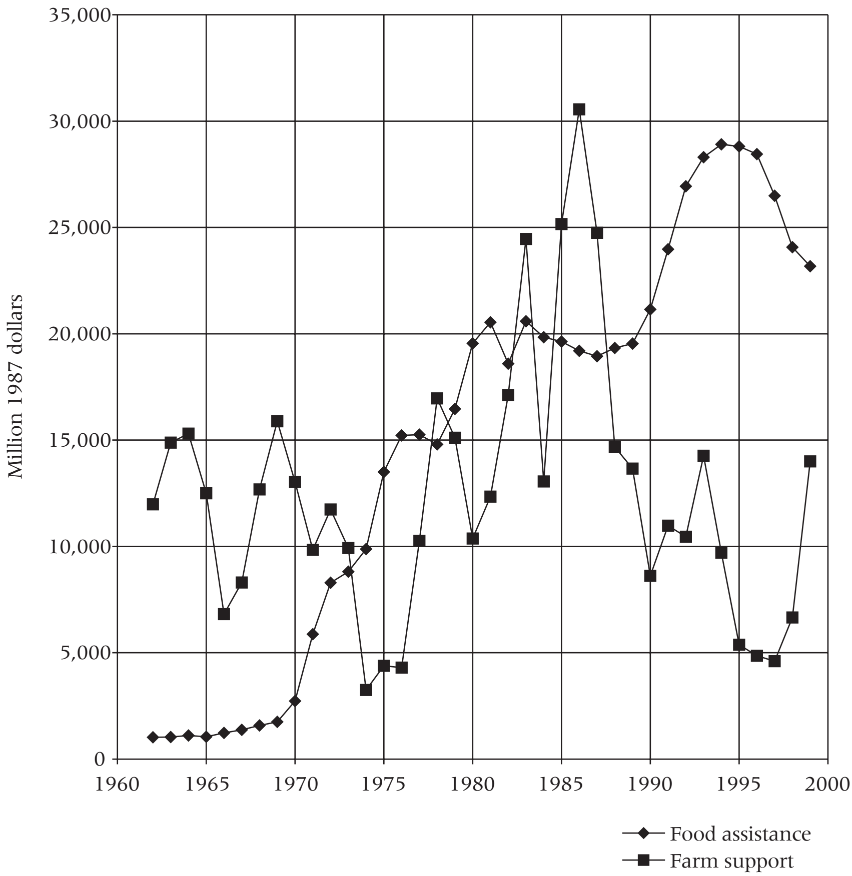

Figure 7.4 Federal farm support and food assistance budgets. Data from U.S. Office of Management and Budget website, <http://w3.access.gpo.gov/usbudget/fy2002>.

three times as much on farm income support as on food assistance. In the 1990s almost three times as much was spent on food assistance as on farm income support, notwithstanding high farm payments and declining food assistance in 1997–1999.

Benefit-Cost Analysis of Farm Programs

All aspects of government action in agriculture have been the object of criticism, but the criticism of commodity programs has been exceptionally strong since their conception. The McNary-Haugen debate in the 1920s by no means ended with the political success of the AAA and its successors in the 1930s and 1940s. Several kinds of critics have produced detailed indictments. Some are economists, bemoaning efficiency losses caused by the programs, for example, D. Gale Johnson (1973), Bruce L. Gardner (1981), and B. Delworth Gardner (1995). Critics from the left include populists regretting that the programs have not been focused on small farms or poor people (Hightower 1973; Strange 1988) and environmentalists unhappy with the consequences they see for soil loss and water quality (Cook 1994; Faeth 1995). And quite severe overall critiques have been launched by ex-politicians and journalists who see the process distorted by special-interest politics (Findley 1968; Bovard 1989).

An analytical task prior to evaluating farm programs is estimating what their effects have been. Estimates are necessary because all we can observe is the situation that exists with the programs. In order to compare this situation with that in the absence of the programs, one needs to specify quantitatively what the programs do. Identifying one component of what they aim to do is easy: they aim to increase farmers' revenues from the commodities they sell. The increase is easiest to estimate in the case of tariff protection of U.S. producers who compete with imports from abroad.

SUGAR POLICY

A notable example is sugar, upon which import tariffs have been levied since colonial times (but for purposes of raising revenue, not protecting domestic producers, since no U.S. sugar crops were produced in that period). The processing of sugar from beets began to expand substantially in the 1890s, and by 1915 the United States was producing over 2 million tons of sugar annually (including Hawaii and Puerto Rico). Domestically produced sugar still counted for less than half of U.S. sugar consumption, however, the rest being imported. From the first decade of the twentieth century the tariff on sugar averaged about 2 cents per pound. As the world price fell after World War I, this levy became large in percentage terms. By 1920 the world price (New York basis) averaged 1.5 cents per pound, so the duty-paid price of 3.4 cents meant the tariff rate was over 100 percent (see Ballinger 1978). Prices fell still further in 1931 and 1932 as the Depression deepened, and as in so many other areas, sugar policy came to be seen as hopelessly inadequate to the task of farm income support, complicated in the case of sugar because imports came from places whose economies were also an object of U.S. support, like Cuba and the Philippines.

The heart of the New Deal sugar program, as operated almost continuously from 1934 to the present, has been a moderate tariff together with import quotas calibrated to boost the U.S. price of sugar to a legislated support level. There have also been U.S. domestic production quotas, by region. The policy amounted to a government-operated cartel that divided up the U.S. sugar market among domestic and foreign producers. After a brief period of high world prices in which Congress allowed the Sugar Act to expire in 1974, the program was reincarnated in 1977 by the Carter administration (and subsequently legislated in the Agriculture and Food Act of 1977) in the form of a support price based on CCC loans and storage, as grains and cotton already had. But as imports began to raise the costs of price supports, the Reagan administration in 1982 re-instituted import quotas. This returned the basic price-setting approach to the pre-1974 mechanism of calibrating the quantity of imports allowed so as to achieve the support price.

In 1999 and 2000 the support level held the U.S. domestic price at about 21 cents per pound of raw sugar, while the corresponding world price of sugar was about 7 cents per pound. Over the past seventy-five years the rate of protection has varied with world market conditions. It has averaged roughly 100 percent; that is, the U.S. price has been approximately double the world price.

What are producers' gains from such price increases? The immediate effect of a higher price is to increase farmers' revenues by the same percentage as the price rises. But when a price support is in effect for a sustained period, and thus is anticipated when producers plant their crops, acreage and other input use will increase in response to the expectation of higher returns. How large the increase will be depends on the elasticity of supply response to higher returns (and to greater certainty of returns) that result from the program. U.S. annual sugar production increased from just over a million tons in the mid-1930s to 5 million tons (about half of U.S. consumption) in the 1970s, and to 9 million tons in 1999 and 2000.

By the mid-1980s, U.S. domestic sugar amounted to five-sixths of consumption and left room for only about 1½ million tons of imports. The trend pointed to an achievement of self-sufficiency in sugar (as indeed occurred under the even higher price guarantees of Europe), but long-standing interest in allowing access to favored foreign-country suppliers, and the interests of U.S. sugar refiners based at port locations, prevailed upon Congress to take steps to ensure that at least 1¼ million tons of imported raw sugar would be permitted annually. This assurance was achieved in the 1990 Farm Act by a requirement that if USDA projected imports of less than 1¼ million tons, then production controls would be imposed upon U.S. growers to an extent sufficient to leave room for 1¼ million tons of imports (see Lord 1995).

The United States is a sufficiently large factor in the world sugar market that its imports influence the world price. So if the sugar programs were to end and sugar imports increased, this would increase the world price. Therefore, farmers would not lose as much as the price difference that exists under the program implies. S. V. Marks (1993) estimated that the world price would have increased about 20 percent (one cent per pound) under the conditions of 1984–1989 with no program, and that net gains to sugar cane and beet producers from the program (net losses were the program to end) were $1.2 billion annually. D. Gale Johnson (1973) estimated much lower producer benefits for the sugar program of the 1960s. Two recent detailed studies estimate benefits to sugar producers at $437 million annually in the economic situation of the early 1990s (Haley 1998) and $1,065 million in 1999 (U.S. General Accounting Office 2000), about $100,000 per grower.

Who is paying for these benefits? Taxpayers are the source of funds for the great bulk of the government activity that this chapter has discussed, but not for the sugar program. The source of producer gains in sugar is higher market prices paid by consumers. The cost to consumers is the difference between the U.S. price that the sugar program generates and the price that would prevail if sugar imports were not restricted. This latter price is determined by the world price of sugar—basically the price at foreign export ports plus transportation costs. And since the world price is volatile, ranging between 6 and 12 cents per pound in recent years, the cost to consumers varies substantially from year to year. This cost is measured by consumers' surplus, calculated analogously to producers' surplus as the price difference multiplied by the average of the quantity consumed at the supported price and the estimated quantity consumed at the no-program price. Marks (1993) estimates this consumer cost for 1984–1989 at $2.8 billion annually, and other estimates for the last twenty years are between $2.0 and $3.5 billion.

A complicating factor is that the sugar program has provided a price umbrella under which the corn sweetener industry could flourish. High-fructose corn syrup accounted for only 2 percent of U.S. caloric sweetener consumption in 1973, but by 1987 this had increased to 36 percent. The use of corn in sweeteners has grown enough to affect the price of corn and hence provide benefits to corn growers. Marks (1993) estimates the gains due to corn growers and processors together at $0.9 billion annually in 1984–1989. The corresponding increased costs to consumers of corn sweeteners are included in his consumer cost estimate cited above. But a study of the General Accounting Office (2000) estimates that the sugar and corn sweetener markets had become so segmented by the late 1990s that corn benefits from the sugar programs are negligible.

Foreign exporters of sugar who have access to the U.S. market are major beneficiaries of the sugar program. Economists have long argued that rights of access to the U.S. market, if they are to be limited, should be sold to the highest bidder. Or, if given away, they should be given to U.S. importers rather than to foreign exporters. Nonetheless, from their inception in the 1930s sugar import quotas have been distributed to exporting countries, mainly in pursuit of foreign policy goals. Thus sugar quotas were a reward to former colonies and a form of payment for allowing a U.S. military presence, as in the Philippines. A major change in the Sugar Act of 1948 was to mandate preferential access to the U.S. market to Cuba; in 1960 imports from Cuba were banned in order to smite Fidel Castro. In the 1980s sugar quotas were reallocated to Caribbean nations as part of the Reagan administration's Caribbean Basin Initiative. The value of sugar import quota rights is far from trivial. The opportunity to sell in the United States at 21 cents per pound as compared with 7 cents per pound in the world market amounts to $300 per metric ton. Under market conditions of 1999, GAO (2000) estimates this gain to foreign suppliers at $362 million.

Estimating the various gains and losses generated is the main task in the benefit-cost analysis of the sugar program. The final step is to add them up to obtain the deadweight loss of the program, a measure of its net costs to the nation. The principal economic criticism of the sugar program and other farm programs is that their deadweight losses are too large, in the sense that if it is desired to transfer $1.1 billion to sugar and corn sweetener producers, there must be a way to do so that costs less than the $1.7 billion the program costs sugar buyers, using the GAO (2000) estimates.

GRAINS

Price support policy for grains is central in much historical debate and action. From their inception in 1933, the wheat and corn programs involved government officials with the details of what happened on each individual farm. Acreage and marketing controls required farmers to file intentions and plans for carrying them out, and made farmers subject to subsequent monitoring and enforcement. A farmer who was required to idle, for example, 15 percent of the farm's wheat base acreage had to declare at a county USDA office where that acreage was located on the farm, and to permit inspection of the site by USDA officials to confirm that the acreage indeed was idled. Compliance with regulations was further complicated by year-to-year changes in the programs and variations from county to county in the attention paid to and rigor of enforcement of regulations. The CCC nonrecourse loan program paid farmers according to the amount they sold or stored on their farms. An elevator receipt could verify quantities sold. But quantities stored on the farm could be verified only by on-site inspection. And the bin or crib had to be "sealed" by USDA to ensure the grain stayed in storage during the period in which the loan was held. Moreover, the storage space had to meet standards of adequacy.

Monitoring and enforcement are necessary because farmers have an incentive to violate some program provisions. Idling an acre costs the farmer the returns from that land if it were in production, essentially the rental value of the land. So the farmer has an incentive to idle the least productive acres in the crop acreage base (which is legal) or to plant on acreage that was supposed to be idled (which is not). And when prices are sufficiently high, there is an incentive to expand production on other acreage outside the program, which is also typically illegal. When payment limitations were introduced, there was an incentive to subdivide the farm, at least among the farmer's family members, so as to qualify for more than one payment.

Starting in 1985, "conservation compliance" and other environmental restrictions were imposed that increased farmers' costs and that therefore required monitoring and penalties. In the congressional hearings for the 1990 farm bill, for example, farmers brought complaints about minor violations of wetlands provisions resulting in the loss of thousands of dollars in program payments. Acreage-idling requirements, which persisted until 1996, as well as other land-use regulations to a much lesser extent, impose substantial costs upon farmers, and this reduces the benefit/cost ratio of the programs. In the mid-1980s about 30 million acres were idled under the grain programs (not counting paid acreage idling in conservation programs). At an average rental rate of $50 per acre, the cost of idling this acreage is $1.5 billion annually.

OTHER COMMODITIES

Peanuts and tobacco are unique in remaining to the end of the century under production controls similar to those introduced in the 1930s, but refined to give more exact control of quantities marketed. The tobacco program until the 1960s relied primarily on acreage allotments. But farmers responded by increasing output per acre so much that production control was lost. Since then, growers' sales have been regulated through a marketing quota allocated to each producer, based on the farm's history of sales when quotas were first issued, in 1965 for flue-cured tobacco (from the Southeast) and since 1971 for burley tobacco (mainly from Kentucky and Tennessee). Because tobacco leaf has few buyers, who buy for a few weeks each year at a limited number of auction locations, monitoring of farmers' sales is relatively easy. The aggregate U.S. quantity of marketing quotas for flue-cured and burley tobacco is set annually at a level estimated by USDA to clear the market at or above the support price level established by law. If the supply-demand situation at any auction turns out to be such that prices would be below the support level, a Stabilization Corporation under arrangement with USDA buys tobacco at the support level and stores it until it can be sold at a higher price (which can be achieved by reducing marketing quotas in the years after stocks have been built up).

The tobacco program has taken on a different aura as it has become accepted that smoking is a serious health hazard. In the 1980s, when the Senate Agriculture Committee was chaired by Senator Jesse Helms of North Carolina, the chief flue-cured tobacco growing state, the tobacco program was shielded from political risks by removing it from the omnibus (multi-program) farm legislative schedule and requiring it to have no net cost to taxpayers. This was acceptable to grower interests because the main price support measure is production control, which drives up consumer prices but requires no government payments. This approach by its nature reduces tobacco availability and makes tobacco products more costly, and so is congruent with antismoking measures—essentially the program is a tax on tobacco that is remitted to growers. Nonetheless, as explicit taxes on cigarettes rose in the 1980s and 1990s and the partial settlement of a landmark legal case against cigarette manufacturers led them to raise prices even further, the quantity of tobacco sold fell significantly. Immediately upon the announcement of the tobacco settlement, in November 1998, the main manufacturers announced a price increase of 45 cents per pack. The consumer price index for cigarettes increased 12 percent in 1998 and 32 percent in 1999, while overall consumer prices were rising only 2 percent each year (see Capehart 2000). Program provisions have largely maintained the farm price of tobacco, but sales fell 20 percent between 1998 and 1999, substantially reducing benefits accruing to the owners of tobacco quota.

Peanuts has a program structurally similar to that of tobacco, but with further complications in that growers can sell "additional" peanuts outside the quota system for export, at lower prices. The other major southern commodity is cotton, which formerly had an acreage control program, but in the 1970s moved to a deficiency payment program similar to that of the grains. Cotton policy has been further complicated by the involvement of gins and other cotton marketing and export businesses, many of them farmer-owned cooperatives. One of the first program initiatives of the twenty-first century was a special program "to pay cotton farmers and ginners about $74 million to help offset losses from low 1999-crop cottonseed prices" (USDA 2000).

Livestock products have not had the sustained programs that characterize the main crops, with the major exception of milk. The marketing order system for milk was discussed in Chapter 6. In addition to that complicated set of regulations, dating to the 1930s, the Agricultural Act of 1949 established a dairy price support system. The perishable nature of milk precludes the use of the farm-level CCC loan and storage approach that has characterized price support policy for the major field crops. Instead, Congress legislated a support price level for milk used in manufacturing, which is attained by CCC purchase and storage of butter, powdered milk, and cheese. USDA determines a set of minimum prices for these products that will generate the legislated support price level for raw milk. Prices for other manufactured products, like ice cream, are permitted to find their own level. But makers of these products cannot attract farmers' milk if they pay less for it than manufacturers of the supported products do.

Dairy price supports through the 1960s performed a stabilizing role more successfully than grain policies did. CCC stocks were acquired during the "flush" season of peak milk production in the spring and placed on the market later in the year. Year-end stocks became large in periods of economic slowdown in 1953–54 and 1960–61 (Figure 7.5) but were soon worked down to low levels. The situation changed in the 1970s. A combination of inflationary expectations and intensified political activism by large dairy cooperatives resulted in an increase in the milk support price from $5 per hundredweight in 1973 to $13 in 1980, amounting to an increase of about 50 percent in real terms (as also shown in Figure 7.5). Milk production grew much faster than consumption in response to these prices, and CCC stocks of butter, cheese, and powdered milk reached their highest levels in the early 1980s. Between 1980 and 1986, about 10 percent of all the milk that farmers sold went into CCC stocks of these products.

In 1983 and again in 1985, milk supply management programs were introduced. These were voluntary programs in which producers were paid to undertake steps to reduce supplies, as opposed to set-asides, where farmers were required to idle acreage in order to qualify for price support benefits. In 1983 farmers could contract to ship less milk than in the previous year,

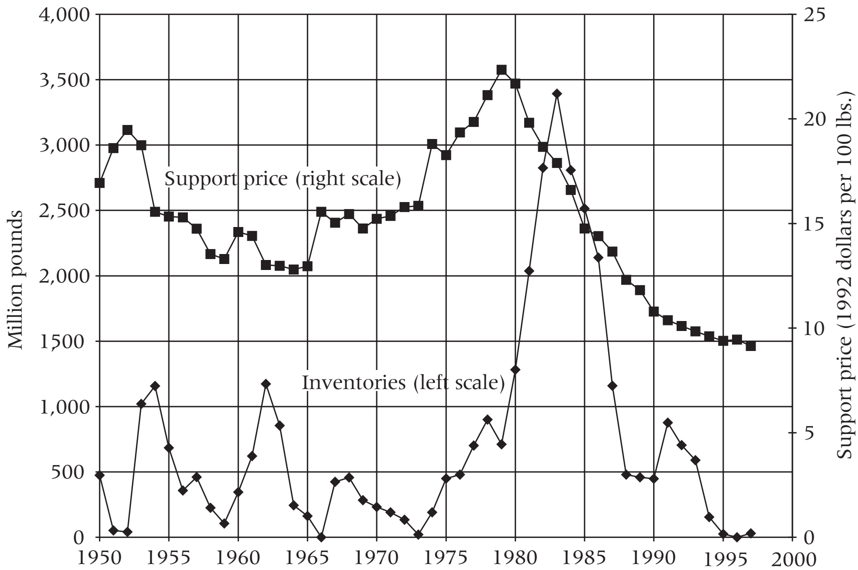

Figure 7.5 Commodity Credit Corporation dairy product inventories and milk support price. Data from U.S. Department of Agriculture, *Agricultural Statistics,* various years. Sum of butter, cheese, and nonfat dry milk owned by CCC on December 31 of each year, by weight, not value.

but this had little effect on aggregate production. The participants tended to be producers who were going to ship less milk anyway. The 1985 program was larger in scale, a "whole-herd buyout," in which producers could bid to have their cows bought by USDA for slaughter, and agreed to stay out of dairy production for five years. More important in the longer term, however, were continued reductions in the milk support price, and commodity distribution programs that disposed of CCC stocks domestically, mostly by giving them away to local food programs and directly, for example, to senior citizens. By the end of the 1980s, CCC stocks had returned to the more purely stabilizing pattern of the 1950s and 1960s.

A low CCC support price of $9.90 per 100 pounds of milk and other dairy support mechanisms remained in place at the beginning of the twenty-first century. The marketing order system continues, USDA continues to buy and distribute dairy products for food and nutrition programs, dairy product import quotas remain in place, the Dairy Export Incentive Program provides export subsidies, and milk promotion legislation continues to authorize a producer contribution program that funds advertising of dairy products (notably the ubiquitous "milk mustache" ads in many national magazines).

In order to estimate the effects of the programs taken together, one needs detailed calculations for all commodity programs like those given earlier for sugar. Few analysts have been brazen enough to attempt such estimates, but the data shown in Table 7.1 summarize one such attempt.

The central point for criticism of farm programs as wasteful is the presumption that market prices in the absence of government intervention are efficient in the sense that they result in producer and consumer decisions that maximize welfare, with welfare defined as the sum of benefits that go to consumers, producers, and all others with economic interests at stake. At the output levels that result from free-market prices, the marginal benefit derived by consuming farm products just equals the marginal cost of producing them (and both equal the free-market price). Departures from the market-driven output necessarily reduce welfare. Governmental attempts to support prices above market-clearing levels therefore reduce welfare to the extent that they cause output to depart from those levels. The net welfare loss to all citizens (sum of gains and losses to consumers, taxpayers, producers, and others who might be affected) is the deadweight loss of market intervention, which quantifies the economic critique. In the estimates of gains and losses from the commodity programs of Table 7.1, producers gain \$17.5 billion at the cost of \$17.7 billion from taxpayers and \$4.8 billion from consumers, in the form of higher commodity prices. The sum is an economywide loss of \$5 billion.

The economic critique is not directed at income redistribution toward farmers per se. If farm income could be supported without distorting production or consumption, or otherwise using up the productive resources of the economy, deadweight losses would be zero and the economic critique

Table 7.1 Gains to producers, consumers, and taxpayers from commodity programs (billions of dollars, 1987 fiscal year)

Commodity	Producers	Consumers	Taxpayers
Feed grains	8.9	0	−10.3
Wheat	2.4	0	−3.7
Rice	0.5	0	−0.6
Cotton	0.9	0	−1.5
Sugar	2.7	−3.1	0
Milk	1.3	−1.2	−1.4
Tobacco, peanuts, and wool	0.8	−0.5	−0.2
Column totals	17.5	−4.8	−17.7
Grand total −5.0			

Source: B. L. Gardner (1990), p. 52.

becomes null. This objective came closer to being achieved in the FAIR Act of 1996.

Economists who reject the deadweight-loss critique argue that "free-market" prices that maximize welfare as just defined would not prevail in the absence of government policies. Reasons include monopoly power and other imperfections of competition, unpriced external costs and benefits of agricultural production (for example, the cost of water pollution from agricultural chemicals and the benefit of pastoral scenery enjoyable by everyone), and incomplete markets, notably for credit and for risk-management tools. George Brandow (1977, pp. 271–274) discusses other reasons why many agricultural economists have been uncomfortable with the deadweight-loss critique, and why farm programs may be a socially beneficial set of policies—or at least were during some periods.

Unstable prices have called for a governmental response, and other market failures (imperfect competition, environmental externalities) unquestionably exist. The question is what they imply in practice, particularly for commodity support programs. The government has to have the knowledge, managerial capacity, and ability to make appropriate economic decisions in the areas where the market fails. This is a tall order.

Benefit-cost analyses can never be airtight, but the accumulation of quantitative and case-study evidence over the past fifty years has been sufficient to change the prevailing opinions of economists. The type of observation that cuts ice in opinion making is, for example, that the U.S. government "subsidizes irrigation and land clearing projects and then pays farmers not to use the land for growing crops" (World Bank 1986). Broader opinion, that is, opinion beyond that of economists, appears equally swayed by evidence that farm commodity programs do little to help the lowest-income farm people. Evidence on income distributional effects was strongly placed on the agenda during the 1960s when several detailed studies quantified findings that the programs were quite ineffective in reducing poverty and were perhaps even regressive (see Bonnen 1968). This view gained widened credibility until by the 1990s it was commonplace to refer to the programs as "Welfare for Millionaire Farmers" (*Wall Street Journal,* May 22, 1990). When the 1995 farm bill debate finally took what looked to be substantive steps, as the *Washington Post* put it, "to phase out the absurd system of crop subsidies" (March 1995), the prevailing expressed views of agricultural economists as well as editorial opinion in the national media backed reform and supported the idea of a phaseout.[2] Why then has it not occurred?

2. For a sampling of economists' opinions, see articles in *Choices,* notably Tweeten (1995).

Farm Politics

Farmers fared well politically as an interest group throughout the twentieth century. Table 7.2 lists significant agricultural legislation, most of it aimed at improving the economic position of farmers. Farmers' political clout is not difficult to explain under the conditions of the 1920s and 1930s, when they were numerous and economically in bad straits compared with the nonfarm population. That influence is harder to explain now that farmers are few and relatively well off. In terms of political representation, the decline of farmers' importance is even more striking than population shares would suggest. John Mark Hansen estimated farm representation in the House of Representatives in 1930 at 55 percent of all districts, with a farming district defined as one in which 20 percent of the population lived on farms. By 1980, representation by this criterion had declined to less than 1 percent of House districts (Hansen 1991, p. 167).

The explanation of political outcomes is a slippery area of inquiry. Often the reasons for the passage of a bill, for example, seem obvious once the bill has passed; but forecasting future congressional action is surpassingly difficult. Even assessing the state of political forces is fraught with pitfalls. The authors of a recent U.S. history text say of post–World War II politics: "Farmers, once a major force in political life, no longer wielded much clout except in the United States Senate" (Henretta et al. 1987, p. 837). Yet in the House as well as the Senate, even in the 1990s, farmers were successful in every major political test they faced. The debate on the 1990 farm bill was particularly telling. A coalition of urban Democrats and conservative Republicans made a concerted effort on the floor of the House to defeat the farm bill reported by the Agriculture Committee, using a series of amendments that began with the seemingly most politically vulnerable parts of the bill, such as the sugar and wool provisions that hit consumers and taxpayers hardest for the benefit of the fewest farmers. The reformers started with an amendment to deny farm program benefits to nonfarm beneficiaries who had more than $100,000 in off-farm income, such as doctors or lawyers who had invested in a farm. This would affect very few members of farm lobbying groups, and it was a populist gesture of the kind that often has appeal in the House. But farm interests argued that the success of this amendment might embolden opponents of commodity programs to take action at a later date that would hit the pocketbooks of rank-and-file farmers. The amendment failed. That signaled the defeat of the whole reform agenda.

The twentieth century's last demonstrations of farmers' undiminished clout in both congressional and presidential politics occurred in the positioning for the 2000 elections. In the face of unexpectedly low farm-com-

Table 7.2 Selected federal legislation related to agriculture

1902	Newlands Reclamation Act	Irrigation subsidies (160-acre limit)
1902	Oleo tax	Federal tax on oleomargarine
1906	Pure Food and Drugs Act	Regulated product quality
1906	Meat Inspection Act	Mandated carcass inspection
1910	Federal Insecticide Act	Product quality control
1912	Apple Standards Act	Regulated apples sold in barrels
1914	Smith-Lever Act	Agricultural extension service
1914	Cotton Futures Act	Regulation of cotton futures sales
1916	Federal Farm Loan Act	Created Federal Land Banks
1916	Rural Post Roads Act	Federal role in rural highways
1916	Agricultural Appropriations Act	Established USDA market news
1916	Grain Standards Act	Federal grain grading (voluntary)
1916	U.S. Warehouse Act	Licensing for warehouses, receipts as loan collateral
1916	Food and Fuel Control Act	Industrial policy measures
1917	Smith-Hughes Vocational Educ. Act	Agric.education in high schools
1921	Grain Futures Act	Regulation of grain futures
1921	Packers and Stockyards Act	Regulated packers
1922	Commodity Exchange Act	Regulation of commodity markets
1922	Capper-Volstead Act	Exempts cooperatives from antitrust
1923	Intermediate Credit Act	Created Intermediate Credit Banks
1923	Filled Milk Act	Prohibited nondairy fats in milk
1929	Agricultural Marketing Act	Created Federal Farm Board to stabilize commodity prices
1930	Perishable Agricultural Commodities Act	Regulated buyers, sellers, and shippers
1930	Smoot-Hawley Tariff Act	Raised agricultural tariffs
1933	Agricultural Adjustment Act (AAA)	Supply-control measures, payments
1933	Farm Credit Act	Created production credit associations
1933	Tennessee Valley Act	Rural development program
1933	Commodity Credit Corporation	Market price support via CCC loans
1934	Jones-Costigan Sugar Act	Sugar production and import regs.
1934	Jones-Connally Act	Expanded commodity scope of AAA
1934	Taylor Grazing Act	Regulation of grazing on federal land
1934	Kerr-Smith Tobacco Control Act	Regulation of tobacco growers
1934	Bankhead Cotton Control Act	Regulation of cotton growers
1934	Reciprocal Trade Agreements Act	Opening toward trade liberalization
1935	AAA Amendments	Authorized open-ended commodity purchases and import quotas on program crops
1935	Resettlement Administration	Assistance to rural residents
1936	Commodity Exchange Act	Regulated futures markets, outlawed commodity options
1936	Soil Conservation and Domestic Allotment Act	Reformulated supply controls after Supreme Court invalidated 1933 act
1936	Rural Electrification Act	Subsidies for rural electricity

Table 7.2 (continued)

1937	Agricultural Marketing Agreement Act	Created federal marketing orders
1938	Agricultural Adjustment Act	Strengthened supply-control powers, established federal crop insurance
1939	Federal Seed Act	Regulated labeling and imports of seeds
1941	Steagall Amendment	85% of parity price supports
1942	Stabilization Act	Agric. exemptions from price ceilings
1944	Flood Control Act	Army Corps of Engineers in drainage
1946	National School Lunch Act	Cash lunch program grants to states
1947	Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)	Pesticide quality regulation
1948	Agricultural Act	90% of parity price supports until 1950
1948	Sugar Act	Sugar import quotas
1948	Foreign Assistance Act	Subsidized food exports
1949	Agricultural Act	Tied price supports to output controls
1954	Agricultural Trade Development and Assistance Act (P.L. 480)	Food aid program for surplus products
1954	National Wool Act	Payments to wool producers
1954	Watershed Protection Act	USDA involvement in drainage
1956	Agricultural Act	Created Soil Bank (acreage retirement)
1957	Poultry Inspection Act	Expanded meat inspection
1961	Emergency Food Grain Program	Voluntary paid acreage reduction
1962	Food and Agriculture Act	Introduced payments to offset lower market price supports
1964	Food Stamp Act	Expanded food assistance for the poor
1964	Meat Import Quota Act	Established import controls for beef
1964	Food and Agriculture Act	Voluntary acreage diversions
1966	Fair Labor Standards Act	Agricultural minimum wage law
1970	Plant Variety Protection Act	Established property rights in seed varieties
1970	Agricultural Act	Introduced annual acreage set-asides, $55,000 payment limitation
1971	Farm Credit Act	Farm Credit System reform
1972	Clean Water Act	Restrictions on draining wetlands
1972	Rural Development Act	Wide-ranging subsidized loans and grants
1972	FIFRA Amendments	Pesticide regulatory authority to EPA
1972	Water Pollution Control Act	Regulatory authority taken from states
1973	Endangered Species Act	Restrictions on farming made possible
1973	Agriculture and Consumer Protection	Target price system, disaster payments
1974	Emergency Livestock Credit Act	Federal guarantee of commercial loans
1975	Rice Production Act	Established rice deficiency payments
1975	Commodity Futures Act	New regulatory regime for futures and options
1977	Agriculture and Food Act (with 1978 amendments)	Farmer-owned reserve, raised target prices
1978	Emergency Assistance Act	Moratorium on FmHA foreclosures

Table 7.2 (continued)

1978	Agricultural Credit Act	Economic Emergency Loans introduced
1978	Public Rangelands Improvement Act	Formula for grazing fees
1978	Fair Labor Standards Act	Farm and nonfarm minimum wages equal
1980	Federal Crop Insurance Act	Reformed and expanded crop insurance
1981	Agriculture and Food Act	High target prices, cut milk support price
1983	Migrant Agricultural Worker Act	Regulation of pay and working conditions
1985	Food Security Act	Export subsidies, Conservation Reserve Program, conservation requirements
1986	Family Farm Bankruptcy Act	Farmer-friendly "Chapter 12" provisions
1986	Immigration Reform and Control Act	Employers must verify worker status
1987	Farm Credit Act	Reforms of Farm Credit System
1988	FIFRA Amendments	Enhanced EPA powers to ban pesticides, protect farm workers from exposure
1990	Food, Agriculture, Conservation and Trade Act and Budget Act	Decoupling and budget cuts in commodity programs, organic food certification; guaranteed private-sector loans replaced direct government loans
1993	NAFTA ratification	Liberalized some trade
1994	Crop Insurance Reform Act	Expansion of coverage, increased subsidies, provision through private insurance companies
1994	WTO ratification	U.S. participation in liberalized global agriculture trade
1995	Plant Variety Protection Act	Strengthened seed companies' property rights
1996	Food Quality Protection Act	Reform of food safety regulation
1996	Agricultural Market Transition Act (AMTA) title of FAIR Act	Replaced deficiency payments with fixed payments, ended set-asides
1998	Supplemental Appropriations Act	Market Loss Assistance Payments
1999	Agricultural Appropriations Act	Doubled AMTA payments, overrode milk market order reform
2000	Risk Protection Act and Agricultural Appropriations Act	Added payments for oilseeds, apples, peanuts, tobacco, wool, mohair, cottonseed, grazed grain, and cranberries; increased crop insurance subsidies

modity prices the Senate, without hearings or a committee report, voted $7.4 billion in emergency assistance to farmers in 1999, including a doubling of their FAIR Act payments. President Clinton criticized this sum as being too little, and the House voted more. Then in 2000, Congress appropriated an even larger amount of emergency assistance. No hint of criticism was heard from the candidates jockeying for position in the 2000 presidential race, from Pat Buchanan on the right to Bill Bradley on the left. A related high point of farmers' clout was the announced support for continued subsidies for fuel ethanol made from corn by Vice President Al Gore, by his only viable Democratic rival Bill Bradley (who had as senator from New Jersey opposed these subsidies), and by the emerging Republican favorite George W. Bush (who as governor of Texas might have been sympathetic to the oil industry position as the most powerful opponent of ethanol subsidies).

One reason farmers have fared well politically is that they have had articulate, insistent, well-organized, and usually unified voices speaking on their behalf; that is, they have been and have employed effective lobbyists. This achievement has been facilitated by the existence of voluntary organizations of farmers. From the beginning of the century many of these have been highly effective.

A second reason farmers have fared well politically is their argument that they are faring badly economically, exploited by middlemen with market power, and misunderstood by an increasingly urban society. As the farm income data indicate, farmers as a group indeed fared badly for a large part of the twentieth century, especially in most of the years between 1920 and 1960. But not today.

A "structural" view of farmers' political power focuses on a "golden triangle" of members of the committees that authorize legislation and appropriate funds, the executive branch department that administers the programs (USDA), and lobbyists representing farm interests. Cotton programs are an example: typically the members of this triangular configuration essentially write the law, and Congress approves and the president signs it with no substantial debate. The evolution of the golden triangle is a key mechanism of the "sclerotic" view of democratic politics in which an accumulation of special interest legislation comes eventually to silt up the economic stream of the regulated economy (see especially Olson 1982). One relevant fact from the initial days of these programs is that Franklin D. Roosevelt essentially turned over farm policy to the interest groups even before he took office. Gertrude Slichter (1956) narrates in detail how in seeking the Democratic nomination in 1932, FDR spent considerable effort with his advisors on a plan for agriculture, about which "his only requirement was that the farm interests must agree on a plan before the candidate would accept it" (p. 248).

Some commodities have been much more successful politically than others. Why doesn't the triangle theory apply equally to them all? One factor that might make a difference is whether a commodity is produced in a large number of states (cattle, corn, hay) or is concentrated in a few districts (tobacco, cotton, oranges). But commodities of both types have been politically successful. Dairy is cited as doing well because every state has milk producers, and cotton because it has states where "cotton is king" in the rural economy. Yet some widespread commodities get little political help (beef cattle, hay), and neither do some localized ones (vegetables and fruits). The impotent localized ones suggest a related criterion: a commodity has to have a large enough dollar value to be economically significant to at least a few districts.

The political mobilization of interest groups seeking a fixed pot of government resources is largely a competition of persuasion and consensus seeking. A more hard-boiled view of events in twentieth-century agriculture takes as fundamental the adversarial nature of economic policy. It is a perspective only sparsely represented among agricultural economists but more common in rural sociology. The idea is that in seeking explanations of policies one should look first to the interests of the dominant economic class, which in agriculture as elsewhere in the economy consists of the owners of capital. The interests of industrial capital in agriculture may be taken as the provision of cheap raw materials for food, to the advantage both of agribusiness in domestic food production and international trade and of businesses throughout the economy who then face less pressure to raise wages. These business interests are roughly the same as those under attack in the rural populist view that has traditionally been strong among some groups of farmers, especially in the Great Plains and the South. In addition, the interests of capital are identified with large farms, paradigmatically corporate farms but also the largest category of individual proprietorships.

In explaining the transformation of U.S. agriculture according to this left-populist view, the key facts involve changes in the interests of capital and the policies necessary to further these interests. Thus A. Eugene Havens (1986) states: "The effect of the AAA was to permit the state to manage the fundamental contradictions of competitive capitalism—increasing production during an overproduction crisis" (p. 35). Proponents of the idea that agribusiness interests dominate the agricultural and food economy, to the detriment of both farm people and the general public, have published a steady stream of articles and books throughout the century. Since World War II the focus has shifted to farm labor and environmental issues and, most recently, biotechnology and the dangers of food (see, for example, Hightower 1973; N. Fox 1997; and Schlosser 2001). The common thread is that corporate agribusiness is the enemy of us all, and its power must be checked.

In this context, perhaps most surprising in the debate on agricultural policies is a marked decline of economic adversarial politics over the last hundred years. Railroad regulation and the series of antitrust laws before World War I, food regulatory laws and marketing regulations of 1900–1916, antifutures and procooperative laws of the 1920s, were all aimed at cutting down to size powerful interests seen to be at odds with farmers or consumers. The Commission of Agricultural Inquiry report mentioned earlier (U.S. Congress 1921), whose antibusiness findings were popularized in the press and elsewhere, was near the center of policy debate in the 1920s and 1930s. But recent assessments of and remedies proposed for farmers' problems that have been taken seriously by policymakers have not attacked the power of agribusiness. The National Commission on Food and Fiber, established by President Johnson in 1965, was an excellent opportunity for people skeptical of agribusiness and the market to place their views on the policy agenda. But this did not happen. The commission recommended better opportunities for rural people, social investment in rural areas, equal protection for rural workers, foreign food aid, and the promotion of agricultural exports, but did not address improving farmers' bargaining power or diminishing the market power of agribusiness—indeed the summary of recommendations opens with a call for market orientation (National Commission on Food and Fiber 1967, pp. 15–42). In seeking to understand this outcome it is natural to look at the makeup of the commission. It did have eight representatives of agribusiness and banks, but twenty-one others were farmers, academics, and representatives of cooperatives, labor unions, and labor and civil rights groups. And among the farmers a representative of the relatively radical Farmers Union was included while the larger and more conservative (and more Republican) American Farm Bureau Federation was conspicuously absent.

During the Clinton administration two commissions undertook lengthy examinations of agriculture's economic problems. Their findings encompassed the range of mainstream opinion on these matters at the end of the century. The first, the National Commission on Small Farms, consisted of thirty farmers, staff of farmworker and farm advocacy groups, agricultural extension workers, and public officials. They held hearings and reviewed developments that had occurred since a cautionary report on the structure of agriculture issued by USDA at the end of the Carter administration (USDA 1981). The Clinton administration's report (USDA 1998) concludes that the situation for small farms—which they defined as farms with less than $250,000 in annual sales—had deteriorated further in the ensuing two decades. What is striking is that so few of the commission's many policy recommendations are directed against large-scale farming or agribusiness. The focus is rather on redirecting federal funds and regulations in ways intended to benefit small farms. The chief causes of problems are seen to be past government policies rather than inherent deficiencies of markets or business practices.

The second Clinton administration commission, on the future of commercial agriculture, was mandated by the 1996 FAIR Act. Its report was issued in early 2001 (Commission on 21st Century Production Agriculture 2001). It recommended an "income safety net" for producers, as a modification of fixed payments under the 1996 act, and generally maintained or increased funding for existing commodity support programs. Notably absent were calls for stepped-up antitrust action, scrutiny of contractual arrangements between integrators and growers, liberalized farm lending programs, regulation of genetically modified seed providers, or increased oversight of other agribusiness involvement in biotechnology. A minority report of the commission did, however, express concern about the market power of agribusiness.

A focus on a few commissions ignores the more voluminous stream of investigative/advocacy journalism, appearing in a wide variety of publications, which continued through the 1990s at an impressive pace. The targets tend to be corporations, the global trade/financial system, large commercial farms, and nongovernment institutions with ties to agribusiness and trade such as land-grant universities and the World Bank. The general idea is to make the case that small farms, farmworkers, consumers of food products, and the environment are being exploited in the service of corporate profit, often with the connivance of the public institutions that ought to be protecting against such exploitation. Such advocacy literature typically receives a respectful hearing in the mainstream press, with prominent coverage of concerns raised about agricultural biotechnology, health threats from fast food, water pollution from large animal-feeding enterprises, manipulation of prices in futures markets, unfair treatment of farmworkers, and small-farm contracting in the broiler industry, to take some recent examples from the *Washington Post* and *New York Times.* The reviews tend to find merit in the arguments adduced even if they argue with details.

With a seemingly broad constituency and substantial intellectual support, why has this populist critique gained so little political traction? Perhaps because corruption of the political process is too complete—people believe the critics' case but are powerless to act upon that belief. It is noteworthy, however, that in some cases a critical view has prevailed. Rachel Carson's *Silent Spring* catalyzed a movement that has resulted in banning the main chemicals she attacked, and the Endangered Species Act and other legislation have entered mainstream policy. Failure of some critiques of agribusiness and commercial farming is attributable to weaknesses in the cases argued in the investigative/advocacy literature. The farm community at large and the preponderance of agriculturalists in universities and nonprofit institutions simply have not been convinced.

A reason for the scarcity of adversarial rhetoric in recent congressional deliberations on farm policy is the widespread nonfarm support for assistance to farmers who are in trouble. The press and other media find a ready audience for stories about catastrophes, and when innocent, hard-working people become economically vulnerable, the American public stands ready to help out. The reception of events ranging from Steinbeck's *Grapes of Wrath* in the 1930s to Willie Nelson's Farm Aid concerts in the 1980s and 1990s testifies to this sentiment.

To summarize, three causes of farm political success are evident: skill in lobbying from the grassroots up; the organization of the federal government, which assigns farm policy largely to specialist congressional committees and executive branch agencies; and a lack of opposition to farm interests in the broad public. Scholars have periodically sensed a trend toward a weakening of farmers' political clout. A recent example is a multicountry study highlighting "agricultural retrenchment" (Sheingate 2001). But it hasn't happened yet.

8

Explanations

Two essential features of twentieth-century agriculture stand out. First, following over a hundred years of important but sporadic improvements in farming technology, a remarkably sustained takeoff in agricultural productivity occurred. Although the takeoff has not been precisely dated, it had not begun by 1935 and was clearly in progress by 1940. The acceleration in productivity growth is surprising not only in establishing a new trend but also in the persistence of that trend. In the 1960s and 1970s, doubts were increasingly raised about the ability of food production to keep up with population growth, much less to continue the accelerated trend. Yet the rate of productivity growth was maintained in the 1980s (even as nonfarm productivity stagnated) and may have accelerated further in the 1990s.

Second, corresponding economic gains were reaped. Consumers gained through lower real prices of food and fiber. On the producer side, improvement was evident in a number of indicators, as Chapters 3 and 4 have shown. Another overall indicator of economic progress is real gross domestic product (GDP). This is the most common measure used to provide a single numerical "score" in economic accounting. Growth in GDP is the main statistical indicator used to judge whether a country is in recession or not, and growth in GDP per capita is a sign of how well the economy is doing over the longer term. At the level of a sector, such as agriculture, an indicator comparable to GDP is that sector's contribution to the nation's real output, the sector's "value added." U.S. statistics on national and sectoral output are developed in the National Income and Product Accounts (NIPA) data of the Bureau of Economic Analysis in the Department of Commerce. Analysts there have estimated gross farm product (agricultural GDP) as *value added on farms:* the real value of output produced minus the cost of goods and services purchased as farm inputs. Value added is the net output generated by farmland, labor, and capital invested in farms.

Agricultural GDP differs from net farm income in that the sector's GDP incorporates value added by hired farmworkers and by land owned by nonfarm landlords. USDA's net farm income measure subtracts hired labor expenses and rents paid to nonfarm landlords as costs (although harvest labor provided by contractors where the farmer pays the contractor rather than individual workers is counted as a purchased service, and therefore the product of these workers is not part of agricultural GDP). Thus net income is more narrowly defined. In the 1990s, value added on farms averaged about $75 billion and net farm income about $45 billion. In 1997 agricultural GDP was $93 billion, of which $16 billion was wages paid to hired farm workers, $13 billion was rents received by nonfarmer landlords, and $14 billion was interest on capital supplied by nonfarm individuals and businesses, leaving $50 billion as net farm income (data from USDA–Economic Research Service).

Figure 8.1 shows two indicators of growth in U.S. agriculture since 1900 (with unofficial estimates for years before 1929 when official GDP data are

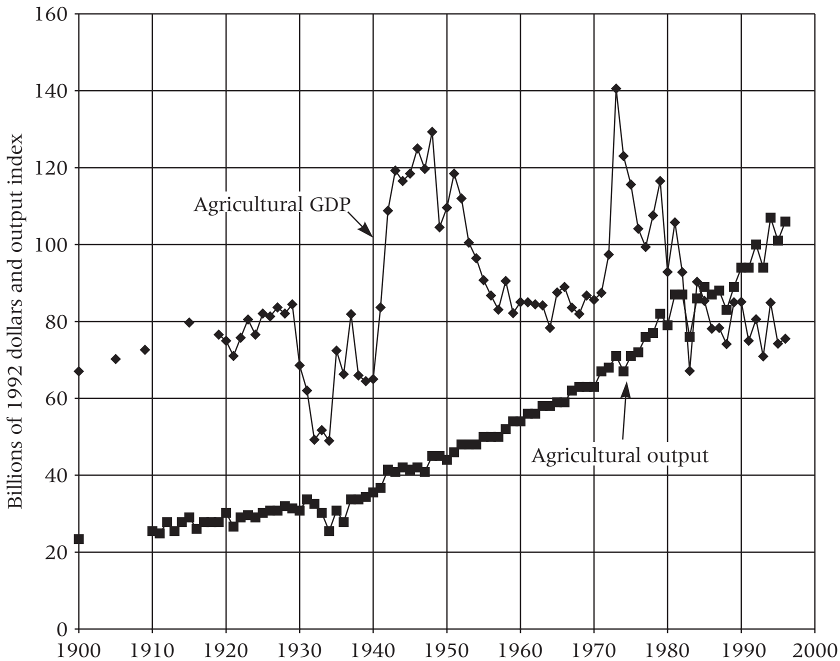

Figure 8.1 Real agricultural GDP and agricultural output. Data for 1929–1996 GDP from U.S. Department of Commerce, *Survey of Current Business,* various years and issues; data for GDP before 1929 from Kendrick (1961) and U.S. Department of Commerce (1975), chapter F, series F127; output data from Council of Economic Advisers (2000).

not available to give a longer-term perspective). Real agricultural GDP deflates the sector's value added by the relevant overall price index, the GDP deflator. This measure shows a downward trend since 1960, and essentially the same level in the 1990s as in 1910.

What happened to the agricultural success story, with its acceleration of productivity since 1940? The main source of difference is that deflation by the overall GDP deflator causes agricultural GDP to decline when farm product prices fall relative to nonagricultural prices; and in fact real farm product prices have declined a great deal. To see the difference this makes, Figure 8.1 also includes USDA's index of agricultural output. It shows the familiar story of agricultural expansion. We have two conceptually quite different measures of agriculture's contribution to the U.S. economy: physical output and output valued at the prices of nonagricultural goods that output will buy. The latter provides a reasonable estimate of agriculture's economic contribution at a point in time; but the GDP measure omits a fact that the output measure illustrates, namely that the reason agriculture's contribution declines is the enormous productivity gains that have permitted farm output to be produced at ever lower real cost.

Economists' studies of economic growth have focused on GDP per person as an indicator of success. The comparable indicator for the agricultural sector is GDP per person in farming. Figure 8.2 shows two measures of this concept: GDP per farm resident and GDP per worker in agriculture (including hired farmworkers). Both measures show a takeoff at about 1940, as was seen earlier for productivity growth and farm income growth. A notable difference between trends in productivity and GDP per person, however, is that while productivity growth remains high and perhaps even accelerates in the 1950s, real GDP growth does not; and GDP per person levels off after 1980 while productivity keeps growing.

The difference between the two measures illustrates a problem in specifying the proper number of people to divide agricultural GDP by to get a per person measure. Dividing by the farm population (the lower measure) is analogous to what is typically done with national GDP data. The problem here is that agricultural GDP includes value added by hired workers and landlords who are not included in the farm population, and the farm population increasingly produces nonfarm output. A perhaps more meaningful measure is obtained by dividing GDP by the number of workers on farms, including hired farmworkers. This is the top measure in Figure 8.2. Neither measure is exactly right, but both deliver the same message until the 1980s. Since 1980 the number of persons employed in agriculture has stayed roughly constant at about 3.4 million, while the farm population has continued to decline. As more workers are only part time in agriculture, GDP

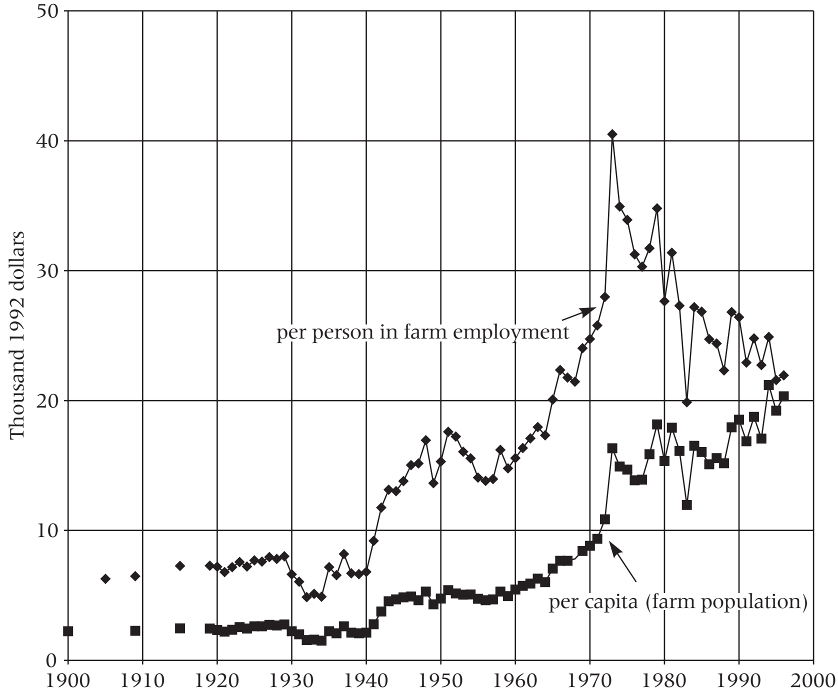

Figure 8.2 Real farm GDP per person. Data for 1929–1980 GDP from U.S. Department of Commerce, *Survey of Current Business,* various years and issues; data for GDP before 1929 from Kendrick (1961) and U.S. Department of Commerce (1975), chapter F, series F127.

per worker understates the growth in GDP per hour worked on farms. Indeed, data on farm output per unit labor input in Chapter 2 indicated no decline since 1980.

This chapter considers explanations of the economic development of U.S. agriculture. The preceding discussion of growth indicators has already indicated that there is ambiguity in what is to be explained. The vigorous, sustained growth of output, productivity, and the real income of farm households calls for an explanation of success. The decline of agricultural GDP since the 1970s can be taken as the basis for a more pessimistic story. The less pronounced trend in net farm income generated by an average farm (Figure 3.10) calls for more complex explanations.

Two quite different perspectives on agriculture underlie some of this ambiguity. The first, a product orientation, focuses on agriculture as a sector of the economy. The second, a household orientation, focuses on farms and the people who operate them. The sectoral data are the responsibility of the

Department of Commerce, farm data the mission of USDA. The difference is notable even for basic data on output. GDP data are produced by the Bureau of Economic Analysis (BEA) of the Commerce Department, which takes a product orientation. So BEA is inclined to count only agricultural products in the sector's GDP, placing timber from farm woodlots, for example, in the forest products sector. USDA, however, is naturally inclined to see everything produced on the farm as agricultural output, even housing services and all manner of productive tasks the farmer undertakes. Fortunately, BEA and USDA have come to almost full agreement on what agricultural output constitutes in recent years, and even in historical data farm output and agricultural output are closely related. The big divide arises with respect to income, where, as we have seen, farm households have come to rely heavily on off-farm income sources.

Theories of Growth

The most widely used growth models are based on the simple idea that underlying every economy is an aggregate production function relating output to labor and capital inputs. The production function is assumed to have the neoclassical properties of substitutability between the inputs and declining marginal products of each input as the quantity of that input increases (holding the quantity of the other constant). The counterpart of real GDP per capita in the model is output divided by labor input, the average product of labor. Capital, and hence output per person, is increased by investment. But declining marginal returns to investment mean that such growth is inherently limited (the "curse of Solow," after the best-known progenitor of such models). In order to achieve sustained growth, technological progress is essential. This is a supply-side model; whatever quantity can be produced will be consumed, and there is assumed to be no unemployment of the kind that fluctuates with business cycles.

The same approach can be employed to model the growth of a sector of an economy. In Chapter 2 we analyzed agricultural output and technological change in the context of a sectoral production function. When considering the agricultural sector as only a part of the economy, the demand side cannot be ignored. A problem for agricultural growth is Engel's Law, with its implication that agriculture's share of the economy tends to decline as the economy grows. Moreover, the demand for food tends to be relatively unresponsive to changes in the price of food commodities. The question then arises whether technological change in agriculture will reduce the demand for agricultural inputs, since fewer inputs will tend to be required in food production and demand for food may not grow sufficiently to offset the reduced requirements of inputs per unit food output.

To explore these issues, two kinds of models are prominent. The first is a supply-demand model of farm product and input markets that simply ignores nonagricultural sectors. These models generate a variety of results about farmers' gains or losses from technological progress. Some of them disaggregate types of farms, and find circumstances in which more aggressive, technology-adopting farms gain, while less aggressive or adventurous farmers lose. When commodity and input supply and demands are considered simultaneously, a notable result is that factor-neutral technological change (which increases the marginal products of all inputs proportionally) increases real returns to farmers if and only if the elasticity of product demand is greater than unity (Muth 1964).

The second type of model explicitly considers the relationship between farm and nonfarm sectors, typically by means of a two-sector model in which all nonfarm products are treated as an aggregate. This enables us to analyze technological change in both farm and nonfarm production, and the returns to inputs in the rest of the economy as well as in agriculture. Typical assumptions are that some inputs are specific to agriculture, notably land, and others are used in both agriculture and nonagricultural production, typically labor. Labor and other nonspecific factors of production receive in equilibrium the same return in both sectors. Economic growth is incorporated by treating the capital input in both sectors as changing over time in response to investment.

A severe limitation of both these models for the purposes of this book is that they focus more on the consequences of growth than on the causes. They incorporate investment and technological change, but do not analyze the adoption of technology. The literature that has gone furthest in bringing in causal factors involves models of "endogenous growth," "idea-based growth," and human capital in growth, as developed, for example, in Jones (1995) and Aghion and Howitt (1998). These models point to possible mechanisms of growth in twentieth-century U.S. agriculture, but in themselves do not provide substantive responses to our historical questions. For proposals of such answers we can turn to a large literature, typically informed by direct observation but without formal economic modeling. Scholars have put forward contending hypotheses that include the following, starting with views on the sources of technical change and productivity growth:

> The effectiveness of technological changes after World War II was testimony to the value of the research programs carried on primarily by the Department of Agriculture and the state agricultural colleges and experiment stations, as well as by industry. Furthermore, the information had reached the farmers. (Rasmussen 1962, p. 590)

> Developments since 1940 are of a wholly different order from all that has gone before . . . [They are] the payoff on . . . [1] the expansion of a commercially minded farm population . . . [2] the development of the institutions and attitudes from which scientific agriculture could grow . . . and [3] the raising of productivity and national wealth to levels at which capital formation—in the soil, in equipment, in ideas, and in the training of human beings—could proceed. (Parker 1972, p. 373)

> Specialization, large-scale operations, and improved financial, insurance, and transportation facilities have contributed in a quite direct way to farm productivity. These direct sources of rising productivity can ultimately be viewed as the result of nonconventional inputs . . . [education and research]. (Tweeten 1971, p. 134)

> This [efficiency of post–World War II farming] is largely because our farmers have had an optimum combination of free incentive, adequate capital, and a long period of sound technological training. (Henry A. Wallace, quoted in Knoblauch 1962, p. 598)

These writers focused on the acceleration of productivity growth that occurred after 1940. This change, called a revolution in U.S. farming by some scholars, only became quantifiable as the data and inputs and outputs in agriculture were developed and refined by economists at USDA's Bureau of Economic Analysis and elsewhere beginning in the late 1940s.[1] The issue of whether technological change in U.S. agriculture was revolutionary or evolutionary was debated by economic historians in 1940–1960, with good points made on both sides (see Rasmussen 1962 for a brief review). Only in retrospect has it become clear how sharp and lasting was the break in productivity growth that occurred during the 1930s. One who saw this early was Theodore Schultz: "With knowledge already at hand, it would appear that the recent surge forward is still in its early stages because it will take years, perhaps decades, to put into practice in all parts of agriculture what is already known" (1953, p. 112). It is also noteworthy that less than a decade earlier, Schultz (1945) gave no indication of the significance of developments in productivity.

The break in the productivity trend after the mid-1930s provides fodder for explanatory work, in that one can look specifically for what causal factors changed at that time. Rasmussen points to "the strength of and variations in demand for farm products" (1962, p. 579), noting that prices of farm products doubled between 1939 and 1945, as they had in ushering in a

1. See Barton and Cooper (1948); Kendrick and Jones (1951); Johnson and Nottenburg (1951); T. W. Schultz (1953), chap. 7.

period of agricultural expansion in 1861–1865. But this appears too transitory an impetus for a new trend that has lasted so long (and the length of which Rasmussen could not have known at the time he wrote). A related idea is that what changed after 1940 was not so much the availability of and knowledge about technological innovations as the economic environment in which they would be used. Zvi Griliches's (1957) classic study of the adoption of hybrid corn established the connection between the profitability of a technological innovation and the extent of its use by farmers. Profitability can be the result of favorable prices as well as reduced cost from a technological advance. But the reduced costs of a new technology encourage adoption of the new technology, whereas favorable product prices encourage output and investment in both new technology and technology already in use.

In agricultural commodity markets there did occur a long-lasting change in the 1930s: the set of commodity support policies introduced with the New Deal farm programs. Willard Cochrane and Mary Ryan make the case for their importance:

> What did the price and income support programs have to do with these gains in agricultural productivity? They had a lot to do with it. They provided the stable prices, hence price insurance, to induce the alert and aggressive farmers to invest in new and improved technologies and capital items, and the reasonably acceptable farm incomes and asset positions to induce lenders to assume the risk of making farm production loans. (Cochrane and Ryan 1976, p. 373)

Sally Clarke (1994) made a variant of this hypothesis the focus of her book. She concentrates mainly on farmers' investments in tractors in the Midwest in the 1930s, concluding that "farmers' willingness to invest turned in large part on the long-term changes initiated by the New Deal farm policy" (p. 200). However, the New Deal also introduced a variety of regulatory requirements and action-specific subsidies that arguably retarded adoption of new technology; and although market sources of instability were reduced, uncertainties associated with the policies themselves were increased. David Sunding and David Zilberman (2001) cite evidence that irrigation subsidies retarded the adoption of new water-saving technology. But their wide-ranging review of the literature on the adoption of agricultural technology did not uncover evidence that would either support or refute the specific Cochrane-Clarke assertions.

A case may also be made for an alternative hypothesis, the scientific "supply-side" view, seen in earlier quotations, that the key factor was the availability of a continuing stream of better and more applicable new technology beginning in the 1930s. An acceleration in productivity growth during that decade could be explained by the acceleration of agricultural research that took place between 1910 and 1930, with long lags for developing commercially viable new inputs from this research. Public spending on agricultural research tripled between the decade of 1900–1909 and the 1910s, and tripled again between the 1910s and the 1920s, and agricultural extension efforts under both federal and state support also grew rapidly (Alston and Pardey 1996, pp. 34, 54).

Ronald Mighell (1955) presents the considered view of U.S. government analysts based primarily on 1950 Agriculture Census data. He sees an acceleration of productivity growth in the mid-1930s (p. 5), and although this event is linked to agricultural research and education, he does not even mention a possible connection with New Deal commodity support policies. Similarly, in their classic text generally favorable to governmental economic influence, Merle Fainsod, L. Gordon, and J. C. Palamountain (1959) give no credit to the idea of a commodity program boost to agricultural innovation or investment. Some writers have gone further to argue that the New Deal's Agricultural Adjustment Act was economically harmful. Paul Johnson calls the AAA a "policy of despair" that delayed the general recovery from the Depression by driving up food prices and reducing consumers' purchasing power (1999, p. 756). In their discussion of international productivity comparisons, Richard Nelson and Gavin Wright single out accelerated public investment in research and extension infrastructure in stating that while the United States lagged behind Europe in agricultural technology prior to World War I, "a generation later these investments in infrastructure had unprecedented payoffs in agricultural productivity" (1993, p. 139).

Another long-term economic change at about 1940 was the rise in real farm wage rates as the general economy emerged from the Depression, and especially as labor markets tightened during World War II. One of the sharpest changes of trend in relative prices was the rise in farm relative to nonfarm wage rates that began in 1941 (see Figure 4.4b). Richard Day's (1967) study of cotton mechanization as triggered by wage-rate rises was reviewed in Chapter 2. Its underlying hypothesis is that the economic development of agriculture was fostered by economic progress in the nonfarm industries of the United States, which was reflected in rising real wage rates throughout the economy. The key developments in the farm sector in this view were those that resulted in closer, cheaper, and more rapid connections between rural and urban America—improved roads, faster communications, consolidated schooling, and better information. Schultz (1953, chap. 10) gave support to this view with his reasoning based on the relatively rapid economic progress in the 1930s and 1940s of rural areas that were located near cities as compared to more remote areas.

Gavin Wright (1986) combines a variant of the Cochrane-Clarke hypothesis with labor market considerations to explain the mechanization of cotton in the South. He points to the mechanization of preharvest operations as being available since the 1920s but not being adopted until the New Deal Cotton Program (of the 1933 Agricultural Adjustment Act) and its successor programs made sharecropper and tenant labor expensive through regulations that attempted to raise returns to farm labor. Higher labor costs induced growers to adopt labor-saving technology, which, together with supply control under commodity programs, helped to force labor off of southern farms even before the mechanical cotton picker and World War II off-farm opportunities accelerated the great out-migration in the 1940s. Wright's summary statement is that "mechanization in the South was induced by economic incentives, and in the 1930s, these incentives were largely created by government programs" (1986, p. 233). The most telling evidence he documents is the rapid adoption of tractors in plantation areas of the South during the 1930s. He points out that "accelerated mechanization in a depressed region, a depressed sector, and a depressed economy is anomalous. But it makes sense in conjunction with the incentives to switch to wage labor that were offered under the federal farm programs of the 1930s" (p. 234).

A more general approach to analyzing the growth of farm productivity and farm labor returns can be developed from the findings of Griliches (1963), discussed in Chapter 2, which became important in the thinking of many agricultural economists. The central point is "disequilibrium" in agricultural factor markets. New technologies increase the returns to capital and to purchased inputs embodying the innovations (machinery, pesticides) and permit a single farmer to operate at a larger scale of output. Because farmers do not immediately adjust to these opportunities, we observe at a given point in time a farm labor force that is too large for what will ultimately prove optimal, and over time this circumstance results in movement of labor out of agriculture. This phenomenon complicates both the measurement and the interpretation of productivity growth. Griliches's findings suggest that measured productivity growth between 1940 and 1960 was in large part caused by adjustment to disequilibria that existed during that period, in part as a result of technical changes in place as of 1940, as opposed to being the result of technical progress during the 1940–1960 period.

These dynamics are important because they suggest that relying on data from any two points in time can easily be misleading, and in particular that the accelerated rate of growth estimated in 1940–1960 was dependent on one-time factors that would not be maintained even if technology continued to improve at the same rate. In this respect, subsequent experience has dispelled some of the concerns raised by Griliches's findings. The USDA productivity index that Griliches took as his starting point grew at an annual rate of 2.0 percent between 1940 and 1960. The most recent USDA productivity data, which correct for some but not all the problems that Griliches pointed out, and which generate a rate of productivity growth over the longer period from 1950 to 1996, yield a trend rate of productivity growth that is also 2.0 percent.

A problem with all the scholarly opinions discussed here is that tests of statistical significance for evidence linking New Deal commodity programs, prior research and extension investments, and labor market developments with subsequent productivity growth are difficult to come by, and few are offered by the authors I have cited.

Wallace Huffman and Robert Evenson (1993) attempt to sort out the effects of research, farmers' schooling, and commodity supports using a multivariate econometric model, mainly with state-level data from 1950 to 1982. They find that while they cannot reject the hypothesis that price supports led to increased productivity, about 95 percent of the growth in productivity that they can explain is attributable to lagged effects of research and extension, with only about 5 percent attributable to commodity programs. Related research examines the role of agricultural price policies as they affect productivity outside the United States, primarily in developing countries. Schultz (1979) argued that underpricing agricultural products retarded adoption of new technology and agricultural research efforts in many developing countries. Yair Mundlak (1988) and Lilyan Fulginiti and Richard Perrin (1993) provided evidence that less taxation of agriculture would increase productivity in such countries. But Nicholas Kalaitzandonakes (1994) provides reasons for doubting that price support promotes innovation, and argues that support may reduce competitiveness. His empirical evidence is from New Zealand, where the liberalization that reduced agricultural support is estimated to have increased productivity growth.

Munisamy Gopinath and Terry Roe (1997) investigated determinants of productivity growth with a different approach, a statistical decomposition of a smoothed total factor productivity series, derived from USDA data, 1949–1991. They find that public spending on agricultural research is the most important contributing factor to productivity growth, and that both growth in purchased input use and labor quality have also played a significant role. But other factors, notably private-sector research and development, public investments in infrastructure, and the scale of agricultural output, were all estimated to have little or no importance in productivity growth. Gopinath and Roe reported no attempt to investigate the role of commodity policy.

The conclusions of these econometric studies are not, of course, the last word on these issues, because they considered only relatively short time spans that did not include the late 1930s sea change. Other questions of the kind that plague most econometric findings that use times series data can be raised regarding whether the separate influences of the variables considered have been accurately sorted out. It was especially surprising in the Huffman and Evenson findings that farmers' education had only a weak or even a negative effect on productivity, and that the nonfarm wage rate had an estimated negative effect; and that Gopinath and Roe omitted commodity policy variables and found no effect of private-sector research or of "learning by doing" contrary to what an earlier study by Y. Luh and Spiro Stefanou (1993) had found. Huffman and Evenson cite earlier work by Evenson in arguing that public agricultural research was effective in increasing agricultural productivity during 1870–1950. They note an acceleration in their measure of productivity growth after 1934 that is unexplained by research and related factors and conclude that "the economic pruning and reorganizing that occurred during and immediately following those years [the Depression] seem to have set the stage for an unusually high rate of MFP [multifactor productivity] growth in U.S. agriculture during 1934–1948" (Huffman and Evenson 1993, p. 204).

It is unlikely that any one of the causal factors that have been considered can qualify as *the* explanation for the takeoff in productivity, or for the longer-term history of technological change in U.S. agriculture. For practical purposes it is tempting to lump many factors together, as action-oriented observers who lack patience with scholarly dissection of the subject have indeed done. For example, Lee Iacocca, called on his memoir's dust jacket "the straight-shooting businessman who brought Chrysler back from the brink," wrote about post–World War II agricultural productivity growth:

> There is more going on here than good climate, rich soil, and hard-working farmers. We had all those things fifty years ago, and all we got were dust bowls and disasters. The difference lies in a wide range of government-sponsored projects. There are federal research projects; county agents to educate people; state experimental farms; rural electrification and irrigation projects such as the TVA; crop insurance; export credits; price supports; acreage controls . . . With all that government help (or, some would say, interference) we've created a miracle. Our agricultural industrial policy has made us the envy of the world. (Iacocca 1986, p. 348)

Arthur Schlesinger adds mortgage relief and credit programs to the list and concludes that "national economic planning thus transformed a weak, disorganized and poverty prone sector of the economy into America's most spectacular productive success" (1984, p. 8).

It is important to try to sort out the elements of policy to get as good an estimate as possible of the roles of particular government actions, particularly public investment in research, extension, and education, on the one hand, and commodity support programs, on the other. Could U.S. policies have done better if they had been more selective? For example, what if we had left the research, education, and infrastructure investments in place but had not spent the roughly $500 billion (in 1992 dollars) that we have on commodity support programs in the last fifty years? The 1996 Farm Act created the possibility of ending all commodity support programs in 2002. Would this have adverse effects on future productivity growth?

If what I call the Cochrane-Clarke hypothesis, outlined above, is correct, there is a downside risk of following the deregulatory path that has generally not been taken seriously by economists. A remark of J. K. Galbraith's suggests a reason. After stating that price supports "made it possible for farmers to invest in fertilizer, machinery, hybrid seed stock and other technology" and thus "enormously enhanced such investment and nourished an increase in output per farm worker that much exceeded the productivity gain in industry," he goes on to say: "Nevertheless the support prices had never ceased to be a source of distress to economists, who preferred their free market faith to practical achievement" (1981, p. 356). Perhaps economists have tended to be ideologically hindered from giving the Cochrane-Clarke hypothesis a serious look.

Investment in Agriculture

A central economic activity in both general growth theories and specific hypotheses about agriculture is investment. Farmers' investments in capital equipment, which often embodies new technology, are of particular interest.

Data relevant to capital in agriculture are not as well grounded in surveys as other output and input statistics. We have Agriculture Census data on farm inventories of certain items of equipment, as reviewed in Chapter 2. But these data do not cover a great many investments, notably in new types of equipment. Moreover, census inventory data do not provide enough information about the age, condition, and features of the equipment to construct a total capital stock estimate. Independently of the census, the Economic Research Service of USDA collects a broader range of data from equipment manufacturers, dealers, and other sources. Using this information together with data on farm buildings and other fixed capital such as irrigation equipment, USDA and the Bureau of Economic Analysis of the Department of Commerce construct a measure of "fixed reproducible capital" (to distinguish this form of wealth from natural resources and financial capital). The increase in this measure from year to year provides an indicator of net investment in agriculture. A time series of the BEA investment indicator is shown in Figure 8.3.

USDA also publishes data on expenditures for capital goods by farmers each year, as well as an estimate of capital consumption (depreciation of the existing capital stock). The difference between capital goods purchased and depreciation is a measure of net investment in U.S. farms. The USDA measure is also shown in Figure 8.3. The USDA investment measure is lower than the BEA measure, primarily because BEA includes investment in agriculture by persons who are not farmers. In order to make comparisons over a long time span more nearly comparable, both the USDA and the BEA measures are deflated by the GDP price index.

Although the two measures of investment depart from one another in

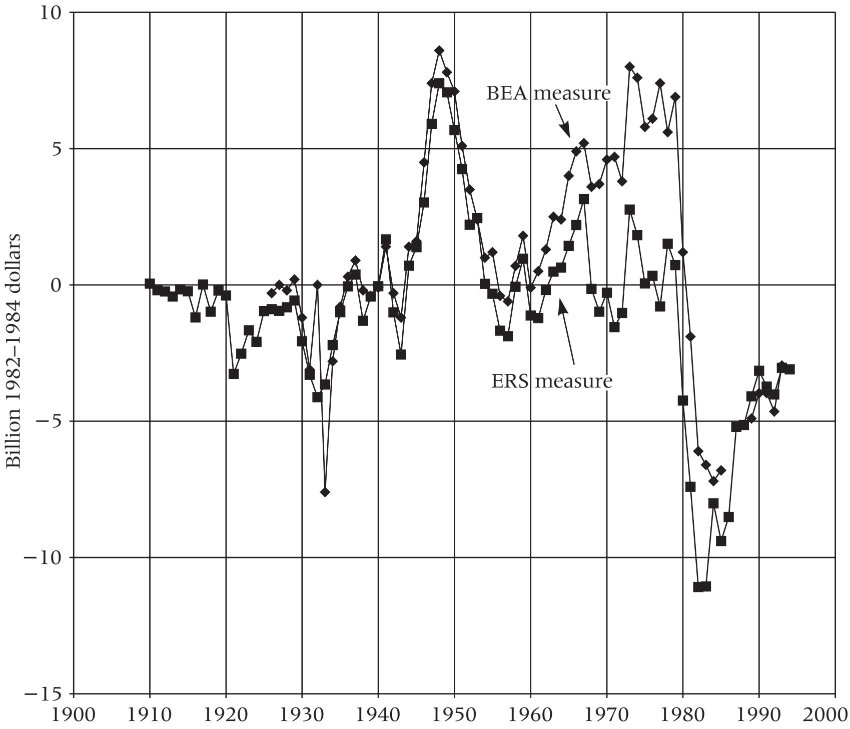

Figure 8.3 Real net investment on farms. BEA–Bureau of Economic Analysis, ERS–Economic Research Service; data from U.S. Department of Commerce (1975, 1999) and U.S. Department of Agriculture, Economic Research Service website, <http://www.ers.usda.gov/>.

some periods, they tell a similar story for the period in which we are most interested, preceding 1960. The data according to either measure indicate the ill effects of the long period of unfavorable economic conditions in agriculture, with net investment by farmers being negative throughout the 1920s and 1930s. The economic meaning is that the farm community was to some extent living off its capital stock, or "eating the seed corn" by letting its capital stock depreciate. In this context, the increase in investment at the end of the 1930s and early 1940s is quite modest. The takeoff in net investment doesn't occur until 1946, after which the rise is spectacular. The timing is suggestive in two important ways. First, since overall productivity growth began to accelerate at about 1940, and had definitely begun its permanently faster growth before 1945, it is a mistake to tie the acceleration of productivity growth to farmers' investment in capital equipment. Second, while the New Deal programs undoubtedly gave farmers reasons for less pessimism, the investment data do not indicate a real switch to an ebullient willingness to invest at any time in the 1930s or early 1940s. Wartime restrictions helped keep a lid on some investment until 1945, but even so the facts of overall investment limited the extent to which underlying optimism could be converted into productivity-increasing new equipment.

The cumulative effects of investment determine the capital stock in agriculture. To make a big difference in the farm sector as a whole, it requires more than just a year or two of investment, especially after years of depreciation of the capital stock as occurred in the 1930s. Figure 8.4 shows the time series of BEA's net reproducible capital stock. Even in 1947, after two years of accelerated investment, the capital stock had only just recovered to its level of 1930. But by 1980 the capital stock had tripled. It is also noteworthy that since 1980 net investment in U.S. agriculture has plummeted, and to this day the capital stock has not recovered to nearly its level of that year. Yet the rate of growth of productivity has not decelerated at all. Overall, the path of productivity growth does not seem related to the path of investment in an obvious way.

These considerations cast doubt on the Cochrane-Clarke hypothesis at least as it pertains to the New Deal programs fostering productivity growth by stimulating investment. There remains a broader notion that the commodity programs generally made farmers more production oriented and optimistic, but more attention has to be given to the mechanism for such an effect. It is not enough that farmers attempted to produce more by applying more inputs (and in fact although there was an increase in input use in the late 1930s, the aggregate agricultural input index was the same in 1930 and 1940). For productivity to grow, output has to increase more than proportionally with inputs. David Orden, Robert Paarlberg, and Terry Roe (1999)

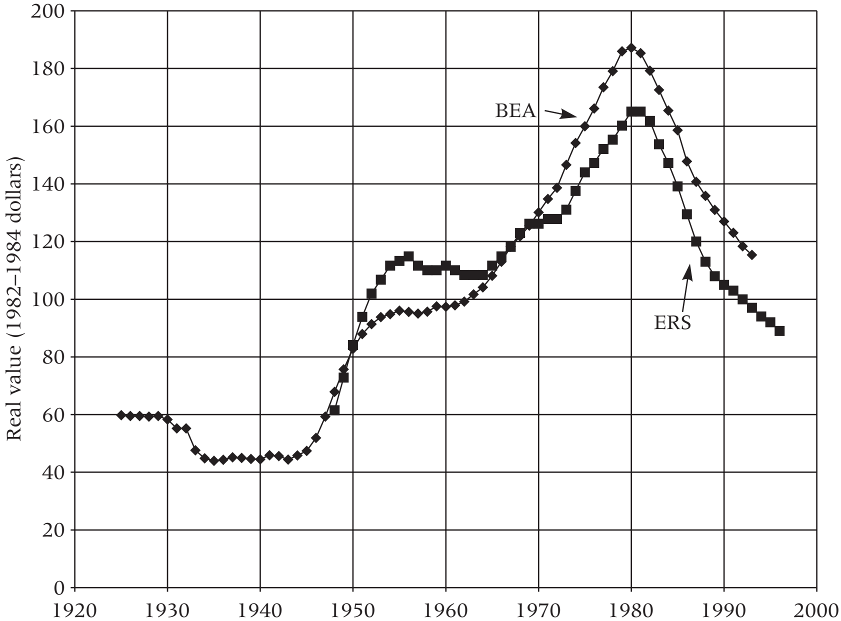

Figure 8.4 Capital stock on farms (BEA–Bureau of Economic Analysis, ERS–Economic Research Service; data from U.S. Department of Commerce (1975, 1999) and U.S. Department of Agriculture, Economic Research Service website, <http://www.ers.usda.gov/>.

argue that even if the programs did stimulate output and investment, increases in them have not been responsible for post–World War II productivity growth.

A particular element of capital investment, farmers' purchases of cars and pickup trucks, is an indicator of change in the degree of integration of farm and nonfarm labor markets that underlies the idea that rising nonfarm wage rates and employment opportunities caused economic improvement in agriculture. Figure 8.5 shows the number of cars and trucks per farm from 1910 to 1970. (After 1970 the Census of Agriculture no longer asked about automobiles on farms, and USDA has no alternative data source that would permit maintaining the time series.) These vehicles were adopted by farmers quite early. By 1930 there were 80 vehicles, over four-fifths of them cars, per 100 farms. This does not mean that 80 percent of farms had vehicles, because some had more than one, but outside the South farmers had undoubtedly become quite mobile by that time. This component of farmers' capital began to grow again in the mid-1930s. These data are consistent with the idea that the turnaround to an improved farm economy owes as much

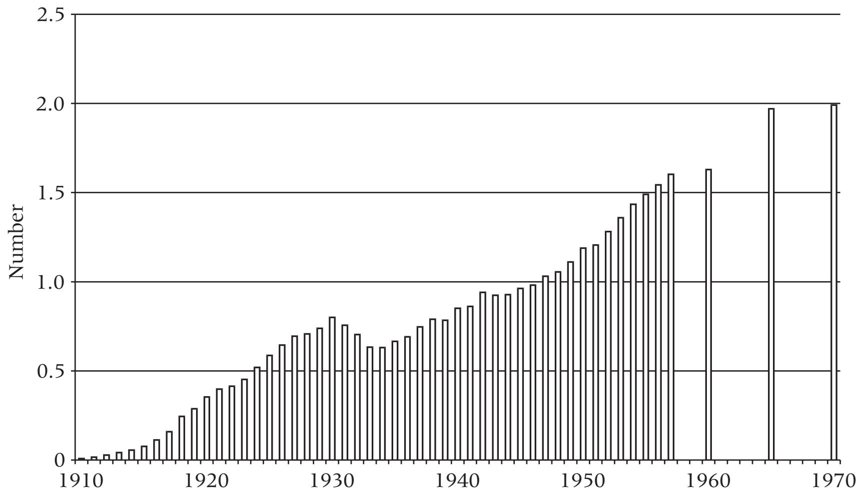

Figure 8.5 Cars and trucks per farm. Data from U.S. Department of Commerce (1975).

or more to connections with the off-farm economy as to developments within agriculture. This issue needs much further analysis, however.

Although discussion has focused on the acceleration of productivity growth in the late 1930s, a further surprising event in the twentieth-century history of farm productivity is the fact that agricultural productivity (both output per worker and total factor productivity) kept increasing at an undiminished rate while U.S. manufacturing and overall productivity slowed down after the mid-1970s. The productivity slowdown has been attributed to a number of factors, of which the most widely agreed upon appears to be the rapid rise in the cost of energy following OPEC's 1972 change in its oil marketing strategy. Agriculture was cushioned from the immediate impact of energy price increases because farm output prices soared at the same time. But by 1977–78 grain prices had collapsed and farmers were marching on Washington in a show of political discontent unique in the last half of the century. Economic problems in agriculture only deepened with the wave of farm business failures that characterized the "farm crisis" of the mid-1980s. Commodity program spending and financial assistance responded with massive assistance to agriculture as documented in Chapter 7, but well into the 1990s a mood of economic pessimism prevailed in the farm community, and farmland prices had still not returned to the levels of 1981 in nominal much less real terms.

Despite all this, agricultural productivity continued to grow at the accelerated 1940 to 1970 pace. Why? This subject has been much less investigated than the post-1940 acceleration, but the data suggest the science-and-research hypothesis as perhaps the most plausible. Not only had net investment essentially ceased after 1980, but in addition the decline in farm numbers that may have previously fostered increased farm size and efficiency of labor use slowed down. Increased environmental concerns as well as input costs led after 1980 to lower use of chemical inputs, which as discussed in Chapter 2 appear to have generated increased output value far in excess of their cost. In the face of these obstacles, improved technology and improvements in farmers' ability to put that technology to work appear to be the most likely remaining explanatory factors for continued agricultural productivity growth.

Economic Adjustment and Farm Income

While farmers have seen the benefits of technological progress in their individual operations, some farm organizations have been skeptical about the benefits to farmers as a group when a large number or all of them adopt new technology. Economists have provided analytical support for such skepticism. There are two kinds of concern: a distributional worry and one about aggregate farm income. The distributional worry is the view of Cochrane cited in Chapter 3 that only the early adopters of new technology gain and that for the remaining farmers technological change is a "nightmare." The idea is that the aggressive, low-cost farmers expand output, and this drives down prices so that farmers who stay with previous technology can no longer cover costs. Their incomes fall, and income equality within agriculture increases. The concern about aggregate farm income is a longer-run consequence. As the high-cost producers are squeezed out, and their farms "cannibalized" (Cochrane's term) by growing, aggressive farm enterprises, the whole sector finds itself with output increasing and prices falling so far as to just cover the new, lower costs (or with overshooting of output, not covering costs for the sector as a whole). Thus only buyers of farm products are sure to gain.

A large literature by agricultural economists has attempted to work out in analytical detail the circumstances under which farmers as a whole can be expected to gain or lose from cost-reducing technological progress after all or essentially all farmers have adopted new technology. There is no strong a priori prediction, for two main reasons.

The first reason why there is no sure forecast of whether farmers will gain or lose is that we cannot be certain whether any factor bias in technical change will increase or decrease the returns to farmer-owned inputs. Technological change may be biased in such a way as to reduce labor requirements (for example, mechanization), land requirements (for example, improved irrigation methods), or the use of purchased inputs (for example, seeds engineered to be pest resistant). If the bias reduces the demand for land and labor that farmers supply, farmers will tend to lose under technological progress.

The theory of "induced" technical change says that if events increase the cost of a factor of production, say labor, then innovations will be encouraged that will reduce labor requirements. That theory suggests at least an approximation to factor neutrality in the long run, since induced innovations will tend to counterbalance changes in factor prices. The evidence on induced innovation in agriculture is mixed. Yujiro Hayami and Vernon Ruttan (1971) find evidence supporting the idea in the nineteenth century, which Alan Olmstead and Paul Rhode (1993) dispute. Richard Day (1967) tells a story of rising wages stimulating the development of mechanical cotton harvesting, which is plausible for explaining many private and public investments in mechanization since 1950.

The second reason for uncertainty is that even if technical change is factor neutral, we cannot be sure what the effects on factor returns will be. Factor neutrality results in the demand for both farm-owned and purchased inputs moving in the same direction, but we don't know if that direction is up or down. The key variable in determining that direction is the elasticity of demand for farm products, as discussed earlier. If technological change generates a 10 percent decline in all input requirements and hence in the cost of a product, and that induces a less than 10 percent decline in demand for the product (inelastic demand), then there will be a net reduction in the demand for inputs, and aggregate farm income will decline. But if product demand is elastic, then more of both farm-owned and purchased inputs will be used, tending to increase their returns, and farm income will rise. This last scenario is most likely when farm products are exported. In this case cost reductions increase competitiveness in a vast market, where a small cost advantage can mean greatly increased sales.

Notwithstanding such theorizing, it remains an empirical question how productivity growth in U.S. agriculture during the twentieth century, and particularly since 1940, affected both aggregate net farm income and the inequality of income distribution among farmers. Looking back at Figure 3.15, we do see an increasing trend in real returns to farming since 1940, the same period over which the rate of productivity growth increased. Figures 3.10 and 3.12 show real farm income, and farm relative to nonfarm incomes, growing after 1940. This evidence suggests that productivity growth may have contributed to farm income growth. But over this same period we also have the growth of governmental support for farm commodities. There are other factors as well that have to be considered as explanations for the time path of farm income.

Average farm income masks wide differences among farms. USDA's detailed economic surveys of individual farms in the 1980s and 1990s indicate that about 40 percent of U.S. farms operate at a loss in any given year. The percentage varies remarkably little between low-price years such as 1994 and high-price years such as 1996. Moreover, the loss-making farms are predominantly small. Large farms have incurred some of the very largest losses, but on average their net incomes have been quite remunerative, as discussed in Chapter 3. Their experience suggests they have overcome the baneful fate envisaged by Cochrane, who emphasizes the short-term gains by progressive, early adopters of cost-reducing innovations being eroded over the longer term by competition, which inevitably brings prices down to the level of production costs.

How do the successful farms maintain their relatively favorable income position? The likely answer is that the managerial capabilities of these farmers extends beyond the ability to spot promising new technology to an ability to manage the year-to-year and day-to-day opportunities and disasters that emerge in production, input acquisition, personnel management, and product marketing. Thus technological change promotes an economic environment in which managerial or entrepreneurial talents and effort can earn permanently higher returns than are possible in routine, tradition-bound farming.

At the same time, bad economic results for smaller-scale farms are avoided by their reliance on off-farm sources for a large percentage of their household income. USDA's surveys as well as other data indicate that although operators of small farms earn little or nothing from their farms, their households earn sufficient amounts from other sources that even the smallest-farm category receives household incomes that are comparable to the incomes of nonfarm people. The increasing importance of off-farm employment by farm household members, and the rise in farm household income associated with that employment, suggests that integration of the farm and nonfarm labor markets has a lot to do with farm income trends since 1940.

The case of cotton in the South, as well as labor migration more broadly, indicates that both the pull of off-farm labor demand and the push of technology-generated labor redundancy have been important. According to this view, technological progress affects the size of farms and of the agricultural labor force but not, in the long run, the earnings of people employed in farming. Differences in labor earnings depend on people's time spent working and their qualitative characteristics (age, education, experience). This view I will call the integrated labor market view. It implies that the earnings of comparable labor would have been the same in farming and in nonfarm work regardless of changes in agricultural technology. Growth in farm household labor income relative to nonfarm households since the 1930s is attributable to improvement in the education and other income-generating attributes of farm people.

A more historically nuanced variant of the integrated labor market view is the hypothesis that labor market integration only gradually emerged after World War II. So what we observe in the household income data since 1940 is not only improvement in farm people's earning capacities but also the correction of a persistent labor market disequilibrium that appeared in U.S. agriculture after World War I, leaving too many workers in agriculture. This disequilibrium was caused in large part by technological change in farming, but the remedy had nothing to do with farming technology and would have operated no matter what occurred in that technology.

Even if the integrated labor market hypothesis is correct, it is not the whole story for farm income. A focus on labor markets omits farmers' returns from their investments in land and other capital assets. Figures 3.13 and 3.14 indicated that since 1950 there has been a trend of increasing real rental value and price of farmland. That trend is not a matter of adjustment to disequilibrium through factor mobility. Land rent is rather a residual, reflecting the demand for land's services in the face of a largely fixed supply. It is true that land can shift from farm to nonfarm use, and it has done so dramatically in suburban areas and elsewhere at the extensive margin of agriculture. But in fact the acreage of land in farms and in crops has not changed greatly, and even increased slightly in the twentieth century. In 1910 the United States had 880 million acres in farms and 310 million acres of cropland. In 1997 there were 932 million acres in farms and 338 million acres used for crops (with an additional 56 million acres idled, mostly under government programs). So the increase in returns to land is likely to be attributable to an increasing demand for agricultural land services, and this could be caused by technological change, by commodity programs, or by other factors in the demand for farm commodities (such as foreign demand for U.S. farm products). Insofar as labor mobility out of agriculture has played a role, it would have been to reduce farm operators' returns to land (just as farm operators' interest in abundant labor is shown in their support for federal programs to import temporary farm workers from abroad).

With respect to farmers' returns to investment in equipment and other nonland capital, the picture is perhaps even more bifurcated between short-run and long-run considerations than for labor. In the short run, one finds evidence at farm sales and junkyards everywhere that new technology constantly creates obsolescent and nearly valueless capital goods. This does not necessarily imply a low return to investment in those goods, for they may have reached the end of their originally expected period of use anyway.

But it is a reasonable hypothesis that farmers have often found themselves in a fixed-investment trap that has caused losses on such capital investments. Among economists who have emphasized this view are Clark Edwards (1959) and the contributors to Glenn Johnson and Leroy Quance (1972).

At the same time, a long-run view of investment in agriculture lends itself to an integrated-market hypothesis even more strongly for capital markets than for labor markets. In the long run (approximately as long as the lifetime of capital goods), the rate of return to investment in agriculture should not be expected to depart much from the rate of return to nonfarm investments of comparable risk. Interest rates for borrowing are set in a national capital market, so the terms on which farmers can obtain funds are close to the same as those for nonfarm businesses; and the opportunity returns for farmers' investments include a range of off-farm investments that potential farm investments must compete with in the farmer's decision making. Empirical evidence—for a useful review see Brake and Melichar (1977)—suggests an integrated U.S. capital market that incorporates agriculture. If so, any trend increase in farmers' income relative to nonfarmers' that is attributable to capital market developments must stem from an economywide increase in returns to investment coupled with farm households earning a larger share of their income from capital than nonfarm households do.

Evidence on Determinants of Farm Household Income

Farm household income includes farm and off-farm incomes of people who live on farms. Farm households (both families and unattached individuals) have on average since 1950 experienced a faster rate of growth in their off-farm incomes than in their incomes from agriculture. Moreover, while the distribution of farm sales, land ownership, and wealth has become more polarized during this period, farm household income has become more equally distributed, as discussed in Chapter 3.

The explanation of these trends involves some of the same factors that have just been outlined, but more besides. The leading plausible causes can be divided into two categories: proximate and underlying. Proximate causes are those that can be seen as having effects on farmers' incomes, but that may themselves be the result of more fundamental developments. The underlying causes are those more fundamental developments.

Proximate causes of farm household income growth include:

- Agricultural productivity growth
- Saving and investment by farm people
- Expanding export markets

- Adjustment to disequilibrium via out-migration of labor
- Off-farm work opportunities for farm people in a growing general economy
- Improved skills of farm people

Underlying causes include:

- Research and extension of new knowledge to farmers
- Improved infrastructure: rural roads, input supply and output marketing services, and information
- Better schooling for farm people
- Lower cost of inputs and services: transportation, chemicals, energy
- Government subsidies and support
- Economic growth in the nonfarm economy

These underlying causes are not claimed to be ultimate or uncaused causes, and the division between proximate and underlying causes is admittedly not a sharp one. Moreover, the causes are not independent of one another. For example, agricultural productivity increases are often the result of new technology that is implemented by investment in new equipment; so one is hard pressed to distinguish new technology and investment as causal factors. Another example: increased availability of off-farm work for farm people may be the result of improved schooling in rural areas, so it is hard to distinguish the causal contributions of off-farm labor market conditions from those of improved schooling.

Causes and consequences can be sorted out conceptually using a supply and demand framework for commodities and farm-owned inputs. Such a framework is presented in Figure 8.6. Figure 8.6a represents the supply and demand for agricultural output (aggregating all commodities). Figures 8.6b and 8.6c are supply-demand diagrams for factors of production owned by farmers and for purchased farm inputs, respectively. Each of these factors of production is an aggregate. Moreover, some of the same inputs are included in both aggregate diagrams; for instance, some cropland is owned by farmers but some is rented from off-farm landlords, and some labor is supplied by farm household while other labor is hired. The cavalier aggregation used here is too crude for purposes of econometric investigation; Figures 8.6a–c are rather a model for use in discussing causes of income growth.

In this model, there are two concepts that can be used to measure the economic well-being of farmers. The first is farm income, which is measured as the price of farmer-owned inputs multiplied by their quantity, shown graphically as the shaded rectangle in Figure 8.6b. The second measure is the economic rent that farmers get, which is the darker area to the left of

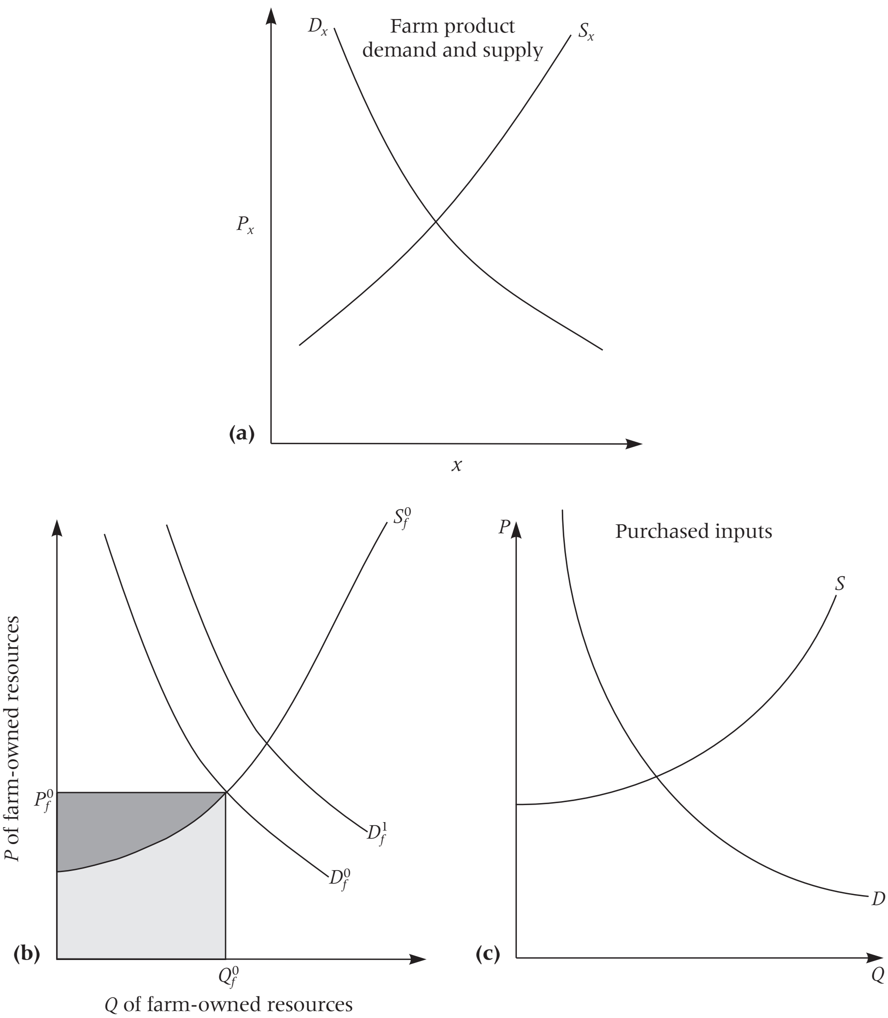

Figure 8.6 (a) Farm product market. (b) Market for farm-owned resources. (c) Market for purchased inputs.

the supply curve S_f^0 and below P_f^0. This is income that farmers receive over and above what they would receive if they used their resources in the next-best opportunity besides farming.

This conceptual setup is helpful for sorting out causal factors. They can only affect farm income by generating a shift in one or more of the supply-demand curves of Figure 8.6. And whatever shifts are generated, the effects on farm income (by either measure) arise in one of two ways: a shift in demand for farm-owned resources, D_f^0, or a shift in their supply, S_f^0. Most of the causal factors that have been discussed influence farm income by shifting the demand curve D_f^0. If foreign buyers of U.S. farm products reduce their import barriers (as under the Uruguay Round Agriculture Agreement), this shifts the demand for farm products to the right in Figure 8.6a, and that generates a rightward shift in demand for farm inputs, as from D_f^0 to D_f^1. This means that farm income and rents both rise. Generally, if an event in farm product markets increases the derived demand for farm inputs, farmers gain economically. Thus farmers like to see not only expanded export demand but also expanded domestic demand, generated for example by a new use for farm products, such as ethanol from corn as a gasoline substitute.

Technological progress and resulting productivity increases are analytically more complicated. One issue arises from the heterogeneity of farmers. As stressed by Cochrane in the passage quoted in Chapter 3, farmers who are early adopters of a profitable innovation can increase their incomes substantially as their costs decline while product prices remain relatively unchanged. But as adoption spreads, the initially given quantity of agricultural resources produces more output, and the price of agricultural output falls. The more fundamental issue about technological change is whether, after farmers have fully adjusted to new production possibilities (which means more aggregate output up to the point that the price of farm output just equals the reduced marginal cost of producing it) farm income will be higher or lower. In terms of our diagrams, will the demand for farmer-owned resources increase or decrease?

Cochrane's pessimism can be derived from the supposition that D_f^0 will shift to the left. The same inputs will produce more output, so to produce the same output we need fewer inputs, and this outcome is expressed as a reduced demand for all resources in agriculture. The counterargument is that more output will be sold at lower prices, and to produce this additional output, more agricultural resources are required. This issue is a quantitative one, the resolution of which has already been discussed. The condition under which a product demand increase is just sufficient to offset the productivity effect on resource demand is that the elasticity of demand for agricultural output should be -1. If demand is more elastic, so a price decline of X percent causes sales to rise more than X percent, then the demand for resources in agriculture will rise (D_f^1 shifts to the right from D_f^0). Farm income and economic rents both increase. The gravamen of farm-income pessimism, then, is that the demand for farm output is inelastic. Indeed, all studies of aggregate U.S. food demand and derived farm product demand suggest that this is the case. In this situation consumers get all the benefits of technological innovation through lower prices, and farmers are the economic losers.

The main opportunity for output demand to be elastic, and hence for farmers to gain, arises from international trade. If U.S. farm output falls in price, the demand for U.S. products abroad will rise. Export demand is commonly found to be elastic, especially in the long run as U.S. products become more competitive and win larger market shares abroad. Overall the issue becomes an empirical one, and one that turns on a quite precisely defined issue: is the demand for U.S. farm output elastic or inelastic?

Matters are not so simple, however, because of the role of purchased inputs, the supply-demand picture of which is shown in Figure 8.6c. Under the scenario just described, the demand for purchased farm inputs would experience the same economic fate as farmer-owned resources—the prices of all inputs would rise when agricultural export demand increased, or when technical progress occurred. A complication is that technical change could be biased, as mentioned earlier. For example, a new crop variety might be more responsive to fertilizer, so that its introduction would increase the demand for fertilizer more than for land. In this case, farmers could see an income decline even if output demand were elastic. Or new seeds that embody pest-resistant genes might reduce the demand for purchased pesticides relative to land. In this case farmers could gain even if output demand were inelastic. The elasticity of product demand is still a crucial parameter in determining whether farmers gain or lose from technical progress, but the elasticity of demand of -1 no longer marks the exact dividing line between farmers gaining or losing.[2]

It remains the case that a sufficiently elastic product demand ensures that farmers will gain from productivity improvements. That fact is particularly important in considering research on products that are exported into a large export market, where additional output has a minimal influence on the market price. This is why Australian and New Zealand farmers, for example, are vigorous supporters of agricultural research on wheat, wool, and milk production. U.S. producers of exported products have generally similar sentiments, but not as overwhelmingly as in the case of countries with smaller market shares, who can double their output without causing the world price to drop appreciably. But in the longer term every country has to worry if it is not engaging in cost-reducing research while other countries are. If foreign production becomes more efficient (or equivalently if foreign producers subsidize their exports as the European Union has done), this shifts

2. Formulae for the exact dividing line in more complicated cases are given in B. L. Gardner (2000a).

D_x and hence D_f^0 to the left and reduces U.S. farm income, whatever the elasticity of demand may be. For this reason U.S. producers of exported crops have been big supporters of trade negotiations, even when sometime fellow populists in labor and elsewhere have become trade skeptics.

Some of the causal factors listed earlier shift the supply of farm-owned resources (S_f^0) rather than the demand, and this raises further complications. It has been argued that improvements in the nonfarm labor market after World War II had as much or more to do with farm income growth as productivity growth or commodity market trends. Analytically, an increase in the opportunity wage of farmers is a shift to the left of S_f^0. The effect will surely be to increase P_f^0, the return to farm-owned inputs. Aggregate farm income may be reduced. It will be, if the demand for farm resources is elastic. Whether economic rents increase or decrease is further complicated because one has to know how S_f^0 shifts along its entire length to calculate the change in rents. A parallel shift is unlikely because, for example, some farm people are better placed by reason of skills or location to take advantage of nonfarm opportunities. If people who are already at the margin of moving off the farm are most affected, then the shift in S_f^0 may occur only at the higher points on the curve, and in this instance rents are more likely to increase. But in any case there is the further complication that when farmers move out of agriculture the number of farmers decreases, and this in itself increases income *per farmer.*

Several attempts were made in the 1960s and 1970s to estimate supply-demand models of factors determining farm income, following analyses of farm labor markets developed by G. E. Schuh (1962). T. D. Wallace and D. M. Hoover (1966) use cross-sectional data for states in 1959 to estimate a supply-demand model of farm labor. They find that a state's research and extension spending in prior years had a positive effect on that state's demand for labor in agriculture and hence on returns to labor in farming. But they note that their finding assumes that farm commodity prices remain constant; and if all states were to increase such spending, commodity prices would fall. Wallace and Hoover estimate that if farm product demand were inelastic, the demand for labor in aggregate would fall and returns to labor would decline. Micha Gisser (1965) focuses on education and farm labor supply, finding that more schooling increases the mobility of the farm labor force and thus increases earnings of remaining farmworkers generally. Daniel Sumner (1982) and Wallace Huffman and Mark Lange (1989) analyze off-farm work decisions, finding that by the 1970s at least, farm people were responsive to off-farm earnings opportunities.

These studies and others like them have investigated various hypotheses about the economic development of U.S. agriculture for relatively short time periods. Discussion earlier in this chapter presented longer time series of data and various hypotheses concerning their evolution. An appealing research program for synthesizing this mélange is a systematic statistical investigation of interactions among the hypothetically interrelated variables. This project could possibly be accomplished using vector autoregression, a search for and testing of lead, lagged, and contemporaneous correlation among the variables investigated. Unfortunately, this has not proved to be a fruitful line of investigation to date. The problem seems to be that the time series data are too dominated by trends, with a few structural changes, that result in too few independent annual observations to identify the relationships among them. We have plenty of observations of prices and some other variables at monthly or even daily frequencies. But the crucial hypotheses to be investigated—the consequences of research and education for productivity; the consequences of productivity growth, farm size increases, and the globalization of commodity markets for agricultural GDP; the role of off-farm earning opportunities and migration from farms for farm household incomes; and the consequences of federal commodity and regulatory policies for the rural economy—all these factors have their postulated effects at the time scale of an annual crop cycle, and even longer time scales. We do not have enough national-level data at these frequencies to use statistical methods to decisively supplant the kind of case-study and severely delimited investigations that have been described in this chapter. The next chapter turns to less aggregated data, for states.

9

Regions and States

The story of U.S. agriculture has been told largely at the national level to this point. For many purposes a national focus is appropriate. The technology used in producing each of the major crops is roughly similar wherever it is grown—in brands and types of machinery, fertilizers, and chemicals used. Farmers have been through similar educational experiences nationwide, and they have similar off-farm labor market opportunities across the country. Most commodity and purchased input markets are national in scope, and there is commonality in the nature of rural culture and communities. Agricultural policies also are for the most part nationally calibrated, with the same support levels and program availability everywhere (in contrast to the greater prevalence of regionalism in European agricultural policies, for example). But as we learned in the preceding chapter, it is doubtful that time series econometrics on national data will ever be able to provide convincing tests of hypotheses, because there is too little independent variation in the causal forces—history simply has not performed enough enlightening experiments.

In much historical research, however, regional features of U.S. agriculture are prominent. Notable are the distinctions between the formerly slaveholding South and the North, and between the semiarid West and the East. Other regional differences exist for smaller areas, such as areas producing sugar cane or the tobacco belts of the Southeast. This chapter uses comparisons of states to isolate causes of U.S. agricultural development that cannot be identified in nationally aggregated data.

State Differences in Agricultural Sector Growth

The states have differed in several aspects of agricultural economic growth, as Table 9.1 indicates by showing annual rates of change from the late 1940s into the mid-1990s of some key economic variables. Consider sectoral real

Table 9.1 Indicators of economic growth in agriculture, annual rates of change

	Agricultural GDP		Real market value of sales	Real value added per farm	Median farm household real income
	1949–1997[a]	1949–1997[b]	1949–1992[b]	1949–1992[a]	1950–1990[a]
Alabama	0.001	0.020	0.031	0.039	0.048
Arizona	0.003	0.022	0.031	0.011	0.028
Arkansas	0.005	0.025	0.034	0.040	0.043
California	0.013	0.032	0.036	0.027	0.031
Colorado	0.004	0.023	0.033	0.019	0.026
Connecticut	−0.011	0.008	0.009	0.029	0.034
Delaware	−0.001	0.018	0.029	0.025	0.036
Florida	0.014	0.033	0.046	0.025	0.041
Georgia	0.012	0.031	0.034	0.049	0.049
Idaho	0.007	0.027	0.035	0.024	0.023
Illinois	0.000	0.019	0.019	0.021	0.023
Indiana	−0.001	0.018	0.022	0.022	0.025
Iowa	0.001	0.021	0.024	0.018	0.020
Kansas	0.003	0.022	0.032	0.020	0.026
Kentucky	−0.001	0.019	0.027	0.022	0.035
Louisiana	−0.004	0.015	0.025	0.031	0.037
Maine	−0.025	−0.006	0.007	0.015	0.033
Maryland	−0.003	0.016	0.027	0.019	0.039
Massachusetts	−0.011	0.009	0.007	0.025	0.034
Michigan	−0.009	0.011	0.023	0.018	0.028
Minnesota	0.001	0.020	0.027	0.019	0.025
Mississippi	−0.009	0.011	0.022	0.038	0.049
Missouri	−0.007	0.013	0.020	0.013	0.034
Montana	−0.005	0.014	0.022	0.005	0.022
Nebraska	0.009	0.028	0.037	0.025	0.021
Nevada	−0.010	0.010	0.029	−0.003	0.032
New Hampshire	−0.014	0.005	0.006	0.027	0.036
New Jersey	−0.016	0.003	0.004	0.012	0.037
New Mexico	0.002	0.021	0.031	0.017	0.033
New York	−0.019	0.000	0.015	0.011	0.029
North Carolina	0.005	0.025	0.030	0.043	0.036
North Dakota	−0.004	0.016	0.025	0.013	0.019
Ohio	0.002	0.022	0.021	0.026	0.026
Oklahoma	0.001	0.020	0.028	0.019	0.034
Oregon	0.008	0.027	0.030	0.021	0.028
Pennsylvania	−0.009	0.011	0.024	0.018	0.027
Rhode Island	−0.001	0.019	0.014	0.038	0.040
South Carolina	−0.010	0.009	0.016	0.034	0.043
South Dakota	0.011	0.030	0.026	0.027	0.020
Tennessee	−0.014	0.006	0.022	0.011	0.039
Texas	−0.005	0.014	0.025	0.010	0.035
Utah	0.000	0.019	0.023	0.016	0.023

Table 9.1 (continued)

	Agricultural GDP		Real market value of sales	Real value added per farm	Median farm household real income
	1949–1997[a]	1949–1997[b]	1949–1992[b]	1949–1992[a]	1950–1990[a]
Vermont	−0.008	0.011	0.021	0.020	0.036
Virginia	−0.012	0.008	0.024	0.020	0.038
Washington	0.011	0.031	0.037	0.028	0.026
West Virginia	−0.037	−0.018	0.009	−0.001	0.033
Wisconsin	−0.008	0.011	0.029	0.011	0.028
Wyoming	−0.008	0.011	0.027	0.001	0.023

Sources: Calculated from U.S. Department of Commerce, *Census of Agriculture* and *Census of Population* data, various years.

a. GDP deflator.

b. Farm prices received deflator.

GDP, the economic growth indicator used at the beginning of Chapter 8 at the national level. Following the practice in the literature on economic growth, the focus there was on value added per worker or per capita. In looking at states, we are also interested in the aggregate level of economic activity within each political jurisdiction, and why it has behaved differently in different states.

The first column of Table 9.1 shows the trend growth rate of aggregate agricultural GDP, or value added, for each state over the 1949–1997 period. The fastest growth occurred in Florida, California, and Georgia, with annual rates of 1.2 percent to 1.4 percent. Most states, however, had a declining agricultural sector, with West Virginia's farm GDP falling at an annual rate of almost 4 percent.

Does this mean that economic activity in agriculture is declining in many states? A factor that complicates an assessment, as was the case in national trends, is change in the prices of farm products relative to the overall price level. Real GDP is calculated by deflating nominal value added in agriculture by an overall price index, the GDP deflator. The GDP deflator grew at an annual rate of 3.7 percent between 1949 and 1997, but USDA's index of prices received by farmers for their products grew at only a 1.5 percent rate over this period. We would get a better quantity-based idea of agricultural activity by deflating nominal value added by the Prices Received Index. When this is done, the measure of real agricultural value added increases by an additional 1.9 percent annually, and only two states, West Virginia and Maine, have a shrinking agricultural sector over the period.

A focus on a state's aggregate agricultural output suggests consideration of the market value of agricultural products sold, deflated by the prices received index. The value of products sold is a more comprehensive measure than sectoral GDP or value added, because the market value of products also includes returns generated by purchased farm inputs (which are subtracted out in estimating value added). Since the share of costs accounted for by purchased inputs has been increasing over time, real sales by this measure increase faster than farm-sector GDP. Because the prices received index used is the same nationwide, a state's real output increase measures not only output expansion but also the change in that state's agricultural prices relative to other states. Thus the 4.6 percent annual growth rate of real sales shown in the third column of Table 9.1 is attributable not only to increased quantities of Florida output but also to increases in the prices of Florida's farm products relative to U.S. average farm prices.

The economic base for generating the income of a state's average farmer is value added per farm. The rate of growth of this indicator is shown in the fourth column of Table 9.1. It grows faster than a state's aggregate agricultural GDP because of the substantial reductions in the number of farms over this period, which occurred in every state. The rates of decline in New England and the South, losing an average of about 3 percent of farms annually over forty years, have cut farm numbers in half every twenty-four years. By this measure the farms of all states but two (West Virginia and Nevada) grew between 1949 and 1992.

GDP includes value added by hired farmworkers, nonfarm landlords, and others who are not farm operators but provide services to farms, notably off-farm landlords who own farms but do not operate them. If the services of any of these providers are increasing (or decreasing) over time relative to inputs owned by farm operators, then dividing GDP by farms overstates (or understates) the growth of properly adjusted real output. A more meaningful measure, or at least one whose meaning is more consistent over time when calculated per farm, counts only value added by farm operators in agricultural GDP. We already have a measure of this concept in net farm income. This indicator is roughly correlated with agricultural GDP, as the scatter diagram of Figure 9.1 shows. Each point represents a state. The correlation coefficient between the growth of agricultural GDP per farm and net farm income is 0.93.

If agricultural output were produced entirely by farm operators who owned all their land, hired no labor, and borrowed no money from banks or others who are not farmers, then agricultural GDP and net farm income would be the same except for depreciation of farmer-owned capital. Thus the ratio of agricultural GDP to net farm income is an indicator of the commercialization of agriculture in the sense of departing from the model of

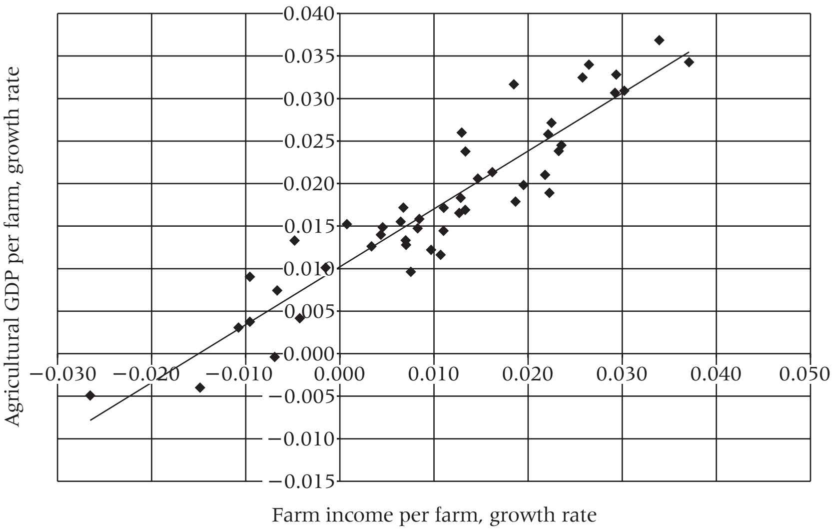

Figure 9.1 Annual growth rates of farm income and agricultural value added, 1949–1992. Data from USDA, Economic Research Service website, <http://www.ers.usda.gov/>.

self-reliant family farming. For the average U.S. state, this ratio was 1.38 in 1949 and 1.84 in 1989—another indicator of the trends discussed in Chapter 3. But the story varies regionally. In the Northeast the ratio has increased little, and in four of the six New England states it decreased. This reflects an increasing importance of smaller-scale, specialized farming in urbanized areas that runs counter to some of the nationally more prominent trends. There are clear indications that profitable farming can be undertaken in suburban circumstances (see Heimlich 1989).

Neither agricultural GDP nor farm income tells the whole story of farm households' earnings, because so much of their income comes from off-farm activity. The importance of off-farm income varies from state to state. It is less important, as one might expect, in states more remote from large urban centers. A fuller picture of farmers' economic standing is given by the average farm operator's household income from all sources.

To focus further on households rather than on the farm sector, the average used in what follows is the median, not the mean, on the grounds that our interest is in the income of the average household rather than in mean income, which is the average income of all the households. The two measures would be the same if the income distribution were not skewed, but in agriculture incomes of farms in the top half of the income distribution are further above the mean than the incomes of farms in the bottom half are below the mean. A further, practical statistical reason for preferring the median is that farm net income as reported has a lot of very high as well as low incomes (about 40 percent of respondents report negative net farm income in USDA surveys). The extremes are difficult to measure accurately, and they have a big influence on the mean. But for the median, all that matters about the extreme observations is that they are properly ordered relative to households with mid-level incomes.

The growth of real median household income is shown in column 5 of Table 9.1. This indicator generally shows more rapid growth than the other performance indicators and varies less from state to state. A possible outcome of our investigation, consistent with the hypothesis discussed in Chapter 8 that nonfarm labor market developments have been as important as technology or agricultural policy, could be that farm households' income growth over the long term is only loosely connected with agriculture and that household income growth is governed by forces distinct from the determinants of net income from farming.

Figure 9.2 shows the relationship between growth in farm income from farming and growth in farm household income from all sources. Although

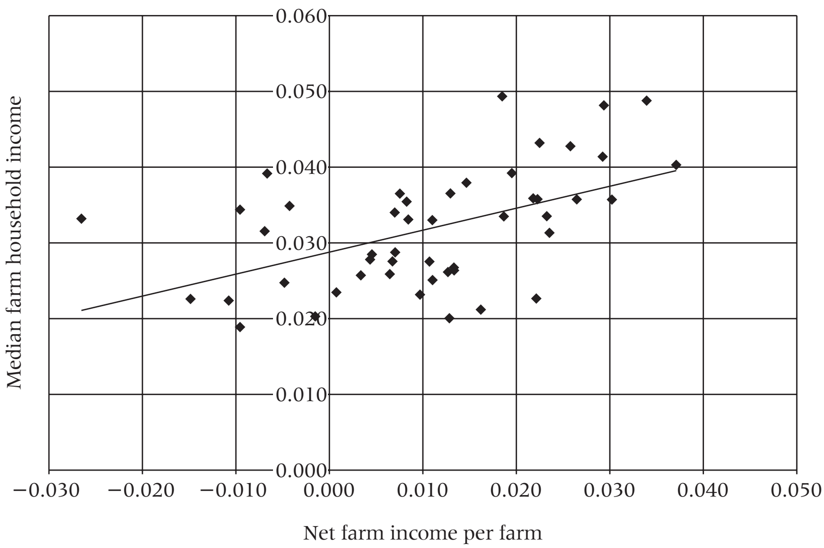

Figure 9.2 Annual growth rates of net farm income and farm household income, 1950–1990. Data from USDA, Economic Research Service website, <http://www.ers.usda.gov/>, and U.S. Department of Commerce, *Census of Population*, various years.

the two measures of income are closely related in that farm income is a component of farm household income, the sources of data for these two measures are very different. Net farm income, like the GDP indicators, is estimated by USDA from aggregate data on farm output, prices, and costs. Farm household income is estimated in the decennial Census of Population by asking farmers directly what their net income from all sources is. There are problems in obtaining accurate estimates by either method, but they are quite different problems. One is that there is a notable tendency for respondents to understate their self-employment incomes. Since farm households got less of their income from self-employment in 1990 than in 1950, a tendency exists for the data to overstate income growth. The U.S. Department of Commerce (1993a, p. C-12) conducted a comparison of survey-reported income with estimates from independent aggregate data sources. For wage or salary income, the survey found 97 percent of the wage and salaries estimated from aggregate data. For self-employment income generally, income reported in the survey was 71 percent of the estimated total. For farm self-employment income, the amount reported in the survey was only 37 percent of aggregate farm income as estimated by USDA.

States with higher growth rates of net farm income do show faster growth in farm household income, but the relationship is loose (see Figure 9.2). The correlation coefficient across the forty-eight contiguous states is 0.27. Note also that the relationship appears slightly nonlinear: over the middle range of farm income growth rates, the growth of household income is at about the same average rate, but the states where the growth of farm income is highest and lowest have higher household income growth (observations at the right and left ends of the linear trendline in Figure 9.2 tend to lie above the line).

Before 1950, state-level data on a consistent basis are not available. USDA and the Commerce Department's Bureau of Economic Analysis have developed unified state-level data series for the second half of the twentieth century, but not for the period before World War II. For earlier years, USDA and several independent scholars have developed historical state-level series, based on more fragmentary data, for a few indicators. These indicators are not directly comparable to the more recent GDP-accounting data. Consequently most of the following analysis considers the first and second halves of the century separately.

For the 1900–1950 period, a most useful set of data was created in the work of Richard Easterlin (1957), under the leadership of Simon Kuznets in the monumental project whose main findings were published in *Population Redistribution and Economic Growth: United States, 1870–1950.* Easterlin produced state estimates of "agricultural service income," essentially sectoral GDP minus income accruing to property ownership, for 1900, 1920, and

1950, the latter two as three-year averages of 1919–1921 and 1949–1951, respectively. Figure 9.3 shows the trend of real labor GDP per worker for a sample of the most important agricultural states. All the smaller states fall within the range of outcomes shown. The data are plotted on a logarithmic scale so the slope measures the rate of growth.

On average for the United States, the rate of growth is 2.3 percent annually during 1900–1920 and 2.1 percent during 1920–1950—about the same average rate over the whole half century (though with substantial decline in the 1920s and 1930s and recovery in the 1940s that falls between the 1920 and 1950 data of Easterlin). The rate of gain and loss varies across states, from a low of 1.8 percent annually during 1900–1950 in North Dakota to a high of 3.6 percent in Florida. Over a fifty-year time span, this means that if the two states started at an equal real GDP of 100, North Dakota would have risen to 244 while Florida would have risen to more than twice that level, at 586.

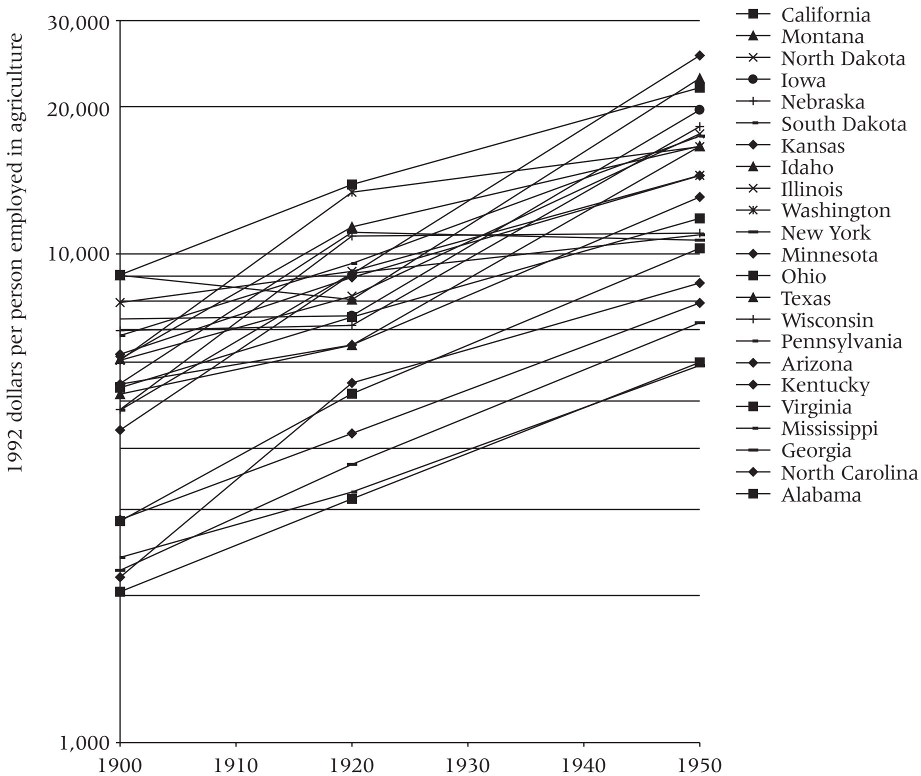

Figure 9.3 State growth in real agricultural labor returns per person employed. Data from Easterlin (1957).

Growth and Convergence

The range of GDP per worker across states (measured in percentage terms as a vertical distance in Figure 9.3) is about the same in 1950 as it was in 1900. This result is remarkable, given the large variation across states in long-term rates of growth. The unchanging range of relative differences between states might be taken as an indicator of a kind of dynamic stability—things change yet stay the same—as opposed to convergence or divergence over time in state differences. But an inference of stability in this sense would be misleading. The fact that some states grew faster than others over the long term yet dispersion among states did not increase implies that some of the states that grew fastest tended to be those with lower initial GDP levels.

Easterlin (1960) in fact found convergence in these data, in the sense that GDP per worker in initially low-income regions moved up relative to mean U.S. income levels, and initially high-income regions moved relatively lower. He attributed this convergence to mobility of labor and capital, a primary theme of the Kuznets-led study of which Easterlin's work was a part.

Recent research on economic growth has revisited the question of economic growth and convergence in a more theoretical context, based on neoclassical growth models (see, for example, Barro and Sala-i-Martin 1992). These models focus on investment that increases the capital stock per worker as the generator of increased real income per capita. Growth occurs as long as the rate of return to capital exceeds the rate of return necessary to induce people to forgo current consumption and save. But as capital per worker increases, each addition to capital per worker leads to diminishing marginal returns and the rate of increase of income per capital slows. The application of neoclassical growth ideas to regions within a country predicts that regions below average in per capita GDP at an initial date will tend to catch up. Assuming that the same technology can be used everywhere, initially low output per person in a region indicates a high marginal return to capital investment in that region. With a well-functioning capital market, investment will occur at a higher rate in a low-income area and its per capita income will grow faster than in high-income areas (from which capital flows may be coming). Even in the absence of capital flows, people will move out of low-income areas into high-income areas, and this will also cause convergence in per capita incomes. The initial state is one of economic disequilibrium, in the sense that the initial state is not sustainable. The initial state itself generates actions that move the economy out of that state.

One may ask why, if the disequilibrium state is observed at one point in time, it should not continue? Maybe for technological or other reasons the rate of return to investment in a poor region is not larger than in a rich region. Moreover, if an initial situation of disequilibrium is observed in a region, it is important to consider how the disequilibrium came about. Whatever force is at work might be moving a poor region away from, rather than toward, a long-run equilibrium.

Schultz (1950) argued that U.S. agriculture was in just that situation. From initial conditions at the time of rural settlement in which disparities in income between different rural communities were not large, big income differences arose not because some areas became poorer but, rather, because others became richer for reasons unavailable to communities that were economically left behind. Schultz (1953) cites a study in which the farm "level of living" in 1945 is estimated to have an average index value of 13 in the ten lowest counties of Kentucky, compared with 190 in the ten highest counties of Iowa, although in earlier years counties in the two states were economically much more similar. The data are developed in Hagood (1947). The index is crude. It is a weighted sum of the percentage of farms having electricity, percentage with telephones, percentage with automobiles, and the average farm's sales of products. In the counties with low index values, few farms had the first three items and the index is thus close to zero. It is scaled so that the average value is 100. There is no meaningful sense in which the index value of 190 for Iowa means the Iowa residents were on average 190/13 = 14.6 times better off than the average of the Kentucky residents. Despite the index's serious weaknesses, over the time period in which the estimates were made, 1930 to 1954, Schultz's point is well taken that the vast differences in the index between the counties of Kentucky and Iowa indicate large disparities emerging in the process of rural economic development.

Thus convergence may or may not occur during the growth process. Labor and capital mobility may be slowed by cultural factors that hinder adjustments to disequilibrium in the initial situation. Easterlin gives other reasons why convergence between regional income levels might fail to occur, as was true for a subperiod he analyzed, finding that already high agricultural incomes in the mountain states increased at a rapid rate while a slower rate of growth was observed in the low-income South.

To quantify convergence, an approach used in Barro and Sala-i-Martin as well as other recent studies is helpful. Convergence can be estimated from the following equation:

$$g_{t,0} = a + by_0 \tag{9.1}$$

where g is the rate of growth of real GDP per worker between 1900 and a later time, t; y_0 is the log of the level of real GDP per worker in 1900; and a

and b are parameters to be estimated. The value of b indicates the change in the annual growth rate resulting from a 1 percent higher level of y_0.

Estimating equation (9.1) using annual rates of change from 1900 to 1950, in a weighted ordinary least-squares (OLS) regression, the estimated values of a and b are .061 (6.4) and −.005 (3.7), respectively. The b value means that a state that had a 30 percent lower GDP per worker in 1900 than the national average is predicted by the regression equation to grow at a rate 1.5 percent faster than the national average of 2.2 percent annually between 1900 and 1950. The numbers in parentheses are absolute values of t-statistics. They indicate statistical significance at the 95 percent confidence level (against the null hypothesis of a zero coefficient, or no convergence). Weighted regression is used because of the substantial variation in the size of the agricultural sector in the states. Unweighted regression gives too much influence to the smaller states, and may create heteroskedasticity in the equation's errors. The observations are weighted by the agricultural labor force of 1950, which varies from 39,000 (Rhode Island) to 4.5 million (Texas). (An unweighted regression was also estimated and gave the same value for b as the weighted regression.)

Several recent authors have warned against bias that would cause acceptance of the hypothesis of convergence when it is false, or alternatively rejection of the hypothesis when it is true. For assessments of these arguments, see Quah (1996) or Nerlove (2000). The practical point for the purposes of the preceding regression result, finding convergence across states, is that this finding might be a statistical artifact. One reason for bias toward a negative value of the estimated b is that variables omitted from the equation are positively correlated with growth but negatively correlated with initial income. This would be a serious problem if the conclusion of convergence were taken to provide evidence for a particular model of convergence, as do, for example, the studies that predict convergence using a neoclassical growth model and then take a negative b as confirmation that the model applies. But the present purpose is not to test a model. States that have initially low GDP per worker may grow faster because the marginal return to investment is higher in them, or because low-income workers leave those states for richer states, or because public policies invested more in infrastructure or human capital in those states. For the moment the issue is only whether some source of income convergence has been at work, or not.

A second line of criticism is potentially more damaging for simple convergence econometrics. If initial GDP levels are temporarily low just by chance, then we are liable to observe convergence according to equation (9.1) even if in fact there is no convergence in underlying or permanent income. Christopher Bliss (1999) relates this phenomenon to "Galton's fallacy," the conclusion that because tall fathers tend to have sons shorter than the fathers, and short fathers, taller sons, then we should expect the variance of men's height to decline over time. We can test for the applicability of this problem in the GDP data by estimating whether the variance of GDP per worker across states is declining over time. Figure 9.3 suggests that in fact variation across states, at least the percentage difference between the highest- and lowest-income states, did not decline between 1900 and 1950. However, the coefficient of variation (standard deviation/mean) of real GDP per worker across states declined from 0.402 in 1900 to 0.373 in 1950.

Suppose the estimates of $a = .061$ and $b = -.005$ were the true parameter values indicating the extent of convergence. The predicted values of income by state can then be calculated from the actual 1900 GDP values. The resulting predicted coefficient of variation of GDP per worker across states in 1950 is 0.307. That is, if there had truly been as much convergence as the estimated a and b parameters say, the reduction in GDP variability across states would have been about three times the reduction that actually occurred between 1900 and 1950; thus about two-thirds of the estimated convergence appears to be spurious. Changes in variance across states are not a conclusive test of "true" convergence, however. It could be, for example, that convergence is actually occurring in the sense of economic adjustments working, but that new sources of income differences among states are introduced over time, such as differences in the influx of immigrants or relatively poor retirees heading south for noneconomic reasons.

For the period since 1929, a more complete data set is available for farm-sector income. For those more recent years, USDA has state-level estimates of farm gross and net income including property income, which is left out of Easterlin's agricultural service income estimate, for each state. But USDA's net farm income omits returns to hired farmworkers. For the period since 1949 the USDA's Economic Research Service has estimated state-level annual statistics that follow the approach used in the BEA's National Income and Product Accounts to measure sectoral value added, which is equivalent to GDP. This measure includes value added by all labor, land, and capital committed to agriculture. Table 9.2 summarizes the state-level data and shows estimated convergence statistics, b of equation (9.1), for both the net farm income and the value-added concepts over several time periods.

For neither net farm income nor value added is there a clear tendency for convergence. This is borne out not only by the lack of significance of the estimated b coefficients, but more directly by the observation from the means and variances shown in Table 9.2 that net farm income per farm becomes substantially more variable across states, with a coefficient of variation (standard deviation/mean) of 0.73 in 1989 compared to 0.36 in 1929

Table 9.2 Statistics of convergence and economic variation among states

A. Net farm income per farm, in 1992 dollars

	48-state mean	Standard deviation	Coefficient of variation	Average in lowest state	Average in highest state	Ratio max./min.
1929	9,691	3,468	0.358	5,297	20,738	3.92
1939	8,679	3,039	0.35	4,423	17,007	3.85
1949	14,982	8,642	0.577	5,414	55,566	10.26
1969	20,767	13,655	0.658	2,728	81,303	29.8
1989	27,361	19,910	0.728	1,870	93,345	49.92

Net farm income convergence

			Estimate excluding regional effect	
Period	Parameter *b* coefficient	*t*-statistic	Coefficient	*t*-statistic
1929–1989	−0.004	1.04	.013	2.56
1929–1949	0.003	0.67	.008	1.18
1949–1989	−0.007	1.60	.007	1.45
1929–1939	−0.019	2.69	−.021	1.84
1939–1949	0.013	1.31	.006	0.99
1949–1969	−0.006	0.94	.006	1.00
1969–1989	−0.002	0.57	.007	1.41

B. Value added per farm, in 1992 dollars

	48-state Mean	Standard deviation	Coefficient of variation	Average in lowest state	Average in highest state	Ratio max./min
1949	21,949	14,300	0.652	6,213	88,187	14.19
1969	34,095	25,508	0.748	4,871	154,345	31.69
1979	41,521	28,991	0.698	6,718	164,216	24.44
1989	44,666	27,403	0.614	5,239	145,138	27.70

Coefficient b *for value-added equations: basic model*

			Excluding south-north adjustment	
	Coefficient	*t*-statistic	Coefficient	*t*-statistic
1949–1989	−0.006	2.15	0.005	1.56
1949–1969	0.001	0.13	0.010	1.76
1969–1989	−0.013	3.08	−0.007	1.47
1969–1979	−0.026	3.80	-0.026	3.27
1979–1989	−0.010	1.15	0.000	0.05

Source: Regressions discussed in text.

and 0.58 in 1949. This divergence, in the sense of an increasing relative spread between states, is quite different from the story of convergence in Easterlin or in the recent estimates for U.S. state aggregate (farm and nonfarm) GDP in Barro and Sala-i-Martin (1992). Why?

A regional element that appears most important in recent U.S. agricultural development is that of the South. Chapter 5 discussed regional equalization of farm wage rates, which is associated with the national rise in farm relative to nonfarm household income. This trend was explained in Chapter 8 as a story of adjustment to disequilibrium between returns to labor in farm and nonfarm employment. Wright (1986) makes a good case that since 1940 a striking general equalization between the economies of the South and North has occurred. Barro and Sala-i-Martin (1992) found that convergence of state per capita incomes is pervasive in this century, but that it is not a North-South phenomenon. The question then arises whether what is called an equilibrating process between agriculture and nonagriculture might be just an artifact of regional or state economic adjustments at the level of overall labor markets, with little or no specifically agricultural component.

A simple way to investigate this possibility is to include a regional variable (equal to 1 for southern states and 0 for nonsouthern states) in the convergence equations that generated the results shown in Table 9.2. When this is done, it turns out that indeed the "south" variable is significantly positive, meaning the southern states have grown faster, given the levels at which they started. Nonetheless, the convergence coefficients retain their insignificance, and the parameter estimates change very little. (The South is defined as the eleven states of the Confederacy from the Mississippi Delta east: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, and Virginia.) The results indicate even less evidence of convergence than the simple regressions.

It is apparent that the reason some states have grown faster than others is *not* that some started later and have been catching up. What does explain the differences? Growth models typically focus on technical progress and growth of the capital stock as determinants of the rate of growth of per capita income. Growth in capital services is measured as the percentage change in USDA's estimate of capital consumption per farm, in 1992 dollars. This is an indirect measure, but is an accurate proxy for growth in the capital stock if depreciation is the same fraction of the capital stock in all states. (There are undoubtedly differences between states in this fraction, but since we use only rates of change over time as the regressor, this will not matter so long as the fraction remains the same over time in each state.)

Productivity growth is the rate of growth of multifactor productivity

(MFP), which measures how well the farm operators of a state are able to put their labor, land, and capital inputs to productive use. USDA has not estimated state-level MFP data before 1960. I use the estimates of Klaus Deininger (1995) for 1949–1960, rescaled to match the USDA measure for 1960–1989. The question then is how much of state differences in net farm income growth between 1949 and 1990 can be explained by these capital and productivity variables.

Consider also some additional factors whose levels in 1949 may have influenced the subsequent growth of farm income: the educational level of farmers, the state's public infrastructure, and the importance of government farm programs, all of which vary substantially from state to state. For statistical purposes I measure the first by the percentage of each state's farm males over twenty-five years of age who have completed high school. Infrastructure is a more difficult variable even to conceptualize, much less to measure. I use the state's property tax rate on agricultural land in 1949. This indicates the intensity of local government activity in rural areas, and is assumed to be related to spending on infrastructure to the extent that property tax revenues are used to provide local services in rural areas. The importance of farm programs is measured by government payments received per farm in a state in 1949. Levels in 1949–50 are used to minimize the chance that these variables are caused by rather than causing income growth after 1950. The variables augmenting equation (9.1), with estimated coefficients, are as follows:

Variable	Coefficient	*t*-statistic
1949 net income per farm	0.009	1.54
Growth of capital	1.102	3.09
Growth of productivity	0.981	2.05
Percentage completing high school, 1949	−0.001	0.03
Tax rate on farm real estate, 1949	0.0044	1.64
Government payments, 1949	0.013	2.50

Capital and productivity growth have statistically significant effects. The coefficient of 1.10 on capital means that an increase in the growth rate of capital per farm of one percentage point increases the growth rate of net income per farm in a state by 1.1 percent. The coefficient of 0.98 on productivity growth means that a 1 percent increase in the MFP growth rate increases the growth of net income per farm by almost 1 percent.

The other added variables are all somewhat crude proxies for the concepts we would like to measure, so it would be premature to draw strong conclusions from the regression results for them. The tax rate of farm real estate, taken as a proxy for investment in a state's rural public infrastructure, arguably has a positive effect even though one can't be confident of this with a *t*-ratio of 1.64. More surprising is the lack of effect of farmers' schooling level. This nonsignificance is robust with respect to alternative specifications (various combinations of the independent variables) and alternative measures of schooling attainment such as median years of schooling in 1950 or later years. The government payments coefficient indicates that states growing the commodities that received the most support in 1949 saw their net farm income grow the most in 1949–1989. The Cochrane-Clarke hypothesis that was discussed in Chapter 8 would explain the role of government commodity support as an encouragement of investment and innovation that raised productivity growth. But variables representing investment and productivity growth are already in the equation. And estimating separate regressions in which the growth of capital and MFP growth are dependent variables, I find that 1949 government payments do not have a positive association with either growth of capital or MFP growth. I conclude that government support, if it is truly affecting farm income growth, is accomplishing its effect through some other mechanism.

Finally, note that the 1949 income level is no longer significant, so that we have eliminated most if not all of the unexplained divergence of net farm income per farm during 1949–1989.

An econometric issue in state cross-sectional regressions is spatial autocorrelation of the errors of the estimated equations, essentially whether remaining unexplained differences among states (residuals of the equations) have a geographical pattern. The most commonly considered such pattern is positive correlation of the errors of states that are neighbors. If spatial autocorrelation exists, it means that the estimated equations are likely omitting some important variable(s) that are common to neighboring states. These may be unobserved variables like climate. If we find spatial autocorrelation, that encourages a search for additional explanatory variables that are likely to be similar in neighboring states, as climatic variables are likely to be. Moreover, spatial autocorrelation of the errors has econometric consequences similar to serial correlation of the errors in time series analysis, most importantly that tests of significance of variables will too easily accept their significance (because there are fewer truly independent observations than simply counting the observations indicates).

The data on growth rates in fact appear geographically correlated. For example, the 1949–1989 growth rates tend to be low in the Corn Belt and high in the South. But a test regression using the residuals (actual growth rate minus predicted) as dependent variable, and as independent variables the residuals for the two closest neighbors of each state, indicates no significant spatial correlation of the errors in the results reported above.[1] The regression results find a positive coefficient relating the residual of the closest neighbor to a state's own residual, but the *t*-statistic is 0.9, not significant. The second-closest neighbor's residual has an even less significant negative sign. I conclude that spatial autocorrelation is not a significant problem in this sample of states.

Farm Household Incomes

The data considered to this point are narrowly agricultural. This is a serious limitation in studying farm households' incomes because so much of their income is earned at nonfarm activities, and that percentage has been increasing over time. To obtain a fuller picture, we now turn to farm household income data at the state level, which are available decennially since 1950 from the Census of Population. The rate of growth of farm household income averages higher and varies less from state to state than the growth of income from farm sources. Even states like Tennessee and Missouri, with negative growth of real agricultural income per farm, at the same time had farm household incomes growing at impressive rates of 3.5 to 3.9 percent in real terms over the 1950–1990 period (rates sufficient to double real income twice over forty years). But it is also true that the three states with the lowest growth rate of real farm household income, North Dakota, South Dakota, and Iowa, also had low or negative rates of real agricultural income growth. So the relationship between income from farming and the income of farm households is unlikely to be a simple one that applies everywhere.

Income convergence tests on household income tell a different story from the ones carried out for agricultural income. Estimating equation (9.1) using the 1950–1990 growth rates of median real farm household income indicates significant convergence, in contrast to the results with the agricultural GDP and net income measures, with b estimated at -0.021 and a at 0.22. The *t*-statistics for the null hypotheses of a and b equal to zero are 23.3 and 20.0, respectively, indicating both are statistically significant at the 99 percent confidence level. The regression was estimated by weighted ordi-

1. "Closest neighbor" of a state is defined as longest shared border with another state, so that the closest neighbor of Illinois is Indiana and the second closest is Iowa. But in some cases I overrode that definition, when the longest border was arguably not agriculturally as relevant as some other criterion. Thus I take the closest neighbors of Nevada to be Utah and Idaho, even though Nevada has a longer common border with California than either of those two. Another special case is Maine, which has a common border with only one other state (New Hampshire). In this case I take Vermont as the second-closest neighbor.

nary least squares, with each state observation weighted by farm numbers in the state. An unweighted regression gives essentially the same parameter values but lower t-statistics of 12 and 10, respectively.

The mean annual real growth rate of states' farm household income is 3.2 percent annually, with a convergence coefficient that causes the growth rate to slow by 0.02 for every doubling of base-period income. This means that after forty years about 80 percent of 1950 relative income differences between the states have disappeared. Thus, if we take two states that fit the regression equation well, Arkansas farm households had a median real income (in 1992 dollars) of $5,200 in 1949 and Michigan had $11,900. By 1990 Arkansas's real income had risen to $28,000 while Michigan's rose only to $32,400. The results of this convergence are seen in Figure 9.4a, where each line traces the growth of median household income for a different state. The ratio of income in the highest-income to the lowest-income state declined from 3.9 in 1950 to 2.1 in 1990. Compare Figure 9.4b, which shows the analogous growth of mean net income from farming. The comparison could hardly be more stark with respect to convergence versus divergence among states over time. The forces at work in the evolution of farm household income must be substantially distinct from the factors influencing income from farming, despite the fact that we are looking at the same set of people and that household income and farm income are generally correlated positively as Figure 9.2 indicated.

To investigate the extent to which household income convergence is a regional, particularly a southern phenomenon, a regional dummy variable is added (equal to 1 for the southern states and 0 otherwise) to equation (9.1). If income is growing faster in these states, the common effect would show up in the coefficient of the dummy variable, which is effectively a separate intercept term, a', for this group of states. This variable turns out to be insignificant, and leaves the convergence coefficient b unchanged. That is, when we force the data to choose between saying that income grows more rapidly in initially low-income states or that income grows more rapidly in southern states, the data choose the former decisively. The data can make the distinction despite the fact that low-income levels are initially prevalent in southern states.

However, many of the nonsouthern states are border states, like Oklahoma, and this raises the questions of how we define the South and what it is about the South that makes it different. An obvious possibility is the percentage of the farm population that is nonwhite. We saw earlier that African Americans migrated out of agriculture in great numbers, and perhaps this adjustment accounts for convergence? This possibility is examined by adding the percentage of the 1950 rural farm population that is nonwhite to the

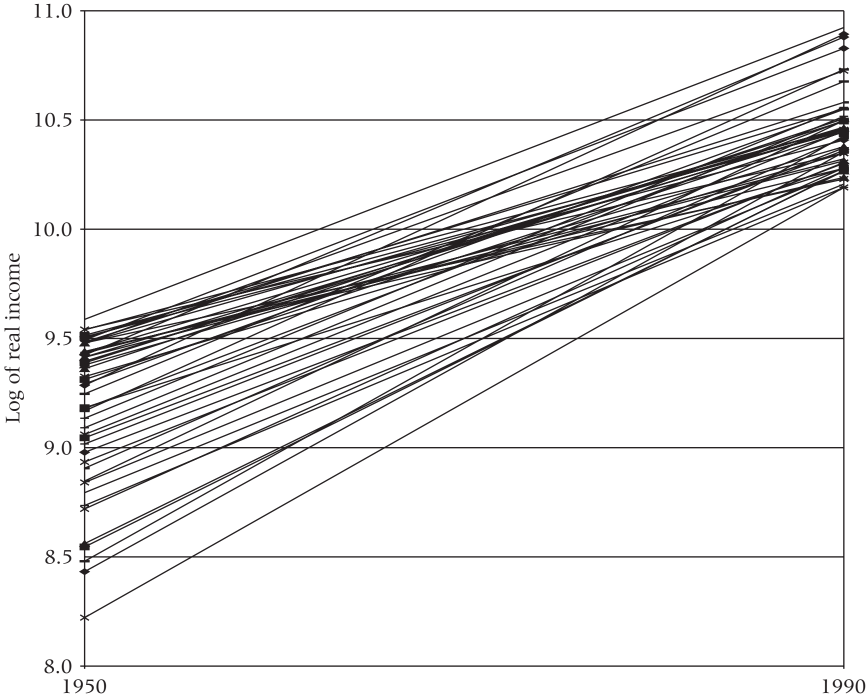

Figure 9.4a Growth of real median farm household income (all sources), forty-eight states. Data from U.S. Department of Commerce, *Census of Population,* various years.

regional dummy. When this is done, neither the regional nor the nonwhite variables add significantly to the explanatory value of the simple equation (9.1). The adjusted R^2 is .885 in the simple regression and rises only to .886 when region and race are both included in the regression equation.

Consider now how the income of farm *relative to nonfarm people* has changed within states. On the one hand, if overall South/non-South migration or other regional aspects of adjustment to disequilibrium are the central economic developments, then we may not observe equalization of farm and nonfarm incomes *within* states of any region. On the other hand, if we see an equalizing tendency within states at about the same rate as for the national data, it is adjustment and mobility in the farm as related to the nonfarm sectors that are the heart of the story. Table 9.3 shows the ratio of rural farm to urban median household income for the U.S. total and for representative states in 1950 and 1990. Farm and urban incomes are converging faster within the southern states than for the U.S. total, suggesting that indeed farm/nonfarm forces rather than interregional adjustments are be-

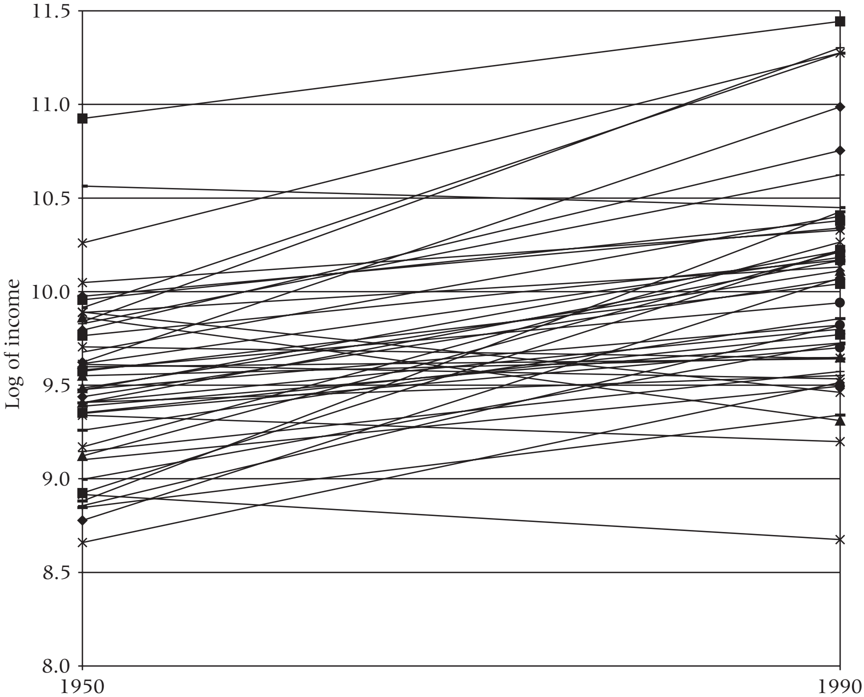

Figure 9.4b Growth of net farm income per farm, forty-eight states. Data from U.S. Department of Agriculture, Economic Research Service website, <http://www.ers.usda.gov/>.

hind the rise in rural farm household incomes. The state data do, however, show that the story is far from uniform across states, and the midwestern states, in particular, have not had nearly the rise in farm relative to nonfarm incomes that the southern states have experienced.

The evidence indicates that farm household incomes have grown impressively since World War II both in terms of real income per household and relative to nonfarm incomes, and that farm incomes have grown most rapidly in the states where incomes were lowest in 1950. Moreover, this outcome does not seem to be a matter of the low-income states sending poor people to high-income states and thus raising incomes in the former at the expense of the latter. What, then, are the economic forces behind the growth of rural farm incomes?

Standard growth models turn on investment in (human and physical) capital being higher in the states that start out behind. We have some state-level indicators of investment, in both human and nonhuman capital, but not of the marginal return to investment. Also of interest are factors lying

Table 9.3 Median farm family income as percentage of urban family income

	1950	1990	Change, 1950–1990
Illinois	0.67	0.82	0.16
Indiana	0.71	1.04	0.33
Iowa	0.78	0.86	0.08
Kansas	0.66	0.89	0.23
Minnesota	0.63	0.76	0.13
Nebraska	0.73	0.83	0.10
North Dakota	0.73	0.83	0.11
South Dakota	0.73	0.87	0.14
Midwest average	0.70	0.86	0.16
Alabama	0.34	1.03	0.69
Arkansas	0.42	1.03	0.61
Florida	0.51	1.07	0.57
Georgia	0.36	0.93	0.58
Louisiana	0.43	1.02	0.59
Mississippi	0.34	1.02	0.68
North Carolina	0.46	0.95	0.49
South Carolina	0.36	0.91	0.55
Virginia	0.43	0.81	0.38
South average	0.41	0.98	0.57
U.S. average	0.61	0.97	0.36

Source: U.S. Department of Commerce, *Census of Population,* 1950 and 1990.

outside neoclassical growth models but highlighted in our earlier discussion, notably government spending on infrastructure or on rural development or farm programs. Was there more governmental assistance in the states that started out behind? Another category of causes are economic adjustments that in part are responses to an initial disequilibrium, notably out-migration, the expansion of off-farm work by farm people, and productivity growth in agriculture. Factors causing convergence may not be primarily agricultural. For example, the convergence of southern to northern income levels may be substantially attributable to nonfarm economic opportunities that opened up after 1950 for African American farm people and their consequent exodus from farming. Our regional investigation casts doubt on *interstate* south to north migration as a cause of convergence in farm incomes across states, but this leaves ample room for the large movement of low-income farm people to nonfarm residence within each state or in a different state but in the urban population, and for farm people's taking off-farm employment while retaining farm residence.

In addition, there are exogenous economic shocks and trends that may have had differential effects by state. For example, real income growth in the overall economy has increased demand for goods with higher income elasticities, and states that produce these commodities will have had some advantage. Similarly, economic growth centered on urbanized areas, *pace* Theodore Schultz, may have advantaged farm people in states more influenced by metropolitan centers. Convergence can occur in these circumstances because innovation or investment reduces the disadvantage of distance from markets. Real transport costs have been decreasing over time and communications have become easier and cheaper too, as discussed in earlier chapters. A regional effect is notable in the access that farm people have to cars and trucks. Table 9.4 shows how the South in 1950 still lagged behind in automobiles on farms; but today cars are found on almost every farm in every state. Therefore the trend since 1950 is expected to be more favorable for growth of household income in the South, other things equal.

The state data on farm household income show not only convergence but also an overall similarity in the growth path of real income. This indicates a strong nationwide impetus for growth, common to all states.

The national picture was investigated in Chapter 8, and we found causes of income growth in productivity improvements, education, and labor mobility. But the national time series did not permit the relative importance of these factors to be sorted out with any confidence. The question here is how much further we can go with state-level data. It is true that whatever is common to all states cannot be elucidated by an investigation of state differences, but if the differences among states can be tied to one or more causal factors, it increases our expectation that these forces have also been important in the national picture. Thus if state differences in farmers' education do not help explain state differences in income, that decreases the plausibility of the argument that the observed nationwide increases in farmers' edu-

Table 9.4 Regional percentages of farms reporting automobiles in the *Census of Agriculture*

	North	South	West
1920	48	14	42
1930	79	39	72
1940	80	37	73
1950	81	45	77
1959	90	67	87

Source: U.S. Department of Commerce, *Census of Agriculture*, "General Report," 1945 and 1959.

cation were a substantive cause of the observed general increase in farmers' incomes.

In order to explore these possibilities econometrically, equation (9.1) is expanded to include variables that measure these factors, as was done earlier for net farm income. The dependent variable is the average annual growth rate of median incomes of rural farm households between 1950 and 1990, using data from the State Reports of the decennial *Census of Population*. The coefficients and *t*-ratios for the independent variables are as follows:

Variable	Coefficient	*t*-statistic
Log of 1950 median farm household income	−0.021	14.10
Median schooling, rural farm males, 1950	0.075	1.32
Multifactor productivity, 1950	0.0022	0.61
Farm capital stock, 1950	0.00019	0.29
Growth of median urban family income	0.331	2.41
Percentage of state population rural	−0.024	7.28
Percentage of rural population nonwhite	0.0084	2.16
Property tax rate (per $100 land value)	0.050	0.91

This regression explains 97 percent of the variation across states in the rate of income growth. The farm-related variables that were important in explaining net farm income growth are not significant in explaining farm household incomes. Multifactor productivity, farm capital, and the property tax rate are not significant. The most significant added variable is the percentage of the state's population that is rural, with greater rurality a hindrance to growth. This finding supports the hypothesis of Schultz that a larger presence of nonfarm people in a state is good for the growth of farmers' incomes, because it increases their off-farm earning opportunities and increases the demand for the goods and services that farmers produce. This appears to be the main reason for the relatively poor income growth performance of Upper Midwest and Plains states. Second, for a given presence of nonfarm people, a higher rate of growth of urban incomes is associated with faster growth of farm household incomes, underlining the importance of farm households' linkages to nonfarm economic activity. The third significant variable is the percentage of the state's population that is nonwhite. Since nonwhites migrated out of the rural farm population at a high rate between 1950 and 1990 and had lower incomes than whites, it is unsurprising that rural incomes grow more when nonwhites leave the rural population. The 1950 income level is already included in the regression, however.

The preceding regressions explain the rate of change of family income between 1950 and 1990 using the levels of explanatory variables in 1950, except for urban income levels (where the rate of change is the explanatory variable). Using the rate of change rather than the initial level for urban incomes and not the other explanatory variables requires justification. It helps to recognize explicitly that we are dealing with time series as well as cross-sectional data, even if the time series observations are only of two points in time. The limited dynamics that we have in the decennial observations of states can be thought of as a variant of the error-correction model (ECM) used in time series analysis. The economic foundation of an ECM is a co-integrating equation that specifies a long-run equilibrium relation among the variables analyzed. That relation in the state income convergence context says that equilibrated incomes of rural and urban people should be the same. Therefore, the urban income variable requires special treatment as the argument in a cointegrating equation, which is estimated as

$$(9.2) \qquad yf_i = \alpha + \beta yu_i + v_i$$

where yf_i is the ith state's farm family income and yu_i is each state's urban family income (all variables measured in logs), and v_i is a random error term that incorporates state idiosyncrasies, measurement errors, or other factors. With perfect integration we should find $\alpha = 0$ and $\beta = 1$. The ECM estimating equation for (9.2) is

$$(9.3) \qquad (yf_{i,t+1} - yf_{i,t}) = \alpha + \beta(yf_{i,t} - yu_{i,t}) + \gamma(yu_{i,t+1} - yu_{i,t}) + u_{i,t}$$

where t is an initial date and $t + 1$ a subsequent date. Using $t = 1950$ and $t + 1 = 1990$, we obtain $\beta = -.027$ and $\gamma = .774$, with t-statistics of 16.0 and 4.3, respectively. The interpretation of β is analogous to that of the coefficient of initial income in equation (9.1). The negative sign indicates that 1950 income differences between farm and urban incomes were eliminated at a rate of β per year between 1950 and 1990. The interpretation of γ is that a 1 percent rate of growth in urban incomes generates a rate of growth of 0.77 percent in farm family incomes. The standard error of the estimate of γ is 0.18, indicating that we cannot, with 95 percent confidence, reject the null hypothesis that a 1 percent rise in urban income causes rural farm incomes to rise by 1 percent.

There is an important ambiguity in the analogy between the ECM and the cross-sectional convergence model. The ECM's integrating equation relates each state's farm income to urban incomes *in that state.* The convergence model relates each state's farm income to a long-run equilibrium income level that is *the same in all states.* We can conveniently investigate both aspects of integration jointly with a slight elaboration of the cross-sectional ECM. To investigate integration with respect to a nationwide common income level as well as integration between farm and urban incomes within each state, we add to equation (9.3) the right-hand side variable, $yf_{i,t}$ (the same as in the earlier convergence equation). In terms of the cointegration framework, this is equivalent to the right-hand side of equation (9.2) with yu_t (the nationwide urban median income at time *t*, which is common to all states). The estimating equation is

$$(9.4) \qquad (yf_{i,t+1} - yf_{i,t}) = \alpha' + \beta'(yf_{i,t} - yu_{i,t}) + \gamma'(yu_{i,t+1} - yu_{i,t}) + \delta' yf_{i,t} + w_t$$

The resulting estimated coefficients (with *t*-statistics) for several subperiods in 1950–1990 are given in Table 9.5.

The bottom two rows in Table 9.5 show coefficients and *t*-statistics for equation (9.4) as estimated above, adding the initial-year (1950) farm income level to equation (9.3). Initial-year income turns out to be statistically significant ($t = 3.40$), and its inclusion reduces the coefficients and significance of the other two variables, most notably the initial-year urban/rural income difference in the state. The economic interpretation is that farm household income grows with urban incomes, and that farm household incomes are converging toward a nationwide common income level during 1950–1990, not just toward urban income levels in the state in which the farm household lives. The same is true even more strongly for the twenty-year period 1970–1990. For income growth in earlier periods, however, the story is different. During 1950–1970, we still see farm incomes

Table 9.5 Regressions explaining growth of farm family income, forty-eight states

Dependent variable: Growth rate of median farm family income:	Coefficients of independent variables (with *t*-statistic)			
	Initial year log of farm family income ($yf_{i,t}$) (δ')	Growth rate of urban family income ($yu_{i,t+1} - yu_{i,t}$) (γ')	Initial year difference between urban and farm incomes ($yu_{i,t} - yf_{i,t}$) (β')	R^2
1950–1960	−0.025	−0.051	0.012	.32
	(0.83)	(0.19)	(0.27)	
1960–1970	0.012	0.84	0.074	.79
	(1.19)	(5.04)	(5.74)	
1950–1970	−0.006	1.32	0.021	.86
	(0.84)	(4.50)	(1.84)	
1970–1990	−0.029	0.827	−0.006	.80
	(6.64)	(4.64)	(0.83)	
1960–1990	−0.016	0.559	0.013	.91
	(4.49)	(4.26)	(3.02)	
1950–1990	−0.013	0.677	0.009	.94
	(3.40)	(4.15)	(1.69)	

growing roughly proportionally with urban incomes, but in that period we see convergence toward the state's urban income but not toward a nationwide common income level (coefficient on 1950 income level is zero). During 1950–1960 we find no evidence of any significant convergence or of farm incomes growing with urban incomes.

The expanded ECM model is like the earlier convergence equations in not attempting to determine the economic causes of income growth, beyond convergence to urban incomes from an initial state of disequilibrium. Adding the explanatory variables that were statistically significant or nearly so in the earlier regression that explained the growth of farm family income during 1950–1990, we find the following:

Variable	Coefficient	*t*-statistic
1950 median farm household income (δ')	−0.018	5.68
1950 urban-farm income difference (β')	0.004	0.95
Growth of median urban family income (γ')	0.419	3.78
Median schooling, rural farm males, 1950	0.095	1.59
Percentage of state population rural, 1950	−0.023	7.28
Percentage of rural population nonwhite, 1950	0.0072	2.10
Growth of farm productivity	0.0431	0.77

In the expanded equation, the state's rurality and percentage of nonwhite farm people have significant effects, as in the earlier estimated equation that excluded the initial urban-farm income difference. The coefficient of the initial income difference (β') is not statistically significant. The equation explains 97.5 percent of the observed state-to-state variance in rate of income growth between 1950 and 1990.

The statistics for the preceding calculations and regressions are largely proxies and are constructed from sometimes sketchy basic data, especially for net farm income earlier in the century. It is therefore worth looking briefly at some simpler data that give only a partial story but are more likely to be consistently derived throughout the period studied. Two such indicators are the value of farm real estate and the wage rate paid to hired farmworkers. The former is an indicator of the returns to farming, net of labor and other costs, and of economic rents generated in the sector. The latter is an indicator of the economic value of labor in agriculture. If the story outlined above is correct, one would expect to see convergence in state data on farm wage rates, but not in real estate values.

Figure 9.5 indicates that state-level wages have indeed converged. It shows the growth of real hourly wage rates from 1910 to 1990 for forty-eight states (Alaska and Hawaii excluded), with each line showing the growthpath of a state. The pattern of convergence is clear. Much of the convergence is regional, with southern states accounting for the lowest ten

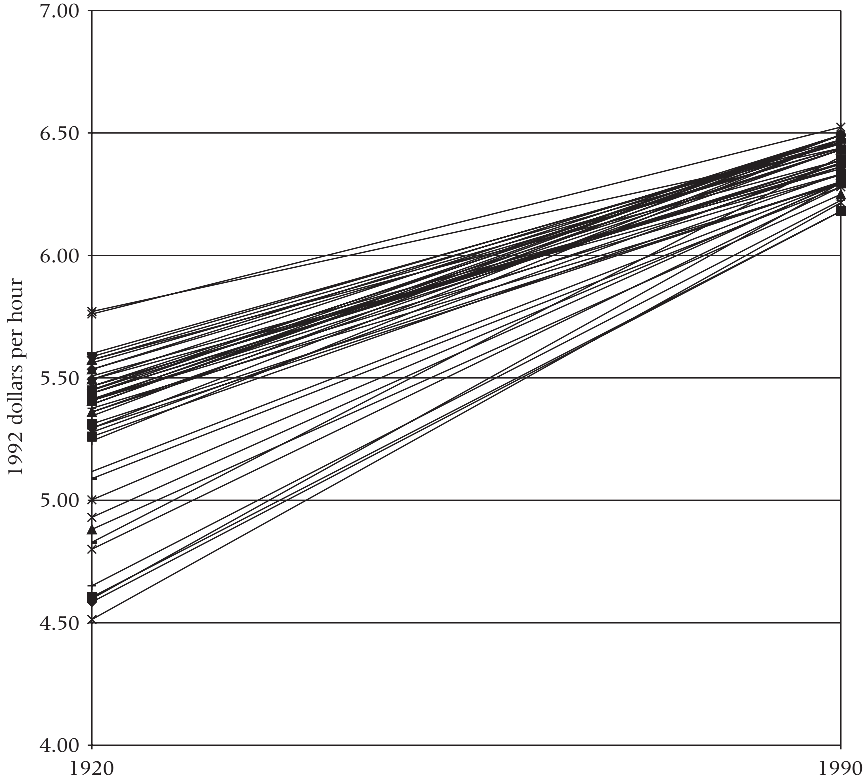

Figure 9.5 Real farm wage rates. Data from USDA, *Farm Labor*, various issues.

wage rates in 1910, and then rising faster than northern states. But there is convergence also within the set of nonsouthern states. The coefficient of variation of wage rates across states declined from 0.25 in 1910 to 0.20 in 1960 to 0.08 in 1999.

Figure 9.6 indicates no convergence in the real value of farmland per acre. Indeed, the coefficient of variation of land prices across states has increased over time, for example from 0.60 in 1920 to 0.86 in 1997. Data consistency problems are less for farmland than for labor, with the Census of Agriculture asking essentially the same question of farmers throughout the period: how much would your land and buildings sell for? (Note that these data are *not* actual market prices of land bought or sold.) A complication for state comparisons of land values is the high and rising value of land with development potential in urban areas. The top four states in land value in 1997 are New Jersey, Connecticut, Rhode Island, and Massachusetts, while in earlier years their farmland was less distinctively priced. However, if

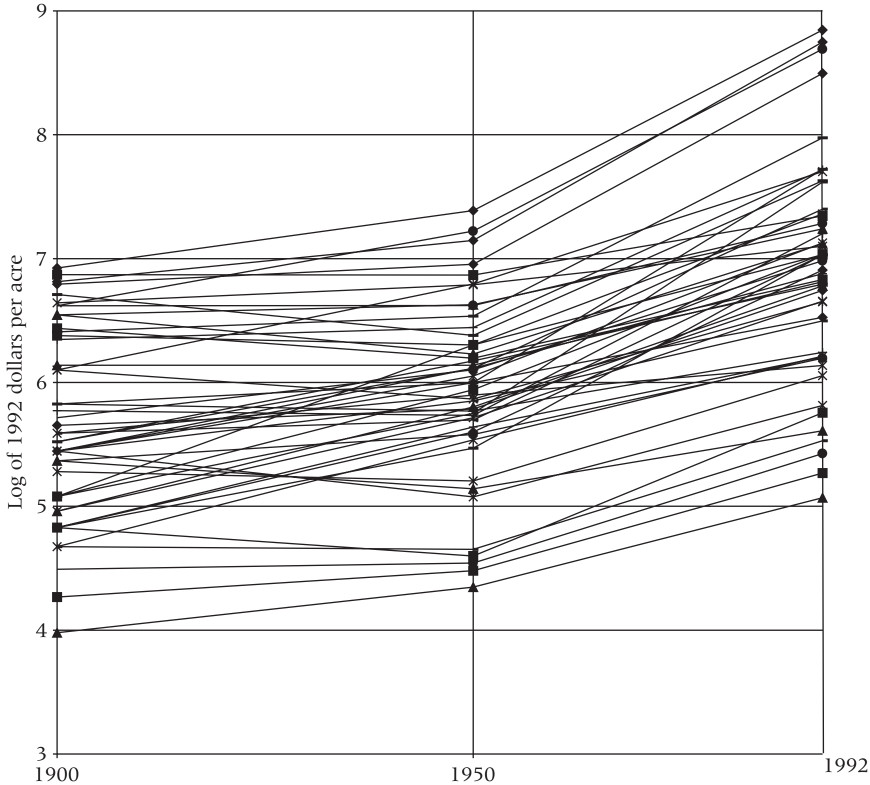

Figure 9.6 Real land values per acre, forty-eight states. Data from U.S. Department of Commerce, *Census of Agriculture,* various years and volumes.

these four states are omitted from the calculations, the coefficient of variation of land prices across states still shows no convergence over time.

Discussion of Findings

State data do not give definitive answers to questions about the causes of economic growth in agriculture, but they do provide useful evidence on several aspects of the growth process. First, they indicate strong and important differences between the twentieth-century evolution of farming as an economic activity and the incomes of farm households. Farming as an economic activity, as measured by value added or net income per farm, grew impressively during some subperiods but not others, the growth rate varied enormously across states, and there was no tendency toward convergence to a common level of income or returns per farm. There is some evidence that governmental action, productivity growth, and investment in agriculture each played significant independent roles in determining the rates of growth.

Farm household incomes showed a stronger and more persistent rate of growth in the decades after 1950, even in the period since 1980 when the growth of agricultural GDP has been spotty. Moreover, farm household incomes have shown a strong tendency toward national convergence to a common income level and toward equality of farm and urban incomes over time. Farm household income growth has surprisingly little relationship with income from farming or its determinants such as farm productivity, government programs, or investment in agriculture. Of the various hypotheses and causal factors discussed in Chapter 8, the findings there do not indicate a fundamental explanatory role for a sectoral version of neoclassical growth models, with their emphasis on capital investment and technological change. Rather, the predominant explanation of farm household income growth is adjustment in labor markets, with off-farm migration and off-farm work by farm family members being the main mechanism of adjustment.

An important unresolved issue is the role of education of farm people. Econometric evidence provides little support for the hypothesis that increases in farmers' schooling increased their income from farming. The evidence is stronger that increased schooling increased household incomes, including off-farm sources, but even here the evidence is mixed. Education appears to have been most important for growth in farmers' incomes in the 1950–1970 period, when the catch-up of farm to nonfarm incomes was most rapid. D. A. McGranahan and L. M. Ghelfi (1991) and Molly Killian and Timothy Parker (1991) conclude that improved skills of rural people would not have generated higher incomes in rural areas in the 1980s, and the state-level regressions are consistent with that conclusion.

10

Counties

County data permit further analyses of factors behind the economic history of U.S. agriculture. They provide a larger number of observations than states and constitute a more diverse sample, while being more homogeneous within each observation. Texas, for example, contains types of farming ranging from Great Plains wheat growing to irrigated cotton growing to large cattle ranches to citrus areas in the Rio Grande Valley. In such a heterogeneous state, we may lose important information by aggregating over its 224 counties.

Example: A Corn Belt County

As an introduction to what can be learned from county data, consider Cedar County, in eastern Iowa. This is a largely rural county, having no city with a population over 25,000. Tipton, the county seat, had a population of 2,998 in the 1990 census. With rich Corn Belt soils and a good grain-marketing infrastructure, Cedar County's cropland is devoted mainly to corn and soybeans, and about 60 percent of the farms raise either cattle or hogs in addition to growing crops. Dairy, poultry, wheat, and other commodities are relatively small in importance. In terms of farm size, land value, and overall income and educational levels, Cedar County is just about average for Iowa. With its concentration on grains and relatively small hog and cattle enterprises, the county is a reasonable representative of Corn Belt farming.

Census data provide a broad picture of the evolution of farming in Cedar County. In 1900, the census counted 2,291 farms. By 1950 the number of farms had declined only slightly, to 2,144; but their number declined rapidly after that to 965 in 1997. At the same time, land in farms remained quite stable: 351,000 acres in 1910, 354,000 in 1950, and 326,000 acres in 1997. Accordingly, the average acreage of farms has about doubled, from 160 acres per farm in 1910 to 338 in 1997. Note also that while land in farms has declined since 1950, this is entirely due to a reduction in pasture and other farmland. Cropland harvested has actually increased from 234,000 acres in 1950 to 265,000 acres in 1997.

In these respects—declining farm numbers, increasing farm size, and a relatively stable acreage in agriculture—Cedar County is similar to the state of Iowa and to the United States as a whole.[1] The county is also typical in details of farm production, notably the ascent of soybeans from negligible in 1900 to major-crop status in the post–World War II era, the demise of horses and associated crops of oats, and the accompanying rise in importance of farm expenditures on petroleum fuels, fertilizer, pesticides, and other purchased inputs. In 1997 Cedar County farms spent $4.3 million on hired labor (including both arrangements with labor contractors and direct hiring of workers). At Iowa's 1997 wage rates, this means about 12 hours of hired labor weekly per farm, which implies that the average farm employs about one-fourth of one full-time worker. Only 36 farms reported any full-time (more than 150 days per year) hired farmworkers, and they employed a total of 74 workers. Earlier census data, for 1950, indicate about 10 hours of hired farm labor per week for an average farm, indicating that Cedar County farms have been, and remain, largely family farms with little reliance on hired labor.

Average farm acreage in Cedar County more than doubled from 156 in 1900 to 338 in 1997, a substantial increase but less than the U.S. average rise in farm acreage over this period, from 147 to 436 acres. Concentration of acreage on the county's largest farms has increased, as the cumulated acreage chart in Figure 10.1 shows. The smallest 50 percent of farms had about one-fourth of the county's land in farms in 1900. This percentage had increased slightly by 1950, but declined to 12 percent in 1997. The largest 20 percent of farms had just under 40 percent of the county's farmland in 1950, and by 1997 this rose to about 55 percent. The increased concentration since 1950 is significant, but both the extent of concentration and its increase in Cedar County is substantially less than for the United States as a whole, as calculated in the earlier data of Table 3.4.

Cedar County farming, while it has changed a great deal, has changed less than has U.S. agriculture generally over the last hundred years. It retains more of the family farm characteristics of the past than most other places. It has not been transformed to an urban-connected community of part-time farmers or caught in a stagnant rural backwater. Net cash returns, at

1. Cedar County also turned out to be paradigmatically divided politically in the 2000 presidential election. On election night its votes tallied 4,025 for George W. Bush and 4,025 for Al Gore, although in a recount Gore won by 2 votes (see *Washington Post,* November 19, 2000, p. F-1).

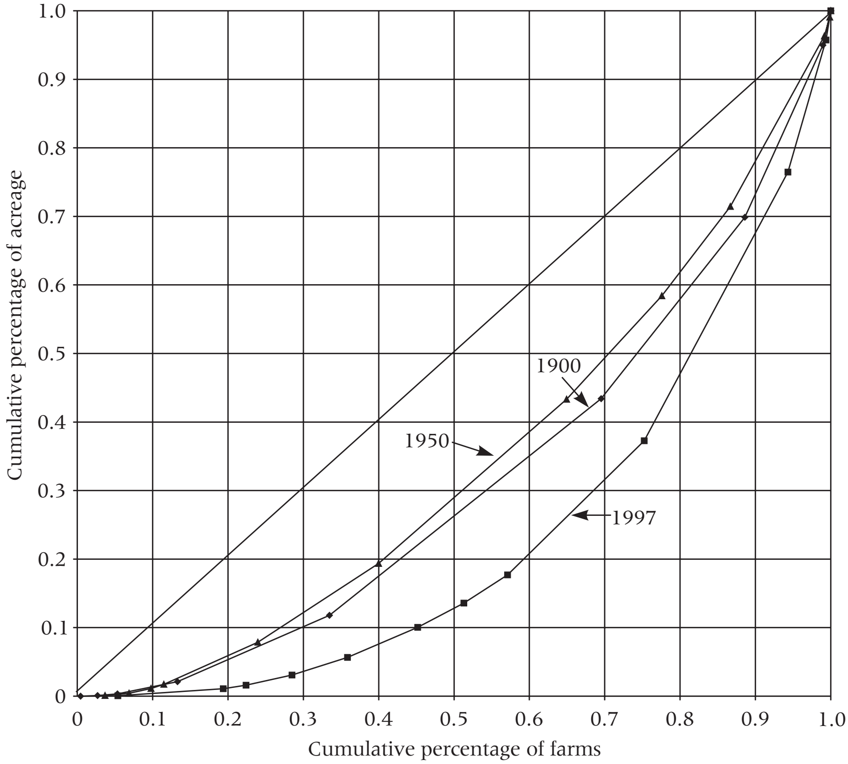

Figure 10.1 Concentration of land in farms, Cedar County, Iowa. Data from U.S. Department of Commerce, *Census of Agriculture,* 1900, 1950, and 1997.

$27,700 per farm according to 1997 Census of Agriculture estimates, were above the U.S. average of $22,300 per farm (although below the all-Iowa farm average of $32,700).

Cedar County farm families had a median income from all sources of $3,400 in 1960, which was 60 percent of the U.S. median income for all families and 80 percent of the median income of all families in Cedar County. Over the next thirty years the growth of real median farm family income in Cedar County averaged 3.1 percent annually. By 1990 the county's farm families had median incomes above those of the nonfarm families of Cedar County and 95 percent of the U.S.-wide median income.

The county, though more rural than most in the nation, has a lot of nonagricultural activity, with the farm population accounting for only 18.6 percent of the county total and a third of farm operators having a principal occupation other than farming in 1997. Labor market adjustments, so important in the national and state data, also appear to have had favorable income consequences within this rural county (reinforcing the earlier conclusion that farm household income improvement is not predominantly a matter of adjustment through geographical migration).

When rapid income growth occurs, the question arises as to how the gains have been apportioned up and down the income scale. An overall indicator is the inequality of the size distribution of income. In 1960, the coefficient of variation of farm family income in Cedar County was 0.88; that is, the standard deviation of incomes was 88 percent of county mean income of farm families. In 1980 this statistic had been reduced to 0.81 and by 1990 further reduced to 0.77 for farm households. This decline in income inequality again parallels earlier findings for the overall size distribution of U.S. farm family incomes since 1960; but the county data show that the nationwide reduction is not just a locational phenomenon caused by average farm family incomes rising faster in poor counties than in richer ones.

With respect to the lowest-income segment of the population, consider as an indicator of overall relative poverty the percentage of farm families whose income falls below half of the U.S. median income for all families. In Cedar County in 1960, 43 percent of farm families fell below this threshold. By 1990 this percentage had been reduced to 26 percent. The 1990 income figures are for "households," which incorporates not only families but also unrelated individuals who operate farms. In 1960 only family size distributions were published for counties, and in 1990 only household distributions. Households that are not families are not numerous, but they tend to have lower incomes than families and their inclusion makes income slightly more unequally distributed. Thus the 1960 data would be expected to show slightly lower inequality than 1990 if the underlying distributions of household income had been unchanged. This makes the reduction in measured inequality even more impressive.

The statistical picture of Cedar County is on the whole an encouraging one, but it would also be possible to focus on farm households that have faced hard times and unhappiness. For wider ranging and more literary studies of counties in Illinois and California that take a less sanguine view, see Adams (1994) and Hanson (1996).

Data from a Sample of U.S. Counties

Each U.S. county has unique features from which one can learn something about the forces shaping the economics of agriculture. For a systematic investigation, we turn to the econometric approach used earlier for state-level data. The sample of counties in this chapter was chosen to represent a variety of agricultural areas. This was done by following the classification developed by the Bureau of the Census in 1950 to delineate "state economic areas," which coincide with the type-of-farming areas defined by the USDA. The number of economic areas varies widely by state, depending on the size of the state and the variety of agriculture within it. Such a classification is inevitably arbitrary, and the classification of areas has changed over time. The classification of 1950 is a reasonable starting point in selecting counties for further analysis. Counties were chosen near the center of an economic area, although such counties may nonetheless be near a state border. For example the sugar-beet growing area of the Red River Valley is centered on the border between Minnesota and North Dakota. The total of counties in the sample is 315.[2]

AGRICULTURE IN THE SAMPLE COUNTIES

A striking uniformity across the counties is a decline in farm numbers. In only two counties did the number of farms increase between 1949 and 1997: Gaines County, Texas, and Palm Beach County, Florida. Gaines County agriculture has grown mainly because of a big expansion of dryland cotton growing there. This is the part of the country that made Billy Sol Estes famous in the 1950s for his efforts to transfer cotton allotments from southeastern states, despite restrictions imposed under the federal cotton program at that time (see Findley 1968, pp. 107ff.). Palm Beach County has been boosted by a stupendous expansion of sugar cane production in the area near Lake Okeechobee (controversial because of the harm that fertilizer nutrient pollution has done to the flora that formerly flourished in low-nutrient situations in the "river of grass" leading to the Everglades).

The Census of Agriculture reports in less detail on costs of production at the county level than at the state level. This makes the estimation of value added by farms more conjectural for counties. In this chapter, the primary indicator of agricultural economic activity is the value of sales of farm products for each county. In order to abstract from changes in the value of sales attributable to commodity price changes, the sales data are deflated by USDA's index of prices received by farmers for commodities they sell. This weights all products by nationwide output shares, so deflating provides an index that departs from a measure of output for each county to the extent that the price of each county's commodity mix changes differently from the national price index. But the approach still provides a meaningful indicator of a county's performance: the real sales measure rises if either a county's

2. Details of counties sampled are available from the author.

output increases or if the prices of that county's products rise faster than the prices of overall U.S. agricultural output.

Figure 10.2 shows the growth rates of real agricultural output sold for the sample counties between 1949 and 1997, ranked from slowest to fastest growth, by deciles. In the slowest-growing tenth of the sample counties, the rates ranged from −4.4 percent to 0.4 percent annually. The slowest-growing county is Knott County, Kentucky, in Appalachian Mountain country. In 1950 Knott County had 1,683 farms, a number that had been reduced to 21 in 1997; one could say that agriculture has essentially disappeared. The remaining farms averaged $3,000 in sales and $4,400 in expenses, according to the 1997 Census of Agriculture. Over the last half century the county moved from being a community mired in farm poverty to one mired in rural nonfarm poverty, with 36 percent of families remaining below the poverty line in 1990 (compared with 16 percent for all of Kentucky and 10 percent for the United States). This is hardly a typical U.S. farm county, of course, but we want our sample to include a wide range of economic conditions.

In the fastest-growing decile of counties, the rate of real agricultural out-

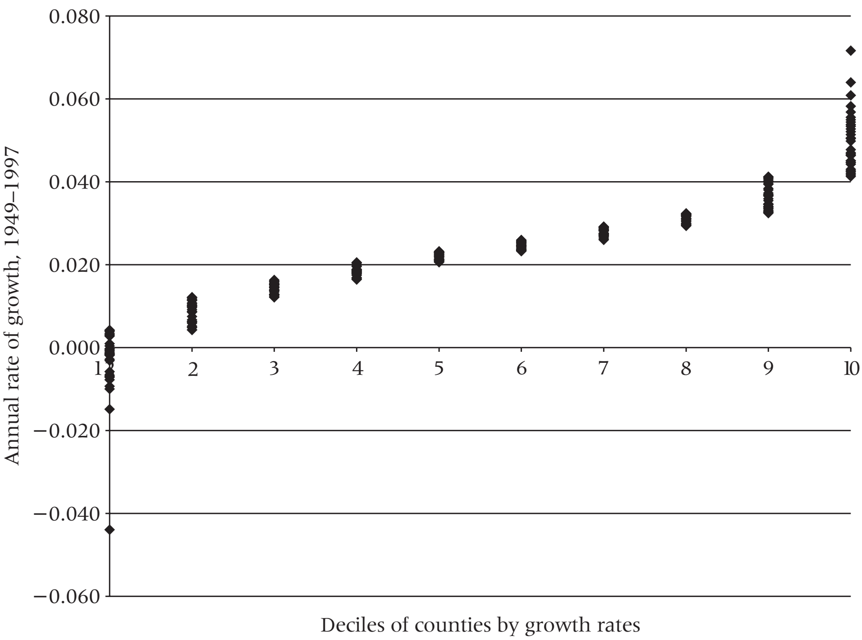

Figure 10.2 Rates of growth of real agricultural sales, 315 counties. Data from U.S. Department of Commerce, *Census of Agriculture*, 1950 to 1997; growth rates are least-squares trends using census data points.

put growth ranged from 4.3 percent to 7.2 percent annually, extraordinarily high rates for so long a time period. The fastest-growing county is Deaf Smith County, Texas, in the High Plains of West Texas. Here the number of farms declined only slightly, and output soared, primarily because of the growth of cattle feeding. In Deaf Smith County the average farm had sales of $1,014,000 in 1997, of which 91 percent came from sales of beef cattle.

As an initial step in the investigation of reasons for the differing growth rates of counties, consider the issue of convergence, as discussed in Chapter 9 for states. Here the question is whether initially large agricultural counties grow more or less quickly than small counties. This is quite different from the issue of whether places with initially low incomes *per capita* grow faster or slower than those with initially high incomes. Neoclassical growth theory provides reasons why convergence in per capita incomes should occur—essentially that low incomes mean less capital per person, hence a larger marginal return to investment, ceteris paribus. But why should counties with initially low aggregate sales grow faster?

Larger counties might grow faster if there were economies of size at the county level. Dividing the 315 counties into halves, the average annual (trend) rate of growth of real county sales between 1950 and 1997 was 1.7 percent for the initially smaller and 2.0 percent for the initially larger counties. This suggests there may indeed be an advantage to being in a county with a large farm economy. The bigger story is an overall lack of convergence. Within both the large and the small county samples there is a notable divergence in the size of the farm economies over time—perhaps a tendency to specialize more, with increasing relative differences in the sizes of counties' agricultural sectors over time because some shift to predominantly nonagricultural activities. Overall, county farm product sales ranged from $395,000 (1992 dollars) to $204 million in 1950, and from $60,000 to $1.8 billion in 1997. The coefficient of variation across counties increased from 1.18 in 1950 to 1.86 in 1997.

Real sales per farm is an economic indicator of farm size that is more generally relevant in theory, but harder to measure meaningfully in practice, than is farm acreage. Acres differ in rental value and productivity from one county to the next, and some agricultural products, notably confined livestock, can generate a lot of real output using little land. A problem also exists with sales, however, namely that the value of sales fluctuates from year to year because of random output and price variations. Thus comparisons over time or between counties may not really indicate permanent differences in the size of farm enterprises. To minimize the problem of transitory factors in any particular year, the rate of change in real sales is not calculated between the endpoints (1949 and 1997), as was done for farm numbers. Instead, data from eight census years between 1949 and 1997 were used to estimate a linear trend rate of growth. The difference between the trend rate of growth of a county's real farm sales and the rate of change of farm numbers is our estimate of the rate of growth of farm size. Farm size so measured increased between 1949 and 1997 in every county sampled except Sussex County, New Jersey.

One may ask whether the growth or decline of real farm sales in a county is mainly attributable to changes in farm numbers or to changes in output per farm. The data indicate that while both play a role, as would be expected, aggregate county sales are more highly correlated with the growth of sales per farm than with farm numbers (simple correlation coefficient of .63 between aggregate sales and sales per farm, and .33 between aggregate sales and farm numbers). Thus growth in a county's agricultural sector has more to do with growth in the output of individual farms than with retaining farm numbers.

HOUSEHOLD INCOMES

The indicator of economic health that performed best in state-level data was the income of farm households. In the county data, the earliest census data we have for rural farm households is in the Population Census of 1960, reporting family income in 1959. The annual rate of growth of real median farm family income from all sources between 1959 and 1989 ranged from negative in Starr County, Texas, and Hill County, Montana, to 6.4 percent in Barnwell County, South Carolina, and 7.0 percent in Navajo County, New Mexico. These extreme differences may be the result of idiosyncratic events that do not generalize well to explaining the overall picture of economic growth. For example, rural farm incomes in 1959 were extraordinarily low in Navajo County, probably because of poverty among Indians on reservations there, and the rapid income growth since then among the 375 farm families counted in 1990 may be due to special circumstances not applicable elsewhere.

In Starr County, Texas, located along the Mexican border in South Texas, real income growth was negative over 1959–1989. The county's estimated median income in 1989 is based on a small number of observations with reported family income way below that of other Texas farm counties and below nonfarm family incomes in Starr County itself. The 1992 Census of Agriculture found 676 farm operators in Starr County, but only 190 lived on the farms they operated, and the 1990 Population Census reports income data for only 129 farm families. Of the 129 families, 87 reported income of less than $5,000, the lowest income category used (meaning the median income is less than $5,000, but one must use a crude extrapolation to estimate what income is at the median, that is, the incomes of the families ranked 64th and 65th from the bottom). It is also noteworthy that Starr County's estimated median income is only one-fifth that of farm families in other Texas counties, making Starr County an outlier either economically or in the statistical sampling sense.

Hill County, Montana, in contrast, reported an extraordinarily high median farm family income in 1959, the highest of any county in the sample. The reason is not clear. It appears to be mainly a matter of high yields on large grain farms that had relatively low costs and, usually, low yields.

Determinants of Economic Growth

The relationship between economic growth as measured by real sales per farm and household income growth is a loose one in the sample counties. In a simple OLS regression, the rate of growth of farm sales explains only 6 percent of the rate of growth of farm household income. The lack of a strong linkage between the agricultural economy and average farm household income is consistent with the similar findings in state data that were discussed in Chapter 9. As in that chapter, we will first discuss the growth of the agricultural economy and then the growth of farm household incomes. Even though the agricultural economy is only loosely related to the average of all rural farm households, the economics of agriculture are crucial for the important minority of farm households that rely primarily on income from farming. And the general economic health and character of many rural counties remain heavily dependent on agriculture. In the state data, we did not have a sufficient number of states that were agriculture-dependent to carry out a meaningful statistical analysis of them. But in county data, we do.

As an indicator of how important the farm economy is likely to be in the determination of farm household incomes in a county, focus on the counties with the highest proportion of their population living on farms. Figure 10.3 plots rate of growth of household income in 1959–1989 against the trend rate of growth of farm sales over a slightly longer time period, 1949–1997. The trend rate for the longer period is used, because the year-to-year volatility of sales makes it hard to capture the relationship between farm sales growth and household income growth using just two points in time. Shown separately are OLS regression lines for rural and "less rural" counties. Rural counties are the 151 counties in the sample in which the farm population in 1960 was more than 20 percent of the county's total population. The 164 "less rural" counties are those in which the farm population

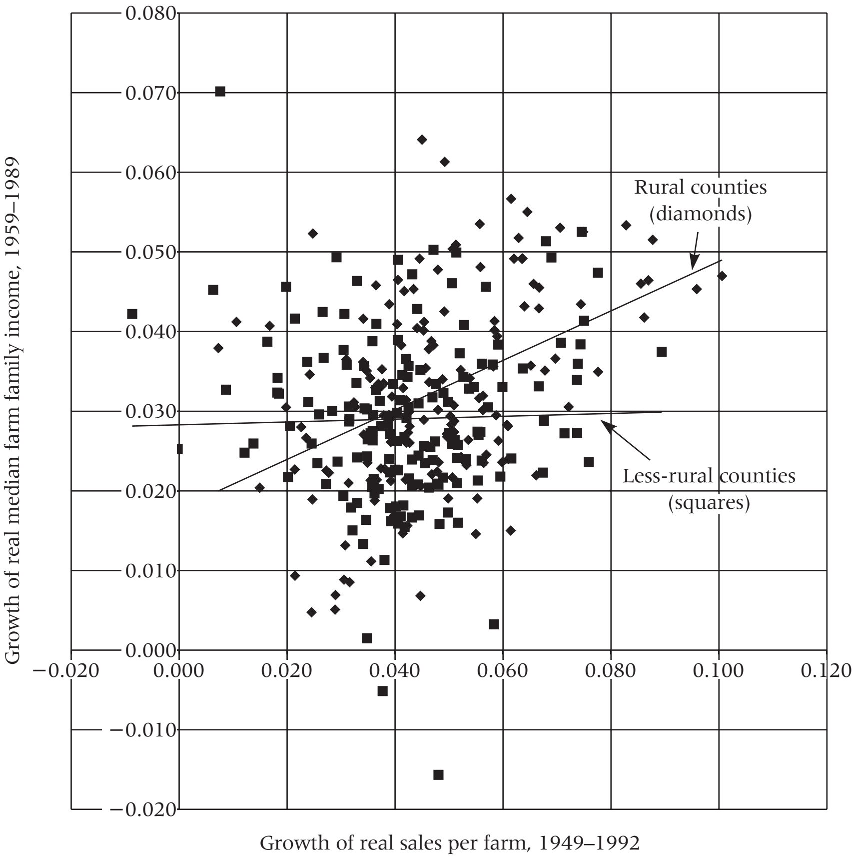

Figure 10.3 Growth of sales per farm and growth of farm household income. Data for sales from U.S. Department of Commerce, *Census of Agriculture,* various years; data for income from U.S. Department of Commerce, *Census of Population,* various years.

in 1960 was less than 20 percent of the total population. In the less rural counties there is virtually no relationship between farm sales and household income (the slope is .02 and R^2 of the regression is less than 1 percent). But in the rural counties, each 1 percent increase in the growth of farm sales per farm is associated with a 0.31 percent increase in the rate of growth of median farm household income.

The state-level analysis of Chapter 9 worked with farm value added, but county data from the Census of Agriculture give only a partial picture of input costs, and asked different questions about costs in different years. Consequently county-level data over time on value added (sectoral GDP) cannot be readily constructed. The best approximation available is Census of

Agriculture data on the value of farm product sales minus farms' expenditures on intermediate inputs. In the censuses from 1950 to 1997, farmers were asked for their previous-year spending on feed for livestock, livestock purchases, seeds, petroleum products, machinery repair and maintenance, hired machinery and custom work, and hired labor. Only in more recent years are more detailed data available on fertilizers and other chemicals, interest, taxes, and cash rent paid. To maintain consistency over time, only expenditure categories available in all years are used.

A few counties are quite specialized in particular commodities. Of the 315 counties in the sample, 48 grew some tobacco in 1950 (of which 18 grew none in 1992) but only 12 (5 in North Carolina, 3 in Kentucky, 2 in Virginia, and 1 each in Maryland and South Carolina) devoted more than 10 percent of crop acreage to tobacco. Sixteen counties grew peanuts, but only 3 (Worth, Georgia; Southampton, Virginia; Hertford, North Carolina) planted more than 10 percent of their crop acreage to peanuts, and these each planted more than one-third of their acreage to this crop.

Such counties are worth looking at separately because they are identifiable areas that have depended heavily on crops with strong supply management programs under U.S. commodity legislation throughout the last fifty years. Did this assistance help them or harm them? The mean values of both agricultural and household income variables in fact show few statistically significant differences from U.S. averages, and what differences there are can be plausibly attributed to the concentration of tobacco and peanut counties in the South (the only nonsouthern counties being in the border states of Kentucky and Maryland).

Data for tobacco/peanut counties and other specializations are shown in Table 10.1. The two sugar-cane-growing counties (LaFourche, Louisiana, and Palm Beach, Florida) are most distinctive in agricultural variables, with much larger average farm size. But this does not translate to high or faster-growing farm household income in these counties. Dairy farming has had strong government support throughout the 1950–1990 period, but one doesn't see performance notably better or worse than average for economic indicators in the dairy-intensive counties.

The earlier discussion of commodity price support programs as a cause of economic growth in agriculture suggests attempting to sort counties by the extent to which they have benefited from these programs. In recent decades this could be done by looking at those counties that received the most government payments per farm. But until the 1960s the major programs operated by keeping market prices up through supply management and other means, and did not rely primarily on government payments directly to farmers. This is still the case for sugar, tobacco, and peanuts.

Consequently, we consider simply whether the counties that devoted

Table 10.1 Characteristics of counties by commodity specialization in 1950

Commodity	Number of counties	1950–1992 Rate of growth of farm numbers	Percentage southern	1950–1997 Trend rate of growth in sales	1950–1992 Growth rate in net farm income per farm	1960–1990 Growth rate of farm household median income
Tobacco >10% of county crop acreage	12	−3.5	67	2.4	1.1	3.7
Peanuts >30% acres	3	−4.5	100	2.7	1.6	5.3
Sugar >20% acres	2	−0.8	100	4.4	1.1	2.0
Grain >40% acres	177	−2.5	26	2.6	3.3	2.8
Cotton >30% of acres	49	−3.5	90	2.1	4.2	4.0
Rice >25% of acres	4	−2.3	75	2.0	1.1	3.0
Dairy >40% of farm sales	38	−2.4	5	1.5	1.1	2.8
Poultry >30% sales	18	−2.9	28	2.3	2.4	3.2
Specialization index >.5	101	−2.0	14	2.4	1.1	2.6
Program crops >⅔ of acres	150	−2.5	44	2.3	1.4	1.3
All	315	−2.6	32	1.5	1.2	3.1

more of their acreage in 1950 to program crops (grains, cotton, rice, peanuts, tobacco, and sugar) were better placed for economic growth than those that devoted more acreage to nonprogram crops (vegetables, hay, specialties). In the sample counties the percentage of acreage in program crops ranged from less than 10 percent (mainly ranching areas where hay was the main crop, or suburban areas with hay and vegetables) to over 90 percent in some southern and midwestern grain-growing counties.

Table 10.1, in its second-to-last row, shows the means of key variables for the 150 counties that had over two-thirds of their cropland in program crops in 1950. The trend rate of growth of real farm sales was higher in these counties. But the rate of decline in farm numbers and growth in net farm income per farm was about the same, while the growth rate of farm household income was slower in the most-protected counties. But as with earlier comparisons, these differences could be due to factors besides commodity programs that differ between the two sets of counties.

Regressions on County Data

FARM SALES

The cross-sectional regression analysis carried out with the county data uses estimation methods and data sources similar to the state-level regressions in the preceding chapter. But with county data we have the advantages of more observations (315 versus 48) in each year, and observations that differ more because of greater commodity specialization and other local characteristics that get averaged out in state-level data.

The most important costs of using county data are lack of some data at the county level (multifactor productivity indexes, for example). Moreover, the greater specificity of counties, together with the smaller number of farms within each county, means more random error in each observation. The problems are greatest for net farm income measurement. We have only census data to work with, and the coverage of costs is only partial in these data. Even with only partial coverage of costs, net farm income calculated as product sales minus variable costs is negative for many counties in any census year, and both the highest and the lowest calculated county income levels have a large transitory component.

Counties are more uniform in size than states, but there is still a great deal of variation in the size of agricultural sectors across the sample counties. With 1950 census data as a benchmark, sample counties range from Tulare County, California, which had 7,062 farms with $105 million in sales, down to 135 farms with $1.2 million in sales in Thomas County, Nebraska, or (economically more ominous) 1,683 farms selling $204,000 of products ($122 per farm) in Knott County, Kentucky. Because of the higher likely errors of measurement and lesser economic importance of the smallest counties, the regressions to follow weight the observations by their value of sales in 1950. An alternative weighting by number of farms was also tried, and made no substantive difference in the results. (The growth rates in Table 10.1 are unweighted, so that small counties have just as much influence on the sample means as large counties.)

The first dependent variable considered is growth in real sales, the data plotted in Figure 10.2. Because of the randomness of sales in any particular year, the rate of growth between particular beginning and ending points is not used to measure growth rates. Instead log-linear trend equations were fit to the data. The trend rate of growth is the dependent variable for the regression results reported in columns (2) and (3) of Table 10.2. Means of all variables are shown in Table 10.3.

The independent variables are mostly initial conditions of 1950 (a few variables unavailable in 1950 are proxied by 1960 census data). In the spirit of the idea that initially less-developed counties might grow faster, other things equal, the value of real agricultural sales in 1950 is included in the regression, but it does not have a significant effect on the subsequent rate of growth.

In the state-level regressions, indicators of investment and multifactor productivity were important, but we do not have county-level data for these variables. In the county regressions, the growth of real expenditures on machinery repairs and petroleum products, available by county in the 1950 and later Censuses of Agriculture, is used as a proxy for growth in the stock of capital equipment. This indicator grows by an average of 0.8 percent annually in the sample counties, about the same as the rate of growth of USDA's measure of the overall capital stock in agriculture. Variations from county to county in the rate of growth of these expenditures will be a misleading indicator of differences in capital stock growth for counties in which the ratio of capital to machinery-related expenditures has changed over time, unless the change has occurred in the same way in all counties. Because disproportionate changes may be associated with changes in the commodity mix of counties, the inclusion of commodity shares in the regression may reduce the possible error arising from this deficiency of the investment proxy. A second indicator of investment is the change in the percentage of a county's cropland that is irrigated. In columns (1) and (2), both indicators of investment have a positive relationship with growth, although the irrigation variable is only marginally statistically significant.

In the absence of county-level estimates of multifactor productivity or ex-

Table 10.2 Regression coefficients (*t*-statistics in parentheses) explaining real farm sales growth, 315 counties, 1950–1997

	Dependent variable			
(1) Independent variable	(2) County sales growth	(3) County sales growth	(4) Growth in sales per farm	(5) Growth in sales per farm
Intercept	−0.059	−0.045	0.033	0.062
	(−3.12)	(−2.59)	(2.434)	(5.72)
1950 sales (log)	−0.000498	−0.0000108	−0.006	−0.007
	(−0.53)	(−0.01)	(−4.53)	(−5.90)
Investment	4.486	4.731	3.020	2.802
	(9.93)	(10.83)	(6.87)	(6.52)
Irrigation	0.008	0.009	0.021	0.021
	(1.56)	(1.67)	(4.16)	(4.10)
Total factor productivity	1.074	1.213	2.496	2.535
growth	(2.98)	(3.45)	(6.64)	(6.66)
State aggregate research	0.000872	0.000673	0.000523	0.000440
spending (1950)	(6.55)	(5.18)	(4.13)	(3.53)
Grain share of acreage (1950)	0.010		0.016	
	(1.04)		(1.64)	
Dairy share of sales (1950)	0.007		0.014	
	(1.20)		(2.20)	
Cotton share (1950)	0.007		0.027	
	(0.72)		(2.75)	
Sugar share (1950)	0.086		0.081	
	(3.35)		(3.24)	
Tobacco share (1950)	0.022		0.031	
	(1.37)		(2.02)	
Poultry share (1950)	0.024		0.028	
	(3.35)		(4.01)	
Soybean share (1950)	0.009		0.046	
	(0.59)		(3.05)	
Vegetable share (1950)	0.027		0.024	
	(3.34)		(3.06)	
Livestock share (1950)	0.024	0.016	0.009	0.008
	(2.52)	(2.12)	(1.02)	(1.11)
Labor share of costs (1950)	0.016	0.005	0.001	0.002
	(1.56)	(0.58)	(0.12)	(0.18)
Machinery share of costs	0.038	0.023	0.019	0.006
(1950)	(3.31)	(2.09)	(1.70)	(0.63)
South (dummy)	−0.000334	−0.001	−0.004	−0.005
	(−0.14)	(−0.42)	(−1.58)	(−1.97)
Specialization (1950)	−0.004	0.006	−0.003	0.009
	(−0.78)	(1.67)	(−0.54)	(2.61)
Percentage of farmers with	0.000345	0.000277	0.0000402	−0.000104
over 6 years of schooling	(4.07)	(3.81)	(0.47)	(−1.37)

Table 10.2 (continued)

	Dependent variable			
(1) Independent variable	(2) County sales growth	(3) County sales growth	(4) Growth in sales per farm	(5) Growth in sales per farm
Percentage of farm population over 25 years of age (1950)	−0.035 (−2.49)	−0.035 (−2.57)	−0.054 (−3.91)	−0.063 (−4.72)
Percentage of farmers working off farm (1950)	−0.013 (−1.48)	−0.014 (−1.58)	−0.020 (−2.30)	−0.22 (−2.53)
Property tax rate (1950)	−0.004 (−3.51)	−0.003 (−2.82)	−0.004 (−3.25)	−0.002 (−1.74)
Program crop share (1950)	−0.002 (−0.17)	−0.004 (−1.15)	−0.015 (−1.37)	−0.008 (−2.17)
Percentage of population on farms (1950)	0.0000402 (0.65)	0.0000540 (0.87)	−0.000135 (−2.25)	−0.000131 (−2.10)
County population growth rate	−0.000559 (−0.26)	0.002 (0.95)	−0.00836 (−4.003)	−0.007 (−3.27)
$\bar{R}^2$	.560	.520	.624	.580

penditures on agricultural research, the Table 10.2 regressions simply use the state-level data for all the sample counties in that state. For the research variable this is not a problem, since all counties in a state are served by a single set of experiment stations with associated extension services. For the productivity variable, the lack of county specificity is more problematic in that productivity is expected to vary substantially from county to county in some states. It turns out that both variables have significantly positive effects in these regressions. Note, however, that including both variables may cause the research variable to understate the contribution of agricultural research, because multifactor productivity is likely itself to be increased by research.

Eleven variables are included to measure various aspects of the initial production situation in a county. These include the shares of the county's cropland acreage devoted to grain, soybeans, cotton, production-control crops (tobacco and peanuts), sugar crops (beets and cane), vegetables, the share of farm sales accounted for by dairy and poultry products, and the share of input costs accounted for by feed and purchased livestock, hired labor, and machinery-related expenses. The difference between the regressions reported in columns (2) and (3) is that the latter drops the acreage- and sales-share variables. Three of the commodity variables—poultry, sugar, and vegetables—as well as the cost share of machinery-related expenses,

Table 10.3 Sample means of variables used in county regressions

Variable	Mean	Minimum	Maximum
Number of farms, 1950	2,401	135	8,984
Number of farms, 1992	849	29	5,469
Value of farm sales, 1950 ($)	11,033	204.5	105,411
Value of farm sales, 1992 ($)	86,850	143	1,386,744
Land value, per acre, 1950 ($)	88.36	1.84	546.29
Land value, per acre, 1992 ($)	1,455	98	17,673
Trend rate of real sales growth	0.023	−0.044	0.072
Growth rate of sales per farm	0.049	−0.0004	0.102
Growth rate of median farm family income, 1960–1990	0.031	−0.016	0.070
Investment % of capital stock	0.008	−0.009	0.012
Irrigation (% of change in land)	0.035	−0.769	0.614
Multifactor productivity growth rate	0.008	0.003	0.013
State aggregate research spending, 1950	7.635	1.00	25.00
Grain share of acreage, 1950	0.436	0.004	0.96
Dairy share of sales, 1950	0.163	0	0.845
Cotton share, 1950	0.096	0	0.812
Sugar share, 1950	0.005	0	0.541
Tobacco share, 1950	0.017	0	0.456
Poultry share, 1950	0.098	0.001	1.464
Soybean share, 1950	0.019	0	0.291
Vegetable share, 1950	0.031	0	1.017
Livestock share, 1950	0.484	0.029	0.921
Labor share of costs, 1950	0.219	0.019	0.788
Machinery share of costs, 1950	0.241	0.010	0.847
South (dummy = 1 in southern states)	0.324	0	1
Specialization index, 1950	0.421	0.0009	2.88
Percentage of farmers with over 6 years of schooling, 1960	78.8	21.0	97.7
Percentage of farm population over 25 years of age, 1960	0.543	0.311	0.684
Percentage of farmers working off farm, 1950	0.238	0.014	2.22
Property tax rate, 1960	0.831	0.08	3.69
Program crop share, 1950	0.579	0.004	0.971
Percentage of population on farms, 1960	21.507	0.2	65.4
County population growth rate, 1950–1990	0.240	-0.583	2.197

had a significantly positive effect on growth. This is taken to indicate that, other things equal, counties with comparative advantage in these commodities in 1950 were well placed for agricultural growth in the next four decades, and indeed these are all commodities for which output has expanded substantially over time. In the cases of broilers and vegetables, consumer demand has been an underlying cause. In the case of sugar, U.S. policy has generated growth in demand for U.S. sugar through tariff protection of the industry, and the market share of imported sugar has declined from about 50 percent in the 1950s to 15 percent in the 1990s.

The set of acreage and sales share variables are dropped in column (3) partly because so many of them are statistically insignificant, although an *F* test on the restricted regression that drops all of them indicates that as a group they are significant. In addition, dropping this set of variables is a test of robustness in the sense that one can then observe which other variables maintain their signs and significance in the face of alternative specifications. The investment, productivity, and research variables pass this test well.

Four related variables in the structure of production are the extent of specialization in farming, work off the farm by farm operators, farmers' schooling, and their age. The issue with specialization is whether, given a county's initial commodity mix, it is beneficial to be specialized in some commodity as opposed to being a producer of a more mixed set of farm products. The measure of specialization used here is the sum of squares of the acreage and sales shares for all the commodities whose census data are used here. This measure is conceptually similar to the Herfindahl index used in industrial organization research to measure industry concentration. The value of the index means nothing per se; its useful property for our purposes is that it is minimized when all the shares are equal and maximized when a county is entirely devoted to one commodity, with continuous variation between the extremes. Specialization so measured for 1950 has an insignificant effect on subsequent growth in column (2), but a significant positive effect in column (3). So while there is some indication that it is good to have been specialized, the robustness of this finding is suspect.

The prevalence of off-farm work is measured by the percentage of the county's farm operators who reported in the 1950 Census of Agriculture that they worked off the farm 100 or more days in the preceding year. Off-farm work can affect growth of agricultural output in two quite different ways. Off-farm work can serve as a source of capital to be invested in the farm and thus contribute to agricultural growth. Alternatively, off-farm work can serve as a stepping stone to further labor mobility out of agriculture and thus be associated with reduced subsequent agricultural growth in a county. In the regressions of columns (2) and (3), off-farm work has no significant effect on subsequent growth, indicating either that neither of these factors is important or that they offset each other.

It might be argued that more important than the initial level of off-farm work is the change in off-farm work over the 1950–1990 period. In this context we would expect increasing off-farm work to be associated with farming in the county being of less importance. But this association would tell us nothing about off-farm work as a causal factor. The likely endogeneity of many of the variables used in these regressions is the reason for using initial 1950 values rather than changes in them over time.

This line of argument may lead one to question the meaning of the coefficients reported earlier for multifactor productivity growth and investment, both of which are measured as changes over time between 1950 and 1990. Multifactor productivity as a measure of technical change is a state-level variable that is arguably not influenced by a county's output growth, so we can be confident that the observed positive association between productivity growth and county output growth indicates causality from the former to the latter. Moreover, if changes in productivity growth as measured were caused by output growth, the most likely reason would be that higher output growth places more demands on fixed resources, for example moving production onto marginal land. Ideally, the addition of marginal land would be measured as a reduction in land inputs, which USDA attempts to hold quality-constant as discussed in Chapter 2. But in practice such input-quality adjustments are imperfect. Even if measured productivity is endogenous in the sense of being influenced by as well as influencing a county's output, output growth would cause measured productivity to decline by the preceding argument. So the correction to the regression results of Table 10.3, if there were any, would be to make the estimated positive effect still more positive.

The investment variable is a more serious problem. It is proxied by the increase in real expenditures on capital-related inputs, and one might argue that growth in sales would be associated with growth in inputs regardless of causality. But if we accept that capital growth is tied to output growth, that is sufficient for the purposes of this chapter. The point here is just to ascertain the extent to which county differences in capital growth explain differences among counties in real output growth, and not to claim investment in capital as an ultimate cause of sales growth.

Off-farm income entered into the analysis as a means by which the nonfarm economy influences the growth of farming. Another such variable is the overall growth of a county's population. Such population growth arguably hinders the expansion of farming because residential and commercial development compete with agriculture for land use. However, it turns out that counties with faster-growing populations did not have less growth in real agricultural sales, other things held constant. It could be that expansion of the market for a county's sales with increased population offsets the competition for land use on average, although there is no doubt that some counties have had their agricultural sectors severely squeezed, at least in acreage, by urban expansion. An indicator of the importance of agriculture in a county is the share of population that has farm residence. This share ranges from 65 percent (Haywood County, Tennessee, is most rural in this sense) to 0.2 percent (Fairfield County, Connecticut). It is possible that a large farm population share in 1950 creates better conditions for subsequent agricultural growth in the county than does a predominance of people who are not farm residents. In the regressions, however, this variable has no significant effect on agricultural growth.

Farmers' schooling made no contribution to explaining agricultural growth in the state-level regressions of Chapter 9. An alternative approach is tried in the county data, focusing on the achievement of minimal skills rather than the median schooling attained or high school graduation. Census of Population data report, for the farm population of counties in 1950 and later, the percentage of adults who have finished more than six years of schooling. In both column (2) and column (3) this variable is significantly positive, providing evidence that the achievement of minimal educational levels (literacy, arithmetic) does promote agricultural growth. Having discovered this relationship, we might go back to the state-level regressions and reestimate them, with this chapter's schooling measure replacing the schooling index used in Chapter 9. However, there are only forty-eight cross-sectional observations in the state data, and extensive estimation of alternative models would reduce the validity of *t*-tests even if the alternative regressions showed greater "significance" for schooling.

It may be argued that low schooling levels are also an indicator of an older farm population, given the history of rural schooling as discussed in Chapter 4. In order to account for this possibility, as well as determine whether the age of the rural farm population in itself matters, the proportion of the farm population over age twenty-five is also included in these regressions. This variable has a negative effect on county agricultural growth rates, but its presence does not take away the negative effect of lack of basic schooling. The schooling and age variables are statistically significant in both column (2) and column (3).

Because the demographic variables as well as some of the commodity variables have a regional dimension, it is also worth considering whether some of their measured effects may in fact be regional effects. A dummy for the southern states is included to reduce the likelihood of confounding regional with demographic or commodity (cotton, tobacco) effects. However, this dummy is insignificant, and removing it while leaving all other variables in place does not significantly affect any of them.

Finally, two variables parallel to those used in the state-level analysis are included in the county regressions to consider the possible role of government: the state's property tax rate in 1950 and the share of each county's crops accounted for by commodities that had federal farm support programs in place in 1950 (grains, cotton, rice, peanuts, tobacco, and sugar). The property tax rate is taken as a proxy for the extent of development of public capital or infrastructure in the state's counties. It has a negative effect on agricultural growth, giving support to the view that taxes measure not public investment in productive resources but rather a drain on those resources. This is the same variable, however, that had a positive effect in the state-level regressions in Chapter 9, so any inference about what its coefficient means would not be statistically well founded.

An increased share of program crops in a county has no apparent effect on the county's subsequent growth. The coefficient of this variable is negative in both column (2) and column (3), but in neither case is it statistically significant. In addition, the share of acreage devoted to the two crops that have had effective production control policies throughout the last fifty years, tobacco and peanuts, has no significant effect. Thus the hints of possible price-support significance that Table 10.1 encouraged do not appear to be borne out.

The regression equations overall explain 56 percent (column 2) and 52 percent (column 3), adjusted for degrees of freedom, of the variance in the sample counties' trend rates of growth in real agricultural sales during the 1950–1997 period. The key variables that came to our attention in the state-level analysis, those associated with investment and technological change, are also important factors in county growth rates. In addition, the county-level analysis points to an important role for basic schooling of farm operators and some other initial conditions. But much of the county-to-county variation in growth rates remains unexplained.

Columns (4) and (5) of Table 10.2 show regression results similar to those we have been discussing, but with the growth of real agricultural sales *per farm* as dependent variable. The results are basically similar to the county-aggregate growth rate findings, but with a few notable differences. The initial level of sales per farm has a significantly negative effect, meaning that convergence occurs in the sense that farms in counties with initially smaller farms see those farms grow faster. The off-farm variables are also strikingly more important in columns (4) and (5). Off-farm work, rapid county population growth, and a large fraction of rural farm residents all significantly hinder the growth of sales per farm. And the overall explanatory power of these regressions is slightly higher, with adjusted R^2 of .62 and .58. The sample means of all variables used are shown in Table 10.3.

Similar regressions were carried out using as dependent variables value added, net farm income, and the price of farmland. Value added and net farm income are closer to measures of farmers' and farmworkers' economic benefits from a county's agriculture, but both have substantial measurement error, as discussed earlier. As might be expected, the same right-hand-side variables as used in Table 10.2 to explain real farm sales growth explain less of the county variation in the growth of value added or net farm income. But investment, productivity growth, and agricultural research spending in the state again have significantly positive effects on growth. (Details of these regressions are not shown.)

Farmland prices are an indicator of the generation of returns more specific to agriculture than are the returns to labor, and land prices are not as subject to year-to-year fluctuations caused by transitory commodity price or yield shocks. But land prices are subject to cyclical booms and busts, such as the rise and fall of prices during 1974–1988, and the market for farmland is influenced by nonfarm alternatives in many areas of the country. In a study of the farmland market in the mid-Atlantic states, my coauthors and I found nonfarm land market forces to be more important than returns from farming in determining farmland prices in the 1980s (Hardie, Narayan, and Gardner 2001).

During 1960–1992 the average annual real rates of increase in land prices varied from −1.8 percent (in Deaf Smith County, Texas) to 7.6 percent (Gwinnett County, Georgia). The extremes are special cases, as usual: in Deaf Smith County the poor performance may have been linked to the major move to livestock feeding from cropping. In Gwinnett County, a former rural backwater became part of the suburban area of Atlanta. In regressions aimed at uncovering more general causal factors, county differences in changes in real prices of land during 1950–1992 were statistically explained using the same explanatory variables as in the previous discussion. As might be expected, factors related to growth in net farm income are significant explanatory variables, but the most important variable is the overall rate of population growth in a county.

FARM HOUSEHOLD INCOME

The availability of data on farm households is more limited for counties than for states. Farm household incomes were not published at the county level until 1960. These data result from asking Census of Population respondents directly about net income from all sources rather than asking about output sales and expenses as the Census of Agriculture does.

Table 10.4 reports county-level regression results analogous to those of Chapter 9 explaining state-level household income. As in the state-level results, county median rural farm family incomes show strong convergence

Table 10.4 Regressions explaining real farm family income growth, 315 counties, 1960–1990

Independent variable	Dependent variable: percentage growth in median farm family income (2)	(3)	(4)	(5)
Intercept	0.246	0.099	0.132	0.076
	(28.24)	(7.76)	(7.35)	(1.56)
Median income, 1960 (log)	−0.022	−0.009	−0.013	−0.007
	(−24.60)	(−7.38)	(−7.60)	(−1.50)
Growth of nonfarm family income, 1960–1990		.704	.600	.804
		(12.3)	(9.21)	(4.10)
Nonfarm/farm income, 1960		0.020	0.016	0.025
		(9.40)	(6.55)	(3.53)
Change in median schooling of farm adults, 1960–1990			0.002	0.083
			(0.50)	(2.22)
Growth rate of county population, 1960–1990			0.002	−0.002
			(2.37)	(−0.61)
Percentage of farm population nonwhite, 1960			0.004	−0.009
			(−1.69)	(−2.02)
Percentage of population on farms, 1960			−0.000078	−0.000073
			(−2.48)	(−0.74)
Percentage of farm population over age 25			0.016	−0.021
			(−2.81)	(−1.54)
Percentage of farm operators working 100+ days off the farm, 1960			−.005	0.023
			(−1.36)	(1.15)
Trend growth rate in real sales per farm, 1950–1997			.019	0.060
			(1.00)	(1.42)
South (dummy)			−0.0002	−0.000096
			(−0.24)	(−0.06)
$\bar{R}^2$			.81	.87

over time. There is, however, more idiosyncrasy in the county data. For example, the lowest median income in 1990 is that of Starr County, Texas, which was already one of the lowest-income counties in 1960; and far from converging, Starr County is one of the very few in which real incomes of farm families were lower in 1990 than in 1960. Hill County, Montana, is similarly an outlier, for which there is no apparent explanation, as discussed earlier. Such data variations provide more fodder for explanation than the state data did, but to the extent the observed differences among counties are just random error, they reduce the precision of statistical analysis. There is no doubt that such random error is present. Indeed, in several counties the sample of farm families is so small that the census does not report a median income estimate for them. The counties for which no median farm household income is reported have an estimated farm population of less than 150. Since income questions are asked on the census "long form" that went to about one-fourth of all households, the average sample size for these counties would have been less than 40. In these cases I estimated the median income from the number of families in the size categories of income that are published in the census.

The adapted error-correction model used to explain household incomes takes an approach that is different from that used in the county farm sales regressions. In the sales analysis, the presumption is that the factors that matter are characteristics of farms and people in that county. The presumption in the household income model is that what matters most are market conditions in a county as related to other counties, most notably that returns to farmers' labor in a county are most importantly determined by prevailing nonfarm labor earnings in that county and the integration of that county's labor market with wider state and national labor markets. One is not led so firmly to the market-integration focus in explaining farm sales, because it is obvious that these differences are as much or more a matter of output quantities as of prices, and quantities produced (both for the county as an aggregate and for the average farm) depend on the size and other features of farms as much as on prices. Indeed, for the main prices involved, those of agricultural products, market integration is taken so much for granted that explaining a county's trend in sales by prices in that county compared with statewide or national average prices is a nonstarter as an explanatory hypothesis.

Improvements in product market integration could nonetheless be important, especially in periods before the post-1950 era that this chapter considers. For recent years, however, it is difficult even to obtain meaningful data on how county price trends vary from national price trends. If one asks local grain buyers for prices and price changes, they consult the latest data from the Chicago Board of Trade or other national-market source. When USDA data indicate large changes in price differences over time, as has occurred for wheat in some counties relative to others, one suspects the county's wheat has changed in some qualitative respect, or is not really the same product in the different counties.

Columns (2) and (3) of Table 10.4 present results of estimating the household income model for our sample of counties. Column (2) shows the basic convergence model in which households in all counties are presumed to have the same underlying income potential, and differ only in initial conditions that place them at different points on a long-term path that will lead them all to the same income level at some future date. The estimated parameter for calculating convergence is the regression coefficient of the log of base-period median income. The coefficient of −0.022 is statistically significant and is very close to the −0.021 estimated from the state data for 1950–1990. With a growth rate of real median income of 3.2 percent annually between 1960 and 1990 on average for these counties, the implication is that more than half of the differences between county median incomes would be eliminated in thirty years. Actually, the coefficient of variation across the median incomes of this example of counties was reduced from 0.36 in 1960 to 0.25 in 1990. But the remaining differences between counties are large, with a range from $16,000 to $76,000, implying that the convergence story is not a complete one.

Column (3) shows the results of applying to county data the error-correction approach of Chapter 9. The idea is that the initial situation was one of labor-market disequilibrium, in which farm labor earned lower returns than farmers could earn if they engaged in nonfarm employment in that same county. Adjustment toward equilibrium then occurred during the (1960–1990) period, and that adjustment was greater, the larger the initial difference between nonfarm and farm incomes. In addition, nonfarm income growth over the period should also boost farm incomes, through the same adjustment mechanisms (principally off-farm migration and off-farm work by farm household members). The regression coefficients indicate that the adjustment-to-disequilibrium phenomenon is a significant factor in farm family income growth in these counties, and it actually explains more than the overall convergence story (that is, convergence to a common median income for all counties). This is apparent in Figure 10.4, which shows changes over time in the ratio of rural farm to urban family income within the same county. Not only do farm families in the counties have average incomes larger than the nonfarm county average in 1990, but this has been achieved even for counties whose farm incomes were furthest below the overall county income level in 1960. And even counties whose incomes remain well below the national average income have made substantial progress in catching up with local nonfarm incomes. This finding suggests that long-standing low-income problems that have traditionally been associated with farming as an occupation are now replaced by less severe but still significant problems of regional disparities in income.

The analysis of farm household income as a matter of labor market adjustment has explanatory power, but the earlier state-level analysis as well as simple observation indicate many other reasons why we observe lower incomes among farmers in some counties than in others. The skills, wealth,

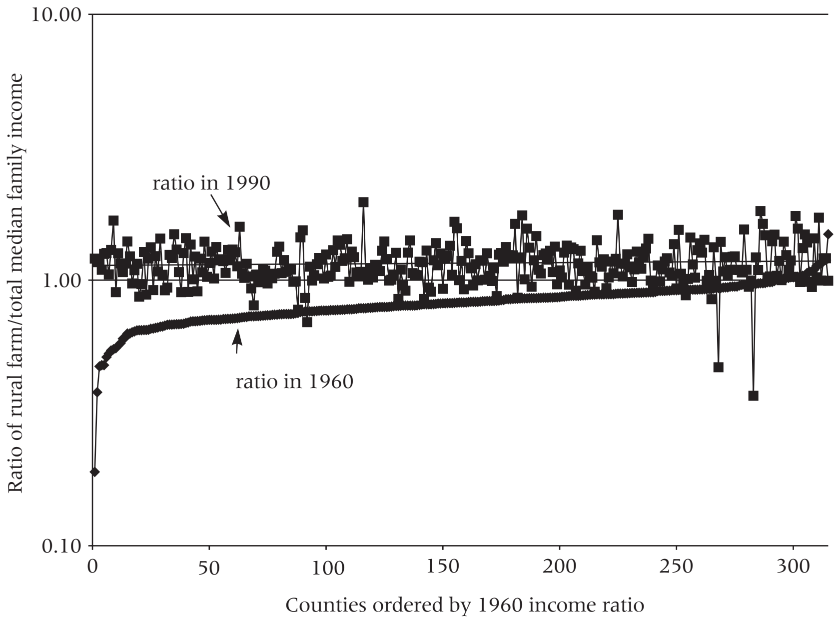

Figure 10.4 Ratio of farm to all-family incomes by county, 1960 and 1990. Data from U.S. Department of Commerce, *Census of Population,* 1960 and 1990.

and other characteristics of farm people differ from county to county in ways that will lead to their having lower incomes regardless of labor market conditions.

Column (4) of Table 10.4 shows regression results intended to test for the significance of some of these income determinants. The variables that are most important are the growth of the total population of a county and the percentage of the county's population that has farm residence. Both variables measure factors that promote labor market adjustment. For given nonfarm income levels, it will be easier for farm families' incomes to rise in response to them if the county is growing in population and harder if the farm population is large relative to the nonfarm population. Other variables that might be thought important, however, notably improvement in the schooling attainment of farm adults, the initial extent of off-farm work by farmers, and southern location, have an insignificant effect on median farm household income growth. And the added variables altogether increase R^2 only to .81 from the .79 of the basic market-adjustment model.

It is also striking, and runs parallel to the state-level findings, that the rate of growth of a county's agriculture, as measured by the trend rate of growth in real agricultural sales, has no significant effect on farm household income. This phenomenon was noted earlier with reference to Figure 10.3, but with the caveat that a more notable association was apparent between agricultural growth and farmers' incomes in the subset of sample counties that were more rural in the sense of having the highest percentage of their populations on farms. This possibility could not be examined further in the state data, because only a few states are highly dependent on agriculture. However, many counties are heavily dependent on agriculture, even in some states that have a large urban population like New York or Florida.

Column (5) of Table 10.4 shows the same regression as reported in column (4), but using as observations the 71 counties out of our sample of 315 in which the farm population is a third or more of the county's total population. In these counties we can explain more of the counties' differences in rate of farm household income growth (R^2 of .87 compared with .81); and the same individual household and agricultural characteristics seem to play a more important role, although they are mostly still not significant. Narrowing the sample still further to the 42 counties in which 40 percent or more of the population lived on farms, or alternatively to the 49 counties in which less than 10 percent of farm operators worked 100 days or more off the farm, provide still more heavily agriculture-dependent counties. But in all of these subsamples it remains the case that nonfarm income growth in the county is the most important influence on farm family incomes. The regression coefficients on growth in the size of farms, productivity, schooling, and other variables are not robust and one cannot confidently pinpoint their contributions to farm family income growth over the 1960–1990 period.

Regressions were also estimated explaining the 1990 level of median real farm family income, as determined by 1990 levels of nonfarm income, farm size, schooling of farm adults, government payments per farm, the prevalence of corporate farming, and other variables. As with the explanation of income growth over the 1960–1990 period, by far the most important determinant of median farm income levels is the median income of the county's nonfarm population.

INCOME INEQUALITY AND POVERTY

Labor market linkage with the nonfarm economy in a county brings to mind the issue of income inequality that was discussed earlier in the national context. Between 1960 and 1980, the key period for changes in income distribution in the national data, the average of the 315 counties in our sample saw a reduction in the coefficient of variation of income from

0.89 in 1960 to 0.81 in 1980 (about the same as in the case of Cedar County, discussed earlier). However, reductions in inequality did not occur across the board. Income inequality increased in 102 counties and decreased in 211. The largest decrease was in Navajo County, Arizona, where the coefficient of variation decreased from an exceptionally high 1.59 in 1960 to 0.86 in 1980 (still far from equality). The largest increase occurred in Starr County, Texas, another relatively poor county.

A cross-sectional regression explaining these changes was estimated to indicate factors behind equalization of income. The results are reported in Table 10.5. The most significant variable explaining the estimated reduction in inequality is the initial level of inequality in 1960. I interpret this as primarily indicating the randomness in individual incomes and statistical errors in income measurement. Both of these sources of error in income data are less a problem when analyzing average county incomes, because the many errors and random variations in particular farmers' incomes will cancel out in the average. But the spread of incomes in the size distribution magnifies these errors, especially if they are large. It is notable that the largest and smallest changes in inequality mentioned above are both from counties with small numbers of farmers and in dry climates (Arizona and the Rio Grande Valley of Texas) where growing conditions may vary widely from farm to farm. Given this situation, a high initial value of the coefficient of variation of income is to some extent an indicator of random income varia-

Table 10.5 Regression results explaining changes in farm income inequality, 1960–1980

Dependent variable: CV80 − CV60, where CV80 is the coefficient of variation of farm household income in 1980 and CV60 is the coefficient of variation of farm family income in 1960

Independent variable	Coefficient	*t*-statistic
Intercept	0.459	6.38
CV60	−0.562	−6.89
Growth rate of average farm household income	0.381	0.40
Growth rate of farm numbers	0.968	1.43
Nonfarm/farm income, 1960	−0.150	−3.12
Change in percentage of farm adults with over 6 years of schooling	0.013	1.42
Growth of farm size	0.466	0.96
Farm productivity growth	−1.184	0.30
South (= 1)	−0.082	−4.12
$\bar{R}^2 = .503$		

tion from household to household, and the contribution of that variable to the regression indicates the significance of that effect.

The other variables are noteworthy for what they do not show. It might be thought that faster growth of average income in a county would be associated with increased inequality, at least insofar as faster growth involves a dynamism in which some farmers are well placed to prosper while others are left behind. The regression, however, shows no evidence of such an effect. Similarly, counties in which farm size or farm productivity grew faster did not experience less decline in inequality. An alternative hypothesis is that a larger reduction in farm numbers should lead to less inequality because those less suited to farming are leaving, and these are the lower-income farmers whose absence would reduce inequality while raising average incomes. But the regression gives little support to this view either, as the coefficient is not statistically significant. This result does not conflict with the idea that those who leave farming are the least well suited to farming; rather, the relevant issue is comparative advantage in farming or other activities, and those less well suited to farming relative to their economic alternatives could as well be younger and better-educated people who would be at the average or better in the income distribution if they had stayed in farming.

The one other variable that appears to have some explanatory power in changing income inequality is the extent of initial nonfarm/farm income disparity. I argued earlier that nonfarm/farm income disparity is an indicator of market disequilibrium, and that adjustment to such disequilibrium is a main factor in the rise of average farm household incomes since 1960. The regression results here suggest that this adjustment has worked disproportionately to the benefit of lower-income farm people. Finally, note that counties in southern states had larger declines in inequality than other states, ceteris paribus. This is not a racial effect, as even if the percentage of a county's farm population that is nonwhite is included in the regression, the southern effect persists (and the racial variable is insignificant).

LOW INCOMES

To focus more explicitly on the lower end of the income distribution, a useful indicator is income level at the twentieth percentile of the size distribution of income. In each county we find the income of households at the position in the income distribution where 80 percent of the households have a higher income and 20 percent lower. Use of the twentieth percentile, rather than the tenth or twenty-fifth, say, is arbitrary but follows the criterion used in recent international research on economic growth and poverty (see Dollar and Kraay 2000).

The rate of increase of incomes at the twentieth percentile indicates the extent to which households at relatively low income levels benefit from economic growth. In 1960 census data, the median (fiftieth percentile) income of farm households was $12,580 (in 1990 dollars), while the twentieth percentile income was $4,510. By 1990 the median income had grown to $29,510, an annual real growth rate of 2.8 percent, while income at the twentieth percentile had grown to $13,930, a 3.8 percent growth rate.

In the sample of 315 counties used in this chapter, differences between counties in the rate of income growth at the twentieth percentile should help us understand which elements of the growth process are most favorable to curing low-income problems among farm households. At the national level, the annual growth rate of real median farm household incomes varied by decades: 5.8 percent in the 1960s, 2.3 percent in the 1970s, and 0.5 percent in the 1980s. The growth of incomes at the twentieth percentile was faster in each decade: 7.1 percent, 3.2 percent, and 1.0 percent, respectively. The analysis to follow focuses on the twenty-year period of fastest growth. The 1960–1980 annual rate of real income growth at the twentieth percentile varies from 1.9 percent to 13.9 percent in our 315 counties, so we have substantial variation to explain.

Regressions like those of Table 10.4 were estimated to explain county farm household income growth rates at the twentieth percentile. The main adaptations of the earlier model are that initial-year levels of income at the twentieth percentile are now used to test for convergence, while growth of median nonfarm income is still used to test for integration in the ECM-like model. In addition, these regressions undertake an explicit analysis of net migration out of farming, measured as the percentage reduction in the number of farm households. This was not done in the regressions earlier in this and the preceding chapter because of ambiguity about what the coefficient would mean—does causality run from out-migration to farm income or from income to out-migration? It is important, however, to try to identify the migration effect if possible, because faster decline in the number of farm households is associated with a faster rate of twentieth percentile income growth in the raw data. This brings up again the nagging question of whether out-migration from agriculture is part of the mechanism of labor market integration, as I have been claiming, or whether out-migration selectively removes low-income households from the farm population. To see the importance of this issue from the viewpoint of a low-income person in agriculture, note the following: if the labor market integration view is correct, then the out-migration of your neighbors makes you better off (by correcting the oversupply of farm labor); but if the selectivity explanation is correct, the out-migration of your neighbors leaves you with the same income as before (even though income at the twentieth percentile increases because people below that level have left disproportionately).

Including the rate of farm population decline in the regressions in fact does not result in a significant effect, either in ordinary least-squares regression or in a two-stage least-squares model that uses exclusion restrictions to identify a separate migration equation to deal with the endogeneity (two-way causation) problem of that variable. I conclude that the labor market integration interpretation of the regression analysis survives intact. (For details of the procedures and findings, see Gardner 2000b.)

Regardless of how one handles the out-migration issue, the evidence persists that convergence across counties and nonfarm income growth within counties plays a strong role in raising farm household incomes at the twentieth percentile. These forces explain even more of low-income household growth than they did of median income growth, indicating that labor market adjustments to the farm labor market disequilibrium as of 1960, as well as labor market integration that appears increasingly evident since that time, have been even more beneficial for low-income farm people than for the average farm household.

Summary Discussion

Analysis of county data on farm sales, value added, farmland prices, and net farm income confirms that the growth of agriculture as a sector of the economy is promoted by investment, farm productivity improvement, and governmental support of agricultural research. These variables are of course not independent of one another, and it is not claimed that any one of them is more important than another as a separable cause of growth. Other variables that were thought likely candidates as causes of agricultural growth, notably farmers' schooling, regional and commodity specialization measures, and government commodity support programs, turn out to be weak as explanatory factors. In the case of growth in the price of farmland, the county's rate of overall population growth is more important than any agricultural variable.

With respect to the growth of farm household incomes, from farm and off-farm sources together, the surprising finding is how little any agriculturally specific variables contribute to explaining differences among counties. This is true even for the counties in our sample that are the most heavily dependent on agriculture. Instead, farm household income growth is explained mainly by market adjustments that brought farm labor earnings more nearly in line with those of the nonfarm economy. Counties where farm family income was relatively low as a fraction of nonfarm incomes in 1960 (and 1960 median farm family income was lower in 294 of the 315 counties) rose significantly faster than counties where farm and nonfarm incomes were close, and farm incomes consistently rose together with nonfarm incomes. These results indicate that the economic mechanism is one of integration of factor markets, with adjustment to an initial state of disequilibrium.

Reductions in the inequality of the size distribution of farm income, which occurred in two-thirds of the sample counties, are consistent with the general picture of labor market adjustment as the key factor in farm household income determination in recent decades. Most striking is the increase in income of low-income households after 1960. As with productivity growth in agriculture, the story in rural America is more positive than in the nonfarm economy. It might be thought that agriculture solved its low-income problem at the expense of the rest of the country, by exporting the poorest of the farm population; but that view gets no support in the county data, as it also did not in the state or national data.

11

Findings and Policy Implications

The main facts concerning the U.S. agricultural economy, and explanations of those facts, have been considered in the preceding chapters. This final chapter provides further discussion of and justification for the conclusions reached, and their implications.

Facts

A difficulty about facts is that so many of them are not straightforward matters of observing, counting, or applying a well-accepted measuring stick. Measurement of productivity, to take an example that was discussed in detail, is far from a simple matter of calculation from input and output data. Aggregation of disparate inputs and outputs is inevitably imperfect. Seemingly clear-cut tasks such as measuring the farm labor input or the capital stock in agriculture are fraught with difficulties that make comparisons over time questionable. The concept of a "farm" may appear simple, yet it turns out to be impossible to draw a consistent and clear line between farm and nonfarm households—so many have a foot in each camp, and the ways in which a household can have feet in both camps have changed so much over time. Measurement of farm income introduces further difficulties and is controversial in both political and scholarly debate.

Notwithstanding such problems, some basic facts about U.S. agriculture are undisputed. The farm population has declined to the point that in 2000 we had roughly a third the number of farms of 1930; at the same time agricultural output has about doubled, meaning farm size (measured as output per farm) has grown tremendously. The acreage of cropland, in contrast to the farm labor force, has been relatively constant over time, while capital and purchased inputs as carriers of new technologies have increased in importance. Because the very nature of many of these inputs has changed so much, it is difficult to construct an accurate measure of the quantity of total resources (land, labor, and capital) committed to agriculture. But a wide variety of scholarly attempts to do so have resulted in findings that output has grown a great deal, while inputs have not (see Figure 11.1), so that productivity has increased at a truly impressive sustained rate since 1940. With respect to the economic well-being of farm people, notwithstanding the chastening difficulties of income measurement, practically all investigations have concluded that farm household incomes were substantially less on average than nonfarm incomes in the first half of the twentieth century, but that since 1950 average farm and nonfarm household incomes have converged, and in the 1990s reached equality.

Among the many changes in the economic organization of agriculture and farms that have occurred, the following are most significant: specialization in production, growth in farm size, concentration of production on the largest farms, and greater use of contractual arrangements that reduce the entrepreneurial and risk-bearing role of farmers. Specialization in commodities has changed the typical commercial farm from a producer of a variety of crop and livestock commodities to a producer of only one or a few products. Specialization does not necessarily cause farms to become larger, but they have; and larger average size does not necessarily cause greater concentration of production on the largest farms, but the trend in this direction has also been strong.

Diversification in the sources of farm household income has reduced earnings from commodity production to the point that such earnings account for only a minority of the income earned by most U.S. farm households. Farms selling less than $100,000 annually in farm products, which amounted to 80 percent of all farms in the late 1990s, earn more than 90 percent of their household incomes from off-farm sources. This in itself means that the returns from agricultural production will be heavily concentrated in the larger farms; indeed in 1996 farms with more than $250,000 in sales (less than 10 percent of all farms) accounted for more than 85 percent of net cash income.

Also notable in the economic organization of farming are changes in contractual arrangements and the pricing of products. The system of sharecropping in which more than 1.5 million southern black and white tenants eked out a living until World War II has almost disappeared. And although the use of hired farm labor has been a constant of farm organization during the last hundred years, crews of workers organized by labor contractors have largely replaced the traditional hired hands living on family farms. The widespread use by farmers of contracts that both fix prices and product delivery terms in advance and place many managerial decisions in the hands of a contractor or integrator who is not the farmer is a recent development that makes many uneasy.

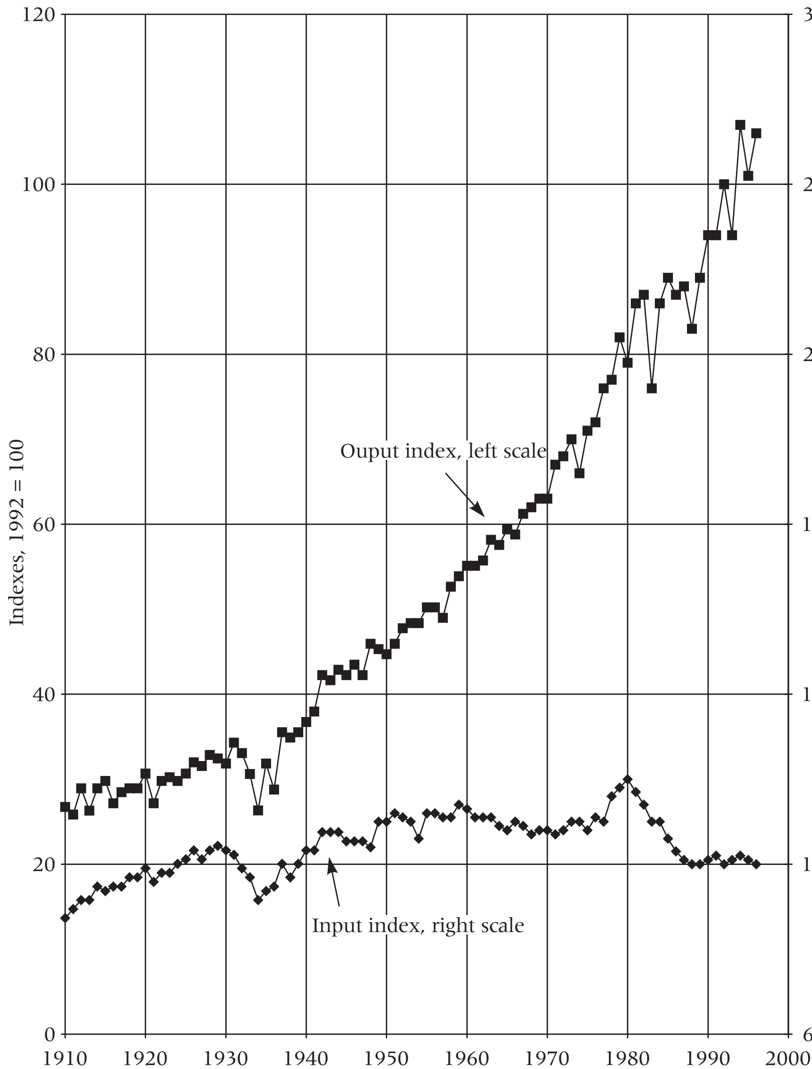

Figure 11.1 Indexes of U.S. agricultural output and inputs. Data from U.S. Department of Commerce (1975) and Council of Economic Advisers (2000).

Given these changes in the economic organization of agriculture, it is noteworthy that, at the same time that the diversity and inequality of farms with respect to most farm-related indicators have been increasing, a contrary trend has occurred in the most basic indicator of economic well-being of farmers, the income of farm households. Not only has the incidence of poverty-level incomes among farm households been remarkably reduced, but contrary to the recent trend in the nonfarm economy, inequality of income distribution among farm households has declined substantially since 1970.

In short, despite the many economic problems of agriculture during the twentieth century, the overall trend was one of strong productivity growth, declining real food costs for consumers, and a rising and more equally distributed standard of living for farm households. Yet some end-of-century assessments in the national media were quite gloomy. The *New York Times* on November 28, 1999, ran a story headlined "Is the Sun Setting on Farmers? Many Can't Survive the 'New Agriculture,'" with a continuation-page heading, "A Gloomy Forecast Worsens." Three underlying problems are cited: "the growing public concern about genetically engineered crops, a spate of huge agribusiness mergers, and commodity prices that have plummeted to their lowest levels in nearly 30 years" (p. 1). The article spends much of its space on details about genetically modified corn and soybeans and about agribusiness mergers. Unwanted consequences of technological change and monopoly power are indeed matters to worry about, and both have been worried about from the Progressive Era to the present day. But neither appears more of a threat to farmers or consumers today, and more likely both are less of a threat, than they were in 1910. Low commodity prices are undoubtedly a real problem for farmers, but this is primarily a matter of supply-demand balance, and again appears not basically different from low-price periods of the past.

The *Times* emphasizes a substantial decline in net farm income between 1997 and 1999, but the 1997 level was a temporary peak of the 1990s. More generally, referring back to Figure 3.10 will indicate the limitations of citing the late 1990s experience as a portent of long-term economic problems. The article also cites data that farms with more than $250,000 in sales "now account for more than 72 percent of all agricultural sales, up from 53 percent a decade ago." This is overstated, although the direction of the trend is correct.[1] It is not clear, however, that this trend is deplorable. In substantial degree the reason the largest farms have a growing share of output is

1. The problem with the comparison is that prices received by farmers for their products increased over the decade (the calculations use 1987 and 1997 Agricultural Census data) by 20 percent according to USDA's price index, which means 1997 farms with $250,000 in sales are on average roughly 20 percent smaller in terms of real output in 1997 than in 1987. Accordingly, 8.2 percent of all farms were producing the 72 percent of sales cited for 1997, while only 4.5 percent of all farms in 1987 were producing the 53 percent of sales cited for 1987. Thus concentration on the largest 5 percent of farms, for example, increased substantially less than the *Times* data would lead the reader to believe, and indeed those data are consistent with no increase in concentration.

that so many small farms, supported by off-farm income, are staying in business. For example, if instead of the 2 million farms of 2000, their number had fallen to 1 million (as some projections made in earlier years had indicated), and the ones that disappeared had been the smaller-sized farms, the top 5 percent of farms that now account for 70 percent of farm output would have been 10 percent; so concentration by this measure has doubled because the small farms stayed in business.

It is important to recognize the problems and deficiencies of the U.S. rural economy, most notably the unrelenting poverty and deprivation visited upon many hired farmworkers and the low standard of living of hundreds of thousands of rural households, both farm and nonfarm, in depressed areas of the nation. And it is correct and appropriate to recognize the struggle and suffering of millions of farm people in the Depression and other periods of economic crisis. Nonetheless, the long-term economic trend has been overwhelmingly positive for the farm population as a whole. Despite the fact that gloomy assessments make more arresting news stories, it is wrong to see U.S. agriculture at the start of the twenty-first century as a world of pain and little hope.

Explanations

The analytical parts of this book have concentrated on explaining the growth of agricultural productivity, the economics of agriculture as a sector of the economy, and the incomes of farm households. Productivity growth and the rising incomes of farm households are the main elements of U.S. agriculture's success story. The question is what made them possible. Four explanatory factors have received sustained attention: (1) the development and diffusion of new agricultural technology; (2) the expansion and commercialization of agricultural commodity markets; (3) the integration of farm people into the growing nonfarm economy in the post–World War II period, especially through increased participation in the nonfarm labor market; and (4) government policies, of three distinct types—(a) regulatory institutions that began to be introduced in the first decade of the twentieth century, (b) public investment in infrastructure (irrigation, transport, communication, research, education), and (c) the commodity programs introduced in the 1930s. Each of these explanatory elements can be supplemented and filled out with supporting hypotheses, such as the role of improved literacy and added skills in fostering the adoption of new technology and in preparing farmers for remunerative off-farm jobs, or the role of the farm credit system in providing capital for farm investment.

In addition we have hypotheses to explain aspects of the economic history of U.S. agriculture that have raised concern: the decline of the small-scale, diversified commercial farm, the decline of small towns in remote areas, and threats to water quality and other environmental problems of rural areas. The same general explanatory factors (technology, commercialization, integration into the nonfarm economy, and policy) have been put forth as important in causing these problems.

Throughout this book I have quoted, paraphrased, and developed many specific variants of these and other hypotheses, and have attempted to bring data to bear upon them. In reviewing the progress made toward explanation, it is helpful to consider three types of analysis, and what has been learned from each.

First, attention to specific facts can itself refute or support some hypotheses. The view that the commercialization of agriculture has reduced farmers' sense of stewardship of the land, and thus generated increasing problems of soil loss and other environmental harms, is seriously deflated by data that indicate that these harms are not increasing. The plausibility of the view that families on small farms are being pauperized by an industrialized agriculture is seriously reduced by data indicating that these families on average have rising real incomes, comparable to those of the U.S. average, and that income inequality among farm families has been declining even while inequality among nonfarm families has been increasing. When grain prices soared in the wake of Russian wheat imports in the 1970s, the results supported the view that export markets matter a great deal in determining farm income, as does the decline in crop prices during the Asian crisis of 1997–98. But when those same crop prices remained weak even though the Asian crisis ended in 1999–2000, it became clear that other factors are important, too.

Recognition of multiple, interacting causes leads to a second approach, econometric analysis of time series data. This approach can uncover relationships among variables that refute or support some hypotheses. Many econometric analyses of prices and other time series data (annual, quarterly, or even daily) have attempted to sort out what is causing what. But solid findings have been scarce for several reasons, particularly (1) multiple causality: almost no observable statistic measures a causal factor that influences other variables but is not influenced by them; and (2) paucity of quantified experience: despite our having one hundred years of data on prices and quantities, our history has seen only a few natural shocks or policy experiments that would provide a sharp test of alternative explanations of economic events. In principle one can use lags in variables to sort out which causal directions in fact dominate, but in practice econometric work using these approaches has not been enlightening. Agricultural economists have had great difficulties estimating even well-defined basic parameters, such as commodity demand and supply elasticities, where well-known and quantifiable shocks due to weather anomalies exist.

With respect to the hypotheses central to this book, time series analysis has left us stranded on some key questions. One is the effect of government commodity programs and payments on farm incomes. Some studies have found a positive effect of programs on incomes, but others have found negative effects or no significance. This is true even of programs that we know have countercyclical effects, by making payments to farmers equal to the difference between a legislated support price and the market price. A problem of two-way causality arises because low prices cause the payments, while at the same time the payments cause incomes to be higher than they would be in the absence of payments. In theory, econometric analysis can hold constant the market factors causing low prices and incomes, and then the positive program effects can be appropriately captured. In practice, the factors to be held constant include determinants of foreign demand and supply that cannot be completely and accurately quantified, as well as domestic determinants of demand and supply that are so numerous they outnumber the data points to be explained; so the analyst of necessity resorts to seriously damaging omissions and aggregation of data.

The problem of few natural experiments arises in that even if we had the ability to isolate the annual income effects of the operation of the commodity programs, the more fundamental issue is the effect of the existence of the programs. We typically have only two observations that are relevant: before the program was enacted, and after. But many differences other than the program are observed in the before and after periods, and it has not been possible convincingly to hold the effects of these other factors constant in order to isolate the effects of the programs.

Consider the question of what accounts for the acceleration of productivity growth that occurred in the late 1930s. Here the big analytical constraint is the uniqueness of the event. USDA has provided forty-nine years of consistent and carefully built annual estimates of multifactor productivity in agriculture, for 1948–1996, and reasonable estimates going back to 1910. But annual changes in these data do not provide the raw material needed to understand the change in trend rate of growth that occurred in the late 1930s. We can point to commodity programs that existed after the mid-1930s but not before. But we can also point to the buildup of scientific technical knowledge before the period of accelerated growth, to improved schooling of farm people, or to the Depression's having weeded out the less enterprising farmers; and the time series data have not allowed a definitive contest between these rival hypotheses.

The third approach to explanation is to expand our range of observed phenomena through disaggregation. We can look separately at different commodities. Some have had governmental support and others not. Did producers of the supported commodities fare better? The main paths of disaggregation followed here have been analyses of state- and county-level data. These give us many more data points to work with. This book's regression analysis using these data is an attempt to determine what causal variables contribute most to explaining economic growth.

The state and county data on the economic situation of farms and farm households are sketchy before 1950, so they do not help directly in understanding why the post–World War II period differs from the pre-1940 experience. But they can provide evidence that helps indirectly. State and county data indicate, in the jargon of the literature, both "beta-convergence" (initially lowest levels rising fastest) and "sigma-convergence" (the dispersion of levels decreasing over time), for both farm wage rates and farm household incomes. This evidence points firmly in the direction of hypothesis (3) above, the integration of farm and nonfarm economies, as being key in explaining the most striking features of the growth story. Yet with respect to agricultural sector output, value added, net farm income, and land prices, there is no convergence, and a finding that comes out strongly from all our investigations is the distinction between the economics of agriculture as an industry and the economic well-being of farm households, again supporting hypothesis (3).

In short, the most important factors in the growth of farmers' incomes are not specifically agricultural at all. The key is rather the economic adjustments of farm people to the opportunities afforded by the nonfarm economy. Even in states and counties where farm households were predominantly poor and made largely redundant by growing farm size and technological change, the availability of higher incomes in nonfarm work made it possible to improve the incomes of both those who left and those who stayed on farms in the latter half of the twentieth century.

Growth of farming as an industry and of income generated on larger commercial farms, in contrast, is promoted by productivity-enhancing technological change and an economic climate encouraging investment. Innovations in technology have tremendously increased the size of operation that a farmer can feasibly run, which in turn has greatly increased capital requirements and entrepreneurial and technical skills required in commercial farming. Even for the best of such farmers, the risks are great. But so are the rewards, as the Chapter 3 data indicate. It is these farms—the roughly 150,000 with over $250,000 in annual sales—that give the United States an earned reputation as an agricultural superpower. The causes of these economic developments are hard to pin down. There is a role for all four hypotheses; but the underlying mechanisms remain unclear.

The state and county data in this respect leave many important questions unanswered. They do not identify causes as opposed to associations. For example, investment in agriculture is positively related to agricultural growth, as would be expected, but the causes of investment are not revealed in the analysis. Particularly important left-out factors are market- and policy-related variables that are common to all states and counties. We have state and county data for several census years, so the combined time series and cross-sectional data can be used to investigate the role of changes over time in some variables. But we have the problem of too few census years with quantifiably different policy or market regimes.

The use of commodity and input market models enables us to draw some tentative inferences even without direct data evidence. Indeed, the commonest approach to the analysis of farm commodity policies, as reviewed in Chapter 7, is the use of supply-demand models of product and factor markets to simulate the results of market intervention. In this approach we do not rely on data generated by policies directly revealing the effects of the policies, so the statistical pitfalls of time series or cross-sectional econometric analysis do not hinder the endeavor. The cost, however, is that the conclusions depend crucially on the market models being correctly specified and on the policies actually affecting the markets in the way the models say they do. Both requirements are difficult to meet. With respect to proper specification, a major problem is that different models' estimates of crucial parameters, notably elasticities of demand and supply, vary widely. For example, one can find plausible models of the market for U.S. wheat that give demand elasticities ranging from −0.5 to −6.0.[2] And models of commodity programs typically simplify outrageously, for example, estimating their effects by applying equal subsidy percentages to all producers, even though the policies typically treat different producers differently and combine subsidies with requirements that are quite likely to influence production for reasons other than the subsidy they provide.

Notwithstanding these shortcomings, a wide range of models is consistent in yielding fairly small output effects, no efficiency gains, and overall deadweight losses to the economy from U.S. commodity programs. However, the supply-demand models omit the dynamic effects of confidence building and risk reduction that underlie the hypotheses according to which commodity programs could have boosted economic growth in agriculture. On this issue,

2. For an assessment of the state of policy modeling that elaborates on these problems, see Alston and James (2002).

some empirical evidence is available from state and county data, since some areas have been substantially more subject to the influence of commodity programs than others. Some counties had and have less than 10 percent of their cropped acreage in government-supported commodities; others have more than 80 percent of their acreage in program crops. And the importance of particular commodities that have different policy or market regimes varies from county to county.

Comparisons among subsets of these counties in Chapter 10 provide no support for the idea that commodity programs have made a difference. Other factors—productivity growth and investment to some extent, but most importantly linkages with nonfarm labor and land markets—appear to have been more important in determining agricultural returns.

The importance of the nonfarm economy in determining the economic fortunes of farm people was emphasized in the past by some scholars, notably Theodore W. Schultz and D. Gale Johnson. It is nonetheless surprising, in reviewing the twentieth century, to find how dominant these effects have been over the longer term. Many economists have carried out substantial investigations of off-farm mobility, but how far-reaching and overwhelmingly positive the effects would be was widely missed. The pessimism of able scholars is illustrated by Hathaway and Perkins's interpretation of migration data, reviewed in Chapter 4. C. E. Bishop cites their conclusion that "the mobility process works less well for those who need it most and that it may well result in a widening of income differences among people and among areas" (1969, p. 253). As late as 1975, Theodore Lianos concluded from a review of data and studies to that time that "despite the impressive volume of farm-nonfarm labor mobility during the preceding fifty years, labor earnings between the agricultural and nonagricultural sectors have not been equalized, and furthermore no tendency toward equalization is apparent" (1975, p. 46).

Similarly, although many economists were aware of and systematically documented the rising importance of off-farm work by farm households who remained in farming instead of migrating, it was not seen how important this would become. W. E. Johnston (1970), building on a careful analysis of the age structure of farmers and demographic trends using 1920 to 1960 data, projected farm operator numbers to decline to 580,000 by 2000. The actual 2000 number was over 2 million. The main element he missed was how off-farm earnings would enable small farm operations to persevere.

In his comprehensive history, Willard Cochrane reviewed the seven main forces and three subsidiary ones he had identified as influencing the development of American agriculture (1993, p. 335). Labor market integration is not among them. At the same time, Cochrane recognized the necessity of reducing the agricultural labor force when farm production is mechanized, in common with the general view of agricultural economists that adjustment in labor markets is necessary to eliminate the excess supply of labor created by labor-saving technological changes.[3]

What subsequent history indicates that was not apparent during the years of rapid reduction in farm labor during the 1950s and 1960s is the extent to which farm people were drawn out of agricultural employment by off-farm opportunities as opposed to being pushed out by mechanization. In part the focus on the excess supply of labor in agriculture, as opposed to the view of the same phenomenon as excess demand for labor in nonfarm work, was a legacy of the Depression. In a famous paper, John Kenneth Galbraith (1954, reprinted in Fox and Johnson 1969) argued against critics of farm price supports who objected to the policies on the grounds that they retained excess labor in agriculture. His argument was that in low-price periods when resources are idle in the nonfarm economy, "the use of resources in the 'wrong' place may then be the alternative to no use at all" (1954, p. 47).

Agricultural economists have been open to the idea that nonfarm labor demand can be a strong causal factor in farm labor markets, as the earlier discussion of Day's analysis of cotton mechanization attests. Indeed, agricultural economists were pioneers in developing the idea of induced innovation as an explanation of agricultural mechanization—that technological changes that apparently forced labor out of agriculture were in fact induced by real wage growth in the nonfarm economy leading to labor scarcity in agriculture (see Hayami and Ruttan 1971; Binswanger 1974). What the empirical investigation of this book indicates is a wider and more pervasive influence of nonfarm economic conditions on the well-being of farmers, in enabling farm households both to catch up economically between the 1960s and the 1990s, and since then to stay abreast of nonfarm income levels despite major ups and downs in commodity prices.

Policy Implications

Recent discussions of low-income problems in rural areas have seen the necessary remedies as targeted to poor households in rural communities, not to agriculture or farms (see Castle 1995; Center for the Study of Rural America 2001). This view is consistent with the finding from earlier chapters that a farm as opposed to a nonfarm occupation is no longer a marker

3. See, for example, the papers by Earl Heady, George Brandow, and others in a landmark conference proceedings (Heady et al. 1958).

for poverty in rural areas, and that the great majority of rural poverty that remains would be untouched by feasible agricultural policies. With respect to farm households more narrowly, the findings here imply that many alternative agricultural policies would have permitted real farm household incomes to grow, so long as the overall U.S. economy grew and farm people had access to nonagricultural economic opportunities. Nonetheless, the growth of a technologically advanced commercial agriculture was not inevitable, and specific resources in agriculture, notably farmland located far from urban influence, and the specific human capital of entrepreneurial farmers could undoubtedly have fared worse or better than they have. That is, some people and places are especially well suited to farming, and their fortunes (the economic rents they receive) are inevitably tied to events in agricultural commodity markets. In this context, what credit or blame can we plausibly attribute to U.S. agricultural policies broadly defined—the whole list presented in Table 7.2?

A fundamental element in any economy is the establishment of appropriate legal and regulatory institutions. Laws of property and contract were largely already in place in 1900. But technological change has required ongoing legal development, both in clarifying property rights in new knowledge and products and in the area of regulations governing the health and safety of novel processes and inventions. Current regulatory institutions were for the most part set up in the first third of the twentieth century, addressing the issues of food safety, antimonopoly policy, the marketing of farm products, rural banking, futures trading, and other financial activities. State and federal institutions for environmental regulation, human nutrition, farmworker protection, and land-use planning in rural areas came later. In all of these matters, the institutions have evolved in response to changing political and economic conditions, albeit often with a considerable lag.

Two characteristics of this evolution are important to keep in mind. First, each change has been the subject of dispute, in some cases long and bitter, and often with reasonable arguments for more than one position. Second, the evolution has not been unidirectional, either toward ever stricter control of farms and agribusiness or toward repeal of former regulation. But since 1980 there has been a tendency (with important exceptions) toward giving free rein to farmers and agribusiness in many areas. So, while significant tune-ups of the legal framework and regulatory activities have been and should be ongoing, it is important to consider the benefits and costs of each governmental action.

The most continuously disputed area of government involvement has been commodity policy, including domestic price supports, import restrictions, and export subsidies. These have been heavily criticized as costing more than the benefits they provided, and their role was significantly reduced in the 1990s (notwithstanding large payments in 1998–2001). Nonetheless, when the Brookings Institution surveyed 450 history and political science professors in 2000 on the "government's greatest achievements of the past half century," the only agricultural item among the fifty greatest endeavors was number 39, "stabilize agriculture prices" (Light 2000). The bipartisan abandonment of price stabilizing efforts since 1985 (while maintaining income transfers to farmers), along with the increasing predominance of economists' negative cost-benefit findings detailed in Chapter 7, suggests that the historians and political scientists have lost touch with the admittedly somewhat peripheral (to them) topic of agricultural commodity programs.

Economists' views of commodity policy have changed substantially over the last fifty years. Market forces had always been generally respected, but a substantial role for government was formerly more widely endorsed than it is today. Even the more market-oriented agricultural economists, such as D. Gale Johnson, proposed government policies to establish "forward prices for agriculture," as his 1947 book was titled. In 1946 a committee of eminent agricultural economists published an outline of desirable policies for the post–World War II period that stated: "In order to give the farmer the orientation and incentive to make shifts in the proper direction, and to assure him against drastic declines in the returns from specific commodities, the government should announce in advance a support schedule of prices for each agricultural commodity." Recognizing the dangers of politicizing these prices, they further stated that "consideration might well be given to transferring the administration of the farm-income support policy to a *Non-Partisan Board*" (Committee on Parity Concepts 1946, emphasis in original). If any significant group of economists believes today that a commodity price-setting board is a good idea, they have kept their opinion well hidden.

In the big picture of how agricultural policies are now seen, two alternative views are on offer. The first is characteristic of those who speak from the viewpoint that predominates among commercial farmers, agribusiness, and the agricultural science and technology establishment centered in the land-grant universities. This view, for short the CAST view,[4] emphasizes the technical progress, low cost of food, and efficiency of larger-scale commercial farming that has evolved over the last hundred years or more in the United

4. CAST is also the acronym for the Council for Agricultural Science and Technology, which indeed is associated with views of the kind I am outlining. See their reports available from their office in Ames, Iowa, or on the CAST website <http://www.cast.org/>.

States. The second view emphasizes eco-friendly, small-farm, populist concerns, for short the "green" view. The greens are skeptical of technology, worried about environmental and human health threats from chemicals and biotechnology, mistrustful of business enterprises, and tend to prefer organic, small-scale, lifestyle-oriented farming. The CAST point of view is most often expressed in, but does not totally dominate, the rural media (farm magazines, small-town newspapers, and radio). The green point of view is most often expressed in, but does not totally dominate, the urban media (big-city newspapers, national magazines, network television news coverage). My own view, as will be obvious to readers who have come this far, is closer to the first than to the second. I believe a more accurate picture of U.S. agriculture can be found in *ProFarmer* than in the *New York Times.* Nonetheless I agree with criticisms that holders of the second view make of the first—that it is too dismissive of criticism, pays too little attention to the costs of and losers from economic progress, and is too ready to spend billions of taxpayer dollars on the promotion of commercial agriculture.

People of many persuasions—farmers, advocates of consumers and the environment, efficiency-loving economists, editorial writers, and much of the broader public—have found wide agreement in one respect: all find a critical stance toward government actions with regard to agriculture congenial, and dislike much of what government has done. A critical stance is appropriate, because commodity programs have been wasteful and so has much other "pork barrel" spending. Even in areas where governmental actions have been on the whole productive—research and education, building infrastructure, protection of human and animal health—appalling examples of waste can be found. In regulation the government has made costly and unsuccessful attempts to fight off innovations—oleomargarine, chain grocery stores, branch banking, just to cite a few examples of misdirected efforts. Today government is being asked to assist in further battles against agribusiness that appear similarly misguided; and agribusiness is asking for its own dubious subsidies and shelters from competition. In commodity programs, while the "freedom to farm" approach of the late 1990s was arguably an improvement over past policies, we continue to spend tens of billions of dollars annually and employ thousands of USDA personnel in program administration to no demonstrable national economic purpose. The deadweight losses are small from the interventions themselves, but those calculations have not given due regard to the more productive results that could be attained if those tens of billions were left in the hands of the taxpayers who provided them and the thousands were employed more productively.

Nonetheless, it is wrong to take shortcomings in the government's role as chief executive officer of U.S. agriculture as a failure of government. The main job of government in agriculture is not to be its CEO but to reconcile conflicting views and interests. When group B adamantly opposes governmental action that group A passionately advocates, the difficulties of attaining a policy resolution that both sides can live with are daunting. The evolving mix of infrastructure investment, research and education, regulation, and commodity programs is properly viewed as an ongoing effort to resolve disagreements in a way that allows various farm and nonfarm interests to achieve what they can politically and then get on with their business productively. The results often make the seeker after rationality in economic policy cringe. But if one believes that the overall record of U.S. agriculture has been a success story, and that the government's role has been generally supportive, one's criticisms should be tempered accordingly. Indeed we may reasonably see the outcome as one of democracy's positive achievements.

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