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THE TRANSFORMATION OF NORTHERN AGRICULTURE, 1910–1990

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INTRODUCTION

American farms and farmers "ain't what they used to be." To start with, there are not so many of them. In 1910, 32 million people, comprising 35 percent of the nation's population, lived on 6.4 million farms. By 1990 only 1.8 percent of the U.S. population (4.6 million people), remained on America's 2.1 million farms. Although dwindling in numbers, the remaining farm work force is highly productive; in 1990, the typical farm worker produced fifteen times as much as his counterpart in 1910. Over this period, the differences between farmers and non-farmers have diminished, so it is now difficult even to define either the farm sector or who is a farmer. Today one-half of people who work on northern farms do not live on farms, and one-half of the people who live on farms work off farms. In 1989 the average income per northern farm was $46,500; but 51 percent came from non-farm sources and another 12 percent from government payments.[1]

Powerful forces have reshaped northern agriculture. Mechanical and biological innovations dramatically increased farm productivity and changed the nature of farm work. The transportation and communication revolutions integrated the farm with the rest of society. The growth in non-farm

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[1] *Economic Report of the President 1992* (Washington, D.C., 1992), 407; U.S. Bureau of the Census, *Historical Statistics of the United States* (Washington, D.C., 1975), 457, 498–99, and *Rural and Rural Farm Population 1987*, CPR Series P-27 No. 61 (Washington, D.C., 1988), 9; U.S. Economic Research Service, *Economic Indicators of the Farm Sector: National Financial Summary, 1989*, ECIFS 9-2 (Washington, D.C., 1991), 12–13.

wages put enormous pressure on agricultural labor markets. And twenty years of depression forged a new farm policy. In 1910 northern agriculture closely approximated the competitive ideal; today it is a highly regulated industry. Federal programs originally justified as emergency measures have proven very difficult to end as Jefferson's once resourceful farmers have become dependent on government handouts. Large operations have become increasingly important, and farmers have become more integrated into the market economy. Today, about 50 percent of gross farm income goes to buy off-farm inputs such as pesticides, machinery, fuel, and fertilizers; and farm families now purchase most of their food from supermarkets, minimalls, and quick-stops.

This chapter will analyze the transformation of northern agriculture since 1910, emphasizing changes in performance, income, structure, and government policy. There are three closely related issues. The first is to understand both the sources and the consequences of the spectacular technological changes that have occurred in the past century. Here was the driving force behind the growth in farm productivity and the change in farm structure. The second theme focuses on the "farm crisis." The popular perception is that agriculture has been in a perpetual state of crisis since World War I, except for a few years during World War II and the early 1970s. What is the basis for this view? The third issue is to trace the development of government intervention in the farm sector. The crop support programs introduced in the 1930s represented a distinct philosophical break with the past. Why did these policies emerge, how did they operate, and what have been their effects?

Agriculture is no stranger to controversy. Many observers consider the twentieth-century record a spectacular success, focusing on the low price of food, the elimination of many low-paying backbreaking jobs, and the relatively high income of the remaining farm population. Others see a tragic failure, noting the loss of farm jobs, environmental destruction, and the disappearance of a rural way of life. But far too often, evaluations of these experiences lack a comparative perspective and apply standards far different from those used elsewhere. In fact, the North's development stands in sharp contrast with the histories of other regions and nations.

The treatment of the American South, for example, typically dwells on that region's backwardness and the stifling effect of institutional barriers on development. Racial divisions, sharecropping, illiteracy, poverty, poor cultural practices, and widespread market failure are all familiar themes. Such discussions are not a dominant part of the northern agricultural heritage. The contrast is even starker if one looks at northern agriculture through the eyes of policy makers in less-developed countries (LDCs) or the former socialist nations of Eastern Europe. By such international standards, the record of northern agriculture has been an unqualified success story. For economies unable to feed their own populations and grappling with a "peasant problem," the North's experience of increasing efficiency and overproduction are concerns others would gladly accept.

For most countries, the common perspective is to evaluate how the agricultural sector contributes to the development of the national economy in five interrelated ways: (1) by increasing the food supply, (2) by releasing workers to the non-farm sector, (3) by generating savings, (4) by providing a market for the products of the non-farm sector, and (5) by earning foreign exchange. The common question is to ask how an institutionally backward and inefficient agricultural sector can be reformed from above to assist in a country's overall development drive. For northern agriculture such questions have seldom been posed, either in contemporary policy debates or in retrospective treatments. The process of northern industrialization was never seriously threatened by food shortages nor stalled by the inability of an illiterate agricultural class to join the ranks of the non-agricultural labor force. Northern farmers have always offered a lucrative market for the industrial sector and have been important earners of foreign exchange. The decision to quit farming was often painful, leading many northern farm families to cling to their land even after the returns to farming fell well below urban incomes. This attachment of farm families to their traditional occupation helps explain the persistence of lagging farm incomes into the 1960s, just as the rapid exit of poorer farmers helps explain the eventual closing of the income gap. But, in general, the problem of rural poverty in the North has been quite different from the extreme agricultural backwardness and widespread market failures that have plagued many countries or even the American South.

The problem in the northern agricultural sector over much of its history has been the opposite from that posed above. In periods of the nineteenth century, the industrial sector may have had trouble competing for resources with a vibrant, competitive, and rapidly expanding agricultural sector. Even during the agricultural depression of the 1920s and 1930s, a key problem was that northern agriculture was too productive and that urban and export markets were not buying enough agricultural goods nor creating enough jobs to absorb the surplus agricultural population. The dominant theme in the American policy debate since the 1920s has focused on

how to limit production and increase farm prices and incomes to preserve the family farm, rather than to speed the movement of resources out of the sector.

REGIONAL CONTRASTS, 1910–1990

For this study, northern agriculture includes the vast expanse of territory stretching from the Atlantic to the Pacific Oceans, capturing the New England, Middle Atlantic, East North Central, West North Central, Mountain, and Pacific census regions. Within this area there is an enormous diversity in soils, climate, and crops. But there also are many common features, including a similar institutional and cultural heritage. Most northern farm families in 1910 were native white Protestants of northern European descent. As a fulfillment of Jefferson's vision, markets in land were well established, public education and literacy were widespread, and medium-sized family farms were the norm. For the most part, northern farm families resided on their own land rather than in villages and relied primarily on their own labor. But there were exceptions to the Jeffersonian ideal. By historical and world standards, most farmers in all of these regions were highly commercialized and highly dependent on national and international markets for their prosperity.

Although there were significant regional differences in machinery and methods, northern farmers, as a rule, were noted for their ingenuity and rapid adoption of new technologies. The agricultural implement industry and the federal-state agricultural research system developed an unending flow of new technologies, crop varieties, and methods tailored to local economic and environmental conditions. Experimentation and economic innovation had already transformed the agriculture of many of the North's regions. By 1910 large numbers of farmers in the Northeast and Great Lakes states had moved from grain to dairy operations. Much of the Midwest had evolved from wheat culture to corn and hog farming, and California, which in 1890 had been the nation's second-largest wheat producer, was rapidly moving into vegetable, fruit, and nut production. Similar changes would continue to transform the landscape and farm practices in the post–World War I era.

Table 12.1 offers an overview of northern agriculture and of its major regions in 1910 and 1987. In 1910 the two North Central regions dominated northern agriculture, accounting for two-thirds of its farms and

farm population, 80 percent of the cropland harvested, and over 70 percent of the gross value of farm output (these regions' contributions to the value of net farm output would be somewhat less). In 1987 these ratios were roughly the same. One of the most prominent features of Table 12.1 is the growing importance of livestock production in Northern agriculture. In 1910 animal products accounted for about 45 percent of gross farm output in the North, whereas by 1987, they made up almost 60 percent of the market value of farm sales. Over this period, there was a notable shift in the location of livestock production from the East and the North Central regions to the West and South. Tenancy rates in 1910 varied significantly among the census regions, ranging from a low of 8 percent in New England to 31 percent in the West North Central. This contrasts with a 50 percent tenancy rate for the American South. By 1987 tenancy rates had been cut in half in the North and had become much more uniform. In addition, today's tenants are often prosperous and highly skilled professional farmers rather than an underclass, with many modern tenants farming significantly more land than farm owners.

The average size of northern farms differed significantly across regions in both periods and has more than tripled since 1910. This increase was most rapid in the interior regions. The percentage of small farms remained about the same, but there was a significant increase in the frequency of large farms over 500 acres. This implies that the growth of large farms occurred at the expense of middle-sized operations. The cropland harvested per male worker in the North increased 4.5 times between 1910 and 1980. Again, the change was most rapid in the interior regions, due in large part to the spread of labor-saving grain harvesting machinery. The relative importance of hired labor in northern agriculture has changed little since 1910; and in both periods the coastal regions with their vegetable and fruit crops depended more on wage laborers. Reflecting the growing reliance on purchased inputs, the ratio of fertilizer expenditures to gross farm sales increased sevenfold. In 1910 fertilizer was rarely used outside of the eastern states; by 1987 it was most intensively used in the interior states.

The differences between the North and the nation as a whole in 1910 highlight the contrast between northern and southern agriculture. The North had roughly one-half of both the farms and farm population and about 70 percent of both the cropland harvested and gross value of farm products. Northern farmers were far more mechanized than their south-

Table 12.1. *Regional contrasts*

	1910							
	New England	Middle Atlantic	East North Central	West North Central	Mountain	Pacific	Northern States	United States
Farm population (thousands)	764	2,137	5,275	5,440	918	887	15,421	32,077
Number of farms (thousands)	189	468	1,123	1,110	183	190	3,263	6,362
Avg. farm size (acres)	104	92	105	210	325	270	161	138
Percentage under 50 acres	51.7	34.0	27.2	13.0	23.4	40.5	25.3	35.4
Percentage over 500 acres	1.4	0.5	0.6	6.2	8.1	10.3	3.5	2.8
Percentage tenant farms	8.0	22.3	27.0	30.9	10.7	17.2	25.1	37.0
Cropland harvested/male labor	18	24	35	66	27	31	42	30
Value of implements/farm ($)	269	358	239	332	270	349	298	199
Value of crop products ($ millions)	118	379	1,072	1,419	160	266	3,414	5,232
Value of livestock products ($ millions)	104	283	721	961	156	130	2,354	3,011
Hired labor share of output (%)[a]	14.1	11.2	6.4	5.6	14.7	18.6	8.3	7.7
Fertilizer share of output (%)[b]	3.8	2.6	0.4	0.0	0.1	0.6	0.7	1.4

	1987							
	New England	Middle Atlantic	East North Central	West North Central	Mountain	Pacific	Northern States	United States
Farm population (thousands)[c]	302		2,637		735		3,674	5,226
Number of farms (thousands)	25	98	365	497	124	154	1,264	2,088
Avg. farm size (acres)	169	175	237	531	1965	436	541	462
Percentage under 50 acres	34.7	28.5	24.6	16.4	30.7	58.3	26.6	28.5
Percentage over 500 acres	6.9	6.7	12.7	28.5	35.3	12.1	20.5	17.7
Percentage tenant farms	6.4	8.2	11.8	15.6	12.1	11.7	12.9	11.5
Cropland harvested/male labor[d]	55	88	203	273	202	73	190	171
Value of implements/farm ($)	37,888	44,143	49,685	50,427	49,594	45,876	48,837	41,227
Market value of crops ($ millions)	626	1,899	10,246	13,809	4,007	12,516	43,103	58,931
Value of livestock products ($ millions)	999	4,117	11,087	22,491	7,186	6,800	52,679	77,117
Hired labor share of output (%)[a]	15.0	10.9	5.8	3.8	8.0	16.9	8.0	8.0
Fertilizer share of output (%)[b]	2.8	3.9	7.6	4.9	3.7	3.7	5.0	4.9

Note: GNP deflator increased about 13 times between 1910 and 1987.

[a] Expenditures on hired farm labor as a percent of the value of output.

[b] Expenditures on fertilizer as a percent of the value of output.

[c] Data are for the Northeast, Midwest, and West.

[d] 1980.

Source: U.S. Bureau of the Census, *1920 Census of Agriculture Vol. V* (Washington, D.C., 1922) 18, 71–72, 94–95, 132, 506–7; *1987 Census of Agriculture, Vol. 1 Geographic Area Series, Pt. 51, United States* (Washington, D.C., 1989), 144–72, 179–85, 218–25.

ern counterparts but spent considerably less on purchased fertilizer. By 1987, there had been substantial convergence between the North and South.

PRODUCTIVITY GROWTH

Technological changes and the resulting increases in agricultural productivity are central to the story of northern agriculture, accounting for the growing output, declining agricultural terms of trade, falling agricultural labor requirements, and rising capitalization and farm size. Increased efficiency lowered food prices for American consumers and improved the international competitiveness of American farmers but, in the larger political context, has added to the costs of government support programs, increasing the burden on the American taxpayer.

Figure 12.1 shows indices of aggregate farm output, inputs, and total factor productivity between 1870 and 1990 for the United States as a whole. The story of agricultural output and productivity growth appears remarkably simple. Farm output grew steadily, with the exception of the Depression years, while input usage rose until around 1920 before leveling off. Productivity growth was quite flat up to World War II, with the productivity level in 1930 roughly equal to that achieved in 1880. After 1940 productivity growth soared, leading to a doubling of output by 1980. Total factor productivity growth in farming had lagged substantially behind that in the manufacturing sector and the economy as a whole, but since World War II, agriculture has been the pace-setter. Its productivity growth has greatly exceeded that of the rest of the economy, and agriculture remained a bright spot during the national productivity slowdown of the 1970s and 1980s.

Although the total quantity of inputs in U.S. agriculture has remained roughly constant since 1920, the relative contribution of labor, machinery, agricultural chemicals, and land have shifted substantially. Figure 12.2 displays indices of input use in American agriculture between 1910 and 1990. The total quantity of land has not changed much, while the use of farm machinery and chemicals took off. Labor employed in farming, especially family labor, has plummeted. The increased use of machinery and chemicals and the reduced use of labor was not solely due to changes in factor prices but also was the result of the nature of technological change over this period. Most studies find a labor-saving and machinery-and

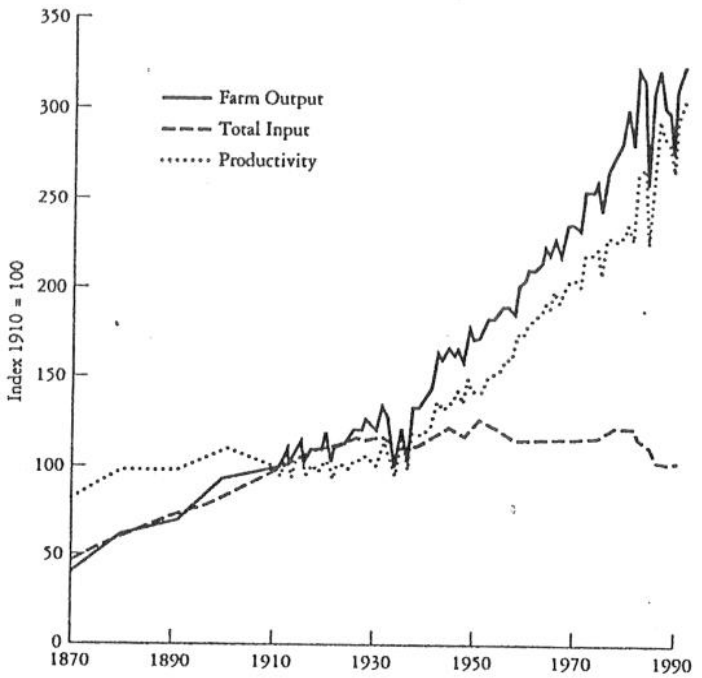

Figure 12.1. Growth of output, inputs, and productivity in American agriculture, 1870–1990. Source: U.S. Economic Research Service, *Economic Indicators of the Farm Sector: Production and Efficiency Statistics, 1980*, Stat. Bull. No. 679 (Washington, D.C., 1982), 64–77; USDA, *Agricultural Statistics, 1991* (Washington, D.C., 1991), 373.

fertilizer-using bias in the direction of technological change in American agriculture since 1910.[2]

Table 12.2 offers a view of these productivity changes for selected northern farm products since 1910. Over this period, the labor required to produce 100 bushels of wheat fell from 106 to 7 hours and to produce 100 bushels of corn from 135 to 3 hours. Changes in labor productivity in animal products have been as striking. Before World War I a dairy farmer worked 1 hour to produce the same amount of milk that a modern farmer obtains in three minutes using new capital-intensive methods. For eggs,

[2] Hans P. Binswanger, "The Measurement of Technical Change Biases with Many Factors of Production," *American Economic Review* 64 (1974), 964–76; John M. Antle, "The Structure of US Agricultural Technology, 1910–78," *American Journal of Agricultural Economics* 66 (1984), 414–21.

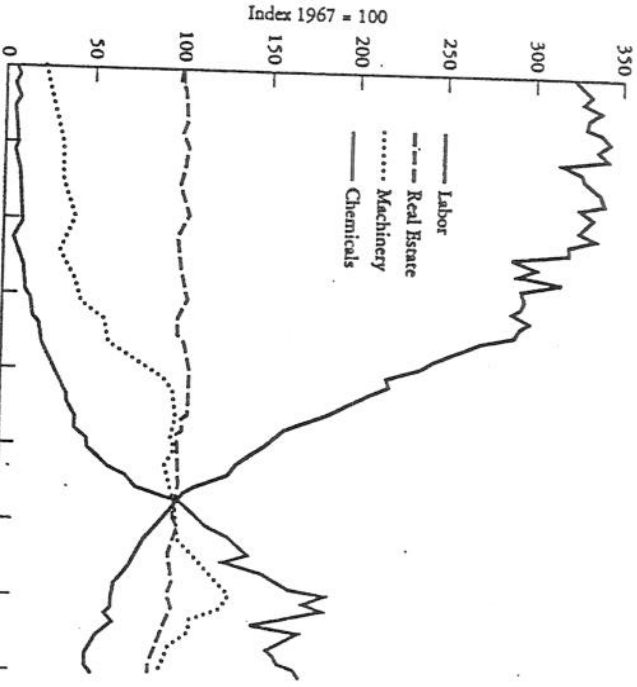

Figure 12.2. Input usage in American agriculture, 1910–1990. Source: See Figure 12.1.

labor productivity increased ten times. Even greater changes occurred in broiler production, where labor productivity has increased eightyfold since 1940. For most products, labor use fell very gradually up to 1940 and then dropped rapidly up to the early 1970s. Since then, the rate of decline has slowed.

The yields of cropland and livestock also rose markedly. The annual number of eggs laid per chicken and the amount of milk produced per cow have both more than tripled. These changes began well before 1940 and accelerated after World War II. The productivity of the broiler industry also soared, with both the quantity of feed and the number of days required to produce a pound of chicken falling by 50 percent between 1940 and 1980.[3] Over the past fifty years, output per acre of hay and wheat

[3] R. Charles Brooks, "Structure and Performance of the US Broiler Industry," *Farm Structure: A Historical Perspective on Changes in the Number and Size of Farms*, U.S. Senate Committee on Agriculture, Nutrition, and Forestry, 96th Cong., 2d sess. (Washington, D.C., 1980), 196–215.

Table 12.2. *Productivity changes in selected farm products*

	1910–14	1920–24	1930–34	1940–44	1950–54	1960–64	1970–74	1980–84
Wheat								
Yield per acre (bu.)	14.4	13.8	13.5	17.1	17.3	25.2	31.1	36.2
Labor hours per 100 bu.	106	90	70	44	27	12	9	7
Corn								
Yield per acre (bu.)	26	26.8	23	32.2	39.4	62.2	83.9	101.4
Labor hours per 100 bu.	135	122	123	79	34	11	6	3
Hay								
Yield per acre in (tons)	1.15	1.22	1.08	1.35	1.43	1.77	2.12	2.38
Labor hours per ton	117.39	100.00	113.89	58.52	23.78	6.21	2.83	1.26
Potatoes								
Yield per acre (cwt.)	59.8	64.6	64.6	82.1	151.2	194.9	234.2	272
Labor hours per ton	25	23	21	17	8	5	4	3
Cattle								
Labor hours per cwt. beef	4.6	4.5	4.3	4	3.6	2.6	1.7	1
Milk Cows								
Milk per cow (in lbs.)	3,842	4,000	4,289	4,653	5,444	7,507	10,075	12,293
Labor hours per cwt.	3.8	3.6	3.4	3.1	2.2	1.2	0.6	0.2
Eggs								
Rate of lay per year	86		121	142	181	212	225	244
Labor hours per 100 eggs	2		1.9	1.6	1.3	0.6	0.3	0.2
Chickens (broilers)								
Labor hours per cwt.				7.7	2.4	0.8	0.3	0.1

Sources: U.S. Bureau of the Census, *Historical Statistics of United States, Colonial Times to 1970* (Washington, D.C., 1975), 500; USDA, *Agricultural Statistics 1975* (Washington, D.C., 1975), 443; *Agricultural Statistics 1985* (Washington, D.C., 1985), 395.

more than doubled, while yields of corn and potatoes more than quadrupled. Such changes in crop yields were without precedent. Between the Civil War and the Great Depression, yields of the northern staple crops had stagnated, if not declined. The rapidly increasing output per acre after the 1930s represented a sharp break from the past, whereas the rapidly increasing output per worker represented an acceleration of the long-run trend.

The growth in productivity is commonly attributed to two forces: (1) mechanization, increasing the number of animals or acreage of land one worker can handle; and (2) biological improvements, increasing the yields per animal or acre of land. These sources are often sharply distinguished. They are embodied in different technologies – better machines as opposed to better chemicals, seeds, or breeds; they are produced by different industries – the agricultural equipment firms as opposed to agricultural chemical or seed companies; and they are the outgrowth of different scientific/technological learning paths – mechanics and engineering as opposed to chemistry and genetics. Although the two paths are typically treated separately, developments in one path often depended on progress in the other. As Wayne Rasmussen has noted, the development of the mechanical tomato harvester in the early 1960s involved a concerted and successful effort to breed tomatoes with properties – uniform ripening and tougher skins – better adapted to machine picking. Even earlier for wheat, corn, and many other crops, farmers selected varieties with favorable characteristics for mechanical harvesting.[4]

Mechanization

The mechanical revolution in agriculture dates back to the mid-nineteenth century and is symbolically identified with the introduction of Cyrus McCormick's reaping machine. Nineteenth-century inventors supplied a marvelous array of labor-saving devices, including riding plows, seed drills, threshers, binders, check-row corn planters, hay forks, balers, and much more. Most of these inventions substituted horse power for human power. In addition, they increasingly substituted metal for wood and relied

[4] Wayne D. Rasmussen, "Advances in American Agriculture: The Mechanical Tomato-Harvester as a Case Study," *Technology and Culture* 9 (1968), 531–43. The tractor, by displacing horses, released millions of acres formerly devoted for feed and effectively increased the yield of the land base. Thus, as William Parker observed, from the perspective of the agricultural sector as a whole, the tractor was a land-saving innovation. William Parker, "Agriculture," in Lance E. Davis et al., *American Economic Growth: An Economist's History of the United States*, (New York, 1972), 372.

on simple mechanisms using interchangeable parts, thereby taking advantage of the key avenues of progress unleashed by the First Industrial Revolution. By 1900 a prosperous northern farmer most likely depended on numerous manufactured tools and machines that were either unknown or only crudely constructed on the farm a century earlier. Although farmers were keenly aware that they were living in a revolutionary age, few could have imagined that even greater changes lay on the horizon.

Most importantly, the internal combustion engine was about to transform rural America. The automobile and motor truck helped integrate the farm into the broader world. On the farm itself, the two most important applications were embodied in the gasoline tractor and the combined harvester. Tractors increased the horsepower available to farmers, and combines reduced cutting and threshing to a single operation. Together these machines dramatically increased farmer productivity, drastically reduced the need for seasonal labor, and changed social relationships.

The early gasoline tractors were behemoths, patterned after the giant steam plows that preceded them. They were useful for plowing, harrowing, and belt work but not for cultivating in fields of growing crops nor powering farm equipment in tow. Innovative efforts between 1910 and 1940 vastly improved the machine's versatility and reduced its size, making it suited to a wider range of farms and tasks. At the same time, largely as a result of progress in the new mass production industries, the tractor's operating performance greatly increased while its price fell.

Several key advances marked the otherwise gradual improvement in tractor design. The Bull (1913) was the first truly small and agile tractor, Henry Ford's popular Fordson (1917) was the first mass-produced entry, and the revolutionary McCormick-Deering Farmall (1924) was the first general purpose tractor capable of cultivating amongst growing row crops. The latter machine was also one of the first to incorporate a power take-off, enabling it to transfer power directly in implements under tow. A host of allied innovations such as improved air filters, stronger implements, pneumatic tires, and the Ferguson three-point hitch increased the tractor's life span and usefulness. Developments since World War II have been limited largely to refining existing designs, increasing tractor size, and adding driver amenities. After remaining roughly constant from 1920 to 1940, the average horsepower of new tractors quadrupled between 1947 and 1977, reflecting a shift in farmers' preference toward

larger machines.[5] The addition of creature comfort such as air-conditioned, enclosed cabs have taken farmers a long way from the days when they walked the fields guiding horse-drawn plows.

The diffusion of the tractor exhibited significant regional variation with the most rapid adoption in the West North Central region. The development of the general purpose tractor in the mid-1920s quickened the pace of diffusion in the East North Central region. All regions experienced a slowing of diffusion during the Great Depression and an acceleration during and immediately after World War II. By 1950 the tractor had largely replaced the horse throughout the North. Nationally, the stock of farm horses declined from 26.5 million in 1915 to 3.1 million in 1960. Overall, this added significantly to America's agricultural surpluses, because about 25 percent of U.S. cropland was converted from growing feed for work animals to growing products for human consumption.[6]

Like the first tractors, early combines were huge, cumbersome machines suited only for the large-scale grain ranches of the arid West. Some of these harvesters had forty-foot-long cutting bars and were pulled by teams of forty or more draft animals. The evolution of combines involved making these machines smaller and more versatile and perfecting cutting heads and threshing equipment for corn, beans, peas, and other crops. By the 1980s combines had become the dominant harvesting technology for virtually every grain and dried legume.

This process started just before World War I, when gasoline tractors began to replace steam tractors and horses to propel the combines and when auxiliary internal combustion engines were attached to power the cutting and threshing machinery. The downsizing was a gradual process. By the late 1920s models with eight- and ten-foot cutting bars with the machinery driven by the tractor's power take-off were widely available. This allowed the combine to be profitably employed in the grain growing regions east of the Rockies. In Kansas combines were an infrequent sight in 1918. They harvested about 30 percent of the Kansas wheat crop by

[5] Austin Fox, *The Demand for Farm Tractors in The United States: A Regression Analysis*, U.S. Agricultural Economic Report No. 103 (Washington, D.C., 1962), 33; USDA, *Agricultural Resources: Inputs: Situation and Outlook*, AR-15 (Washington, D.C., 1989), 1. For the general evolution of the tractor, see R. B. Gray, *Development of the Agricultural Tractor in the United States*, USDA Information Series No. 107 (Beltsville, MD, 1954), and Robert C. Williams, *Fordson, Farmall, and Poppin' Johnny: A History of the Farm Tractor and Its Impact on America* (Urbana, 1987).

[6] A. P. Brodell and J. A. Ewing, *Use of Tractor Power, Animal Power, and Hand Methods in Crop Production*, U.S. Bureau of Agricultural Economics, Farm Management Report FM-69 (Washington, D.C., 1948), 5–11; *Historical Statistics*, 510, 519–20.

1926 and 82 percent of the crop by 1938. By this date, combines havested about one-half of all wheat acreage in the United States. The next important development was the spread of the self-propelled combine, which raised the initial cost of the machine but allowed one worker to operate it. In the 1940s there was a reversal in the trend toward smaller machines as specialized custom harvesting services began to thrive. The combine's share of national wheat acreage rose to over 75 percent by 1945 and to almost 95 percent by 1950.[7]

The combine also spread to other crops. By 1950 combines harvested almost two-thirds of the acreage of oats and almost all soybean acreage. The perfection of corn head attachments in the early 1950s permitted the use of combines in maize harvesting. By the mid-1960s the combine replaced the corn picker as the predominant technology.[8] The combine all but eliminated the need for seasonal harvest labor. Although the specifics may differ slightly between crops, in general a farm family, perhaps aided by a few hired workers or a custom operator, could now manage the harvest. Farm life was irrevocably changed. Perhaps the greatest beneficiaries were farm wives, who no longer had to cook for the armies of migrant workers who followed the harvest.

The above discussion has concentrated on two major technological developments that had a large impact on a wide range of crops. In the process, we have ignored a myriad of inventions that have fundamentally altered the way specific crops are grown and harvested. Mechanical harvesting devices vastly reduced labor requirements for sugar beets, tomatoes, and a variety of fruits and nuts. The post–World War I period saw the introduction of airplanes to spread seeds, fertilizers, and pesticides. Improved orchard heaters and wind machines helped protect citrus groves and vineyards from killing frost.

A number of technological developments facilitated the enormous shift toward annual product production. Dairying was a highly labor-intensive

[7] A. P. Brodell et al., *Harvesting Small Grains and Soybeans and Methods of Storing Straw*, U.S. Bureau of Agricultural Economics, Farm Management Report FM-91 (Washington, D.C., 1952) 2–5; for the general development of the combine, see Graeme Quick and Wesley Buchele, *The Grain Harvesters* (St. Joseph, MI, 1978).

[8] The corn picker itself was a relatively late development. Corn pickers were first commercially produced in 1909 and began to diffuse widely in the late 1920s, after tractor-powered and tractor-mounted pickers were introduced. In 1938, mechanical corn pickers harvested about 12 percent of corn acreage nationally and 28 percent in the Corn Belt. By 1951 the shares had increased to 68 percent and 89 percent, respectively. See William H. Johnson and Benson J. Lamp, *Principles, Equipment and Systems for Corn Harvesting* (Wooster, OH: Agricultural Consulting Associates, 1966), 9–12; Samuel R. Aldrich et al., *Modern Corn Production*, 3rd ed. (Champaign, 1986), 311–18.

activity. As late as 1940 dairying (including the caring for dairy animals) required almost 4 billion hours of labor per year; this was one-and-a-half times more than that devoted to producing cotton. One of the most important mechanical developments was the spread of milking machines employing the intermittent suction principle. First marketed around 1905, these machines saved about 30 hours per cow (about 20 percent of the annual labor requirement). The impact was relatively small until the 1940s because the structure of dairy farming, the lack of electricity, improper sanitary practices, and the depression slowed diffusion. On the eve of World War II, perhaps 90 percent of all cows were still milked by hand. Thereafter, diffusion was rapid, with 50 percent of cows milked mechanically by 1950 and nearly 100 percent in commercial operations by the mid-1960s. The spread of milking machines was part of a larger mechanical revolution on dairy farms. Bulk cooling and handling techniques made the milk can obsolete. And, as part of a process common to a wide range of livestock operations, the mechanization of haying, silage, feeding, manure handling, and transportation became universal by the 1970s.[9]

The Chemical and Biological Revolutions

The mechanical changes of the post–World War I period, in most respects, represented a continuation of a process of invention and diffusion that had been underway for a century. The chemical and biological revolutions represented a sharper break with previous practices. This is not to deny that considerable effort had gone into experimenting with new crops and animals. To the contrary, western expansion was first and foremost a gigantic process of discovery, learning about the newly settled region's land and climate and finding suitable livestock, crop varieties, and production practices. State and federal agencies as well as leading farmers encouraged this process, scouring the world for seeds, cuttings, and animal stocks. There were numerous successes. But for the most part, this was a folk process of trial and error.

All this changed with the formal application of science to agricultural problems beginning early in the twentieth century. New knowledge about

[9] Robert E. Elwood, Arthyr A. Lewis, and Ronald A. Strubel, *Changes in Technology and Labor Requirements in Livestock Production*, Works Progress Administration, National Research Project, WPA Report No. A-14 (Washington, D.C., 1941), esp. v; G. H. Schmidt, L. D. Van Vleck, and M. F. Hutjens, *Principles of Dairy Science*, 2nd ed. (Englewood Cliffs, 1988), 11–13, 78–114; Clayton C. O'Mary and Irwin A. Dyer, *Commercial Beef Cattle Production*, 2nd ed. (Philadelphia, 1978).

genetics and chemistry, along with the emergence of a government-supported agricultural research system, led to breakthroughs that fundamentally changed the path of agricultural development. The story of hybrid corn is the best-known example of the application of biological sciences to agriculture with a revolutionary outcome. The breakthroughs occurred when George Shull, a Carnegie Institute scientist, applied genetic theory to develop pure inbred lines of corn and produced a superior hybrid through single-crossing in 1908. Edward East and Donald Jones of the Connecticut Experiment Station followed up Shull's work, developing double-crossing by 1918. Inbreeding had been shunned by the previous generation of corn breeders because the initial outcome was less vigorous and lower-yielding plants. Hybrid vigor occurred in the crosses of inbred lines. As in much science-based research, the process involved taking one step backward before taking two steps forward. Once developed for corn, similar principles and breeding practices were applied to other crops, with varying results. For wheat, hybrid crosses such as semi-dwarf varieties have become prominent, but the creation of first-generation hybrid seed has proved difficult and is only now beginning to show commercial promise.

Farmers and the agricultural sector in general have been remarkably receptive to adopting the products of the research laboratory. Within a decade of the experiments of East and Jones, commercial seed firms such as Henry A. Wallace's Pioneer Seed Co. commenced breeding hybrid seed for sale. Griliches' classic diffusion studies show that corn growers rapidly adopted the seed in close accord with the economic advantages it offered. Farmers in Iowa were the leaders with initial adoption dating from 1933 to 1935. One-half of Iowa corn was hybrid by 1938 and the diffusion process was virtually completed by 1941. For the country as a whole, the spread of hybrid corn was somewhat slower; hybrid seed accounted for one-half of corn planted in 1943 and over 95 percent in 1959.[10]

Hybrid corn initially offered yields 15 to 20 percent higher than open-pollinating varieties. Even after hybrid seed had fully diffused, corn yields continued to increase rapidly, primarily as a result of greater use of fertilizer, especially nitrogen. Between 1947 and 1980, the share of corn acreage receiving nitrogen jumped from 44 percent to 96 percent, and the average

[10] Paul G. Manglesdorf, "Hybrid Corn," *Scientific American* 185 (1951), 39–47; Deborah Fitzgerald, *The Business of Breeding: Hybrid Corn in Illinois 1890–1940* (Ithaca, 1990), esp. 23–42; Zvi Griliches, "Hybrid Corn: An Explanation of the Economics of Technological Change," *Econometrica* 25 (1957), 501–22.

rate of application increased tenfold. Studies of the sources of yield increases in corn typically attribute one-half or more of the credit to increased application of nitrogen. Its effect appears to have been greatest in the 1950s and 1960s, before seriously diminishing marginal returns set in and real fertilizer prices began to rise. Most studies emphasize the high degree of complementarity between improved breeds and the greater use of fertilizer.[11]

After World War II use of commercial fertilizer skyrocketed. American farmers' purchases of primary plant nutrients, which had doubled between 1910 and 1940, increased eightfold over the next thirty years. Accompanying the growth was a shift from low-concentration, phosphate-based, mixed fertilizers to high-concentration, nitrogen-based, straight materials, such as anhydrous ammonia. The increased use of commercial fertilizer after 1945 was a result of several factors. First, the traditional approach of manuring or using no fertilizer at all was exhausting the soil in many areas of the North. Second, and more important, the real price of fertilizer declined over the post–World War II period. Active antitrust policy and wartime expansion of nitrate plants for the munitions industries increased capacity and competition in the fertilizer industry. Third, technological changes such as the development of super phosphates by the Tennessee Valley Authority and the perfection of methods for direct application of anhydrous ammonia further contributed to the advance in fertilizer use.[12]

Biological and chemical innovations also revolutionized livestock production. Selective breeding dates back to ancient times, but the advent of modern genetic and veterinary science, the development of improved registry of breeding stock, and the spread of artificial insemination greatly accelerated productivity increases. Institutional innovations, such as dairy breeding and herd-improvement associations, first organized in 1906; and the national poultry improvement plan, which dates to the 1930s, stimulated genetic advances. The first known use of artificial insemination on

[11] W. Burt Sundquist et al., *A Technology Assessment of Commercial Corn Production in the United States*, Minnesota Agricultural Experiment Station Bull. No. 546 (St. Paul, 1982); J. J. Bond and D. E. Umberger, *Technical and Economic Causes of Productivity Changes in US Wheat Production, 1949–76*, USDA Tech. Bull. No. 1598 (Washington, D.C., 1979); Dana G. Dalrymple, *Development and Spread of Semi-Dwarf Varieties of Wheat and Rice in the United States*, USDA Agricultural Economic Report No. 455 (Washington, D.C., 1980).

[12] Jesse W. Markham, *The Fertilizer Industry: Study of An Imperfect Market* (Nashville, 1958); Darrell A. Russel and Gerald G. Williams, "History of Chemical Fertilizer Development," *Soil Science Society of America Journal* 41 (1977), 260–65; U.S. Economic Research Service, *Economic Indicators of the Farm Sector, 1988, Production and Efficiency Statistics*, ECIFS 8-5 (Washington, D.C., 1990), 28–31.

U.S. dairy farms occurred in the mid-1930s; and by the mid-1970s, about one-half of all dairy cows and heifers were bred artificially. With these changes came vast improvements in feed, including the use of concentrates and hormones, the control of diseases, and, in some cases, a wholesale restructuring of climatic and environmental conditions.[13]

Transportation and Communication

Most economic history textbooks treat the transportation and communication revolutions as nineteenth-century events. But this is not wholly true for American farmers. The nineteenth-century technologies – the canals, railroads, and telegraph – connected the trading centers and some small towns to world markets but did not reach the front gates and living rooms of the nation's million farms in 1910. The twentieth-century technologies – the automobile and surfaced road, telephone, radio, and television – most significantly reduced distance between farm and urban life.

In 1910 most northern farms remained physically isolated, connected to neighboring farms and nearby cities only by dirt and gravel roads. A 1906 U.S. Department of Agriculture (USDA) survey revealed that farmers in the North Central region typically could make no more than one round trip per day to their nearest marketing center using a horse and wagon. The building of rural roads and the spread of the automobile and motor truck increased the ease of rural transportation. This is well illustrated in a 1918 study that reported that with a motor truck, farmers in the North Central region could average over three round trips per day carrying their products to town. The spread of the automobile improved access to health care and education, leading to a reduction in the number of home births and the disappearance of the one-room schoolhouse. It also contributed to the increased reliance on purchased inputs such as gasoline and store-bought products.[14]

According to most historical narratives, farmers were at first reluctant to embrace the automobile, frequently expressing fears that the "devil wagons" would scare horses and threaten rural values. Though filled with amusing anecdotes, these narratives often fail to emphasize that American

[13] USDA, 1936 *Yearbook of Agriculture* (Washington, D.C., 1936), 863–1143, esp. 997–1143; *Yearbook of Agriculture, 1943–1947: Science in Farming* (Washington, D.C., 1947), 32–244, esp. 160–75; M. E. Ensminger, *Animal Science*, 7th ed. (Danville, IL, 1977), 68–99; and Lyle P. Schertz and others, *Another Revolution in U.S. Farming?* (Washington, D.C., 1979), Part II – Livestock Production, 85–256.

[14] USDA, *1919 Yearbook* (Washington, D.C., 1920), 746.

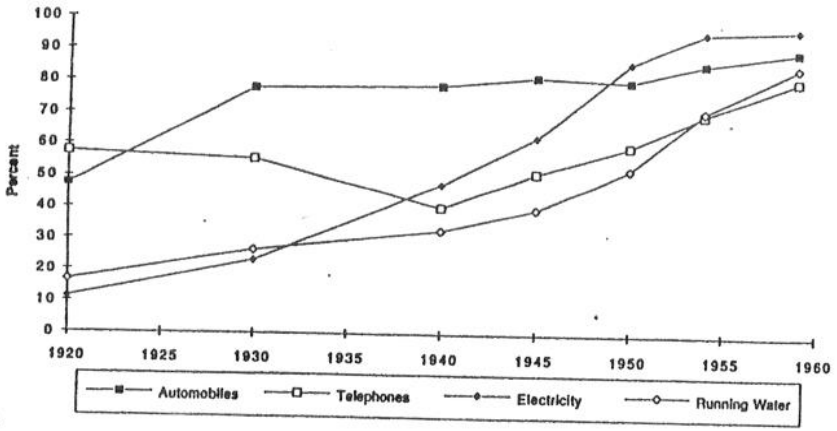

Figure 12.3. Fraction of northern farms reporting specific equipment and facilities, 1920–1960. Source: U.S. Bureau of the Census, *Census of Agriculture, 1954, Vol. II, General Report* (Washington, D.C., 1956), 46; *Census of Agriculture, 1964, Vol. II, General Report* (Washington, D.C., 1966), 683–89, *Census of Housing, 1960, Vol. I, pt. 1–9* (Washington, D.C., 1963), table 5: *Agricultural Statistics, 1961*, 591.

farmers, at least in the North and West, were among the most rapid, early adopters of the automobile in the world. Figure 12.3 shows the proportion of northern farmers reporting automobiles, as well as telephones, electricity, and running water. By 1920 one-half of northern farms had automobiles.

The poor quality of rural roads delayed an even more rapid adoption of automobiles. In 1904 America had about 2 million miles of rural roads, but only about 5 percent were paved; the remainder could be virtually impassable during the wet seasons. The federal government, led by the USDA, worked to improve the rural road network. Legislative initiatives in 1905, 1912, and 1918 organized the Office (later Bureau) of Public Roads to test and demonstrate road-building techniques and provided financial assistance to states building all-weather rural roads and bridges. Between the world wars, the federal government pumped $3.6 billion into rural road construction – all of the federal money devoted to road building before the 1944 Highway Act. The "Good Roads Movement" to get the farmers "out of the mud" was making headway. By the early 1920s there were about 3 million miles of rural roads. After that date, there was little increase in mileage but a significant upgrading in road quality, as

the fraction of U.S. farms connected solely to dirt roads fell from 77 percent in 1925 to 33 percent in 1950. As a result of these efforts, a regular grid of country roads covered major sections of the northern countryside.[15]

The twentieth-century communication revolution, with the spread of the telephone and the radio, further reduced the isolation of the farm. By 1920, well over one-half of the northern farms had telephones; but the share dropped between 1920 and 1946, due to the farm depression and a decline in quality of rural phone service. The spread of the telephone resumed in the 1940s with the rise in farm income and the passage of the Rural Telephone Act in 1949 that extended federal assistance to telephone service. By 1960, 80 percent of northern farms reported telephones. The spread of the radio and television also closed the gap between rural and urban life. In 1925 about 7 percent of northern farm families owned radios. By 1945 the share had increased to 85 percent. The radio and the television put the farm family in daily touch with breaking world news and entertainment as well as substantial programming devoted to agricultural subjects.[16]

The diffusion of the radio and the television depended on the connection of the farm to the electric grid. Electrification required utility companies to build a distribution system over a large territory of low-density demand. Progress was slow, leading to farmer complaints. In 1935 the Roosevelt administration responded with the creation of the Rural Electrification Administration (REA) to promote rural power distribution systems. At that time only about 11 percent of American farms had electricity. The REA provided long-term loans (at what proved to be below-market rates) to locally owned and operated rural electric cooperatives. Expansion was rapid, especially in the 1946–52 period. By 1960, 97 percent of U.S. farms were electrified, of which one-half were served by REA-affiliated utilities.[17]

[15] U.S. Bureau of the Census, *Census of Agriculture: 1950, II, General Report* (Washington, D.C., 1952), 215–16; *Historical Statistics*, 710; C. Phillip Baumel et al., "Alternatives for Solving the Local Rural Road and Bridge Problem" and Donald L. Nelson, "Extension Involvement in Rural Transportation," both in William R. Gillis, ed., *Profitability and Mobility in Rural America* (University Park, PA, 1989), 18–26.

[16] U.S. Bureau of the Census, *Census of Agriculture: 1945, II, General Report* (Washington, D.C., 1947), 314–21. Also see Reynold M. Wik, "The Radio in Rural America During the 1920s," *Agricultural History* 55 (1981), 339–50; Don F. Hadwiger and Clay Cochran, "Rural Telephones in the United States," *Agricultural History* 58 (1984), 221–38.

[17] D. Clayton Brown, *Electricity for Rural America: The Fight for the REA*, Contributions in Economics and Economic History No. 29 (Westport, CT, 1980); USDA, *Rural Lines USA*, Misc. Publ. No. 811 (Washington, D.C., 1960).

The private sector could have provided for some of these goods and services, but as the actual historical process unfolded, the government played a key role. The line between the provision of public goods and pure subsidy is hard to define, and a balanced assessment of these programs is difficult. On the one hand, these investments improved the quality of farm life, encouraging people to remain in the farm sector, thus contributing to the oversupply of farmers in recent decades. On the other hand, these improvements in transportation and communication integrated farmers into the broader society, preventing development of rigid barriers between rural and urban areas. They undoubtedly contributed to increased mobility and led to fewer pockets of extreme poverty such as Appalachia.

Public Research

Besides providing infrastructure, the government also contributed directly to the explosion in agricultural efficiency through its education, research, and extension activities. The origins of the "Agricultural Research System" date back to 1862 with the establishment of the USDA and the state land grant college system. The 1887 Hatch Act set up the agricultural experiment station system, providing the foundation for federal–state cooperation. Between 1900 and 1920 the USDA greatly enhanced its research efforts. It tripled funding, added specialized scientific research bureaus, and forged stronger links to the state experiment stations through the establishment of coordinated research programs. Several key features defined the USDA's research effort. Research was applied rather than basic, organized around farmers' problems rather than around scientific disciplines, and responsive to outside interest groups. To facilitate communication between farmers and researchers, the Smith-Lever Act of 1914 created the final piece of the system, the agricultural extension service.[18]

The research-extension establishment has had an enormous impact on the development and diffusion of new technologies. Beginning with Griliches' study of hybrid corn, there have been dozens of estimates of the returns to agricultural research on specific crops and for the system as a whole. Although the results vary, they are always extraordinarily high.

[18] The classic treatment is A. Hunter Dupree, *Science in the Federal Government: A History of Policies and Activities to 1940* (Cambridge, MA, 1957) 149–83. See also U.S. Congress, Office of Technology Assessment, *An Assessment of the United States Food and Agricultural Research System* (Washington, D.C., 1981).

As an example, Evenson, Waggoner, and Ruttan estimate *annual* rates of return of about 100 percent on research funds expended between 1927 and 1950. The high rates of return are almost always interpreted as a sign that the system is underfunded. But the research-extension system is not without its critics, who argue that its efforts unduly favor large-scale farms.[19]

Integrated with the public research system and enhancing its effectiveness was a dynamic private sector of agricultural supply firms. Recent scholarship has shown that private investment in agricultural research lagged behind public-sector investment until the 1950s. By 1990, annual private-sector investment was nearly double all public contributions.[20] Private enterprises both created their own technologies and made the ideas flowing out of the public system a commercial reality. Mechanical inventions, to a significant extent, came out of the private sector, with International Harvester, Farm Machinery Corporation, Oliver, Caterpillar, and John Deere leading the way. In the biological arena, government scientists played a more central role. But after the major biological breakthroughs, private firms such as Pioneer and DeKalb produced and sold the seed actually planted. The key point is that the whole research-industrial-farm system was integrated by a complex communications network that allowed for trial, error, and feedback at the local level, giving guidance to both the producers and the users of new technologies. This sped up and institutionalized technological change.

Innovation and Diffusion

Numerous studies have analyzed the process of innovation and diffusion of new technologies. Two views going beyond the notion that innovation is purely random have been advanced. The first, popular with technologists, emphasizes the technical and scientific difficulty of a given invention and places it within the broader context of the progress of both applied and basic science. Some problems are just harder to solve than others. As examples, machines that replace the motions of the hand, such as the cotton picker or milking machine, are thought to be more difficult to develop than those that replace the motions of the arm, such as the

[19] Zvi Griliches, "Research Costs and Social Returns: Hybrid Corn and Related Innovations," *Journal of Political Economy* 66 (1958), 419–31; Robert Evenson et al., " Economic Benefits from Research: An Example from Agriculture," *Science* 205 (Sep. 14, 1979), 1101–7; for criticism of the system, see Jim Hightower, *Hard Tomatoes, Hard Times* (Cambridge, MA, 1978).

[20] Wallace Huffman and Robert Evenson, *Science for Agriculture: A Long Term Perspective* (Ames, 1993).

reaper. Plant breeding was initially harder than animal breeding, where the role of both sexes was more readily understood. Technical developments that required knowledge of genetics or chemistry were more difficult than those based on mechanics, and so on.[21]

The second view, popular with agricultural economists, is the induced innovation hypothesis, which argues economic forces drive the development of new technologies. Here demand and relative factor scarcities are paramount. The quest for profit will induce inventors to concentrate on larger markets (wheat versus okra) and on saving relatively scarce and thus more expensive inputs. In the U.S. case, this has typically been labor. As an example, an increase in the price of labor relative to the price of land should stimulate labor-saving innovations. Proponents of the induced innovation model claim that the process of technological change in American agriculture discussed above strongly supports their hypothesis. A closer reading of American history raises serious questions. As examples, the great wave of labor-saving mechanical inventions that began in the mid-nineteenth century occurred at a time when the price of labor relative to land was falling, and the yield-increasing biological innovations that began in the 1930s occurred while land prices were falling relative to fertilizer and wage rates. This is exactly contrary to what the induced innovation hypotheses suggests.[22]

There are also two major views of the diffusion process. One, championed by rural sociologists, emphasizes problems concerning the spread of information and farmer acceptance of improved techniques. According to this view, there are considerable differences among farmers in their awareness and receptiveness to new ideas, with the vast majority having a "show me" attitude. They are likely to adopt a new method only after they see it actually works under conditions like their own. This approach focuses on identifying the characteristics of the early adopters and studying their role in demonstrating new ideas in their neighborhood. State fairs, agricultural societies, farm journals, the extension service, and the agricultural colleges all educate farmers, speeding up the diffusion process.

The second view, championed by economists, emphasizes the relative costs and profitability of the competing methods. This view notes that,

[21] A persuasive exponent of this view is W. Parker in Lance E. Davis et al., *American Economic Growth*, 384–85.

[22] See Yujiro Hayami and Vernon W. Ruttan, *Agricultural Development: An International Perspective*, revised and expanded ed. (Baltimore, 1985), and Alan L. Olmstead and Paul Rhode, "Induced Innovation in American Agriculture: A Reconsideration," *Journal of Political Economy* 101 (1993), 100–18.

depending on one's farm size and particular operating conditions, it may be rational for some farmers to adopt, while others reject a new technique – failure to adopt may be profitable and need not imply conservatism or ignorance. As the relative cost of the new method declines, making it advantageous for a wider range of farmers, diffusion proceeds. Clearly, if properly interpreted, both views offer valuable insights.[23]

THE FARM PROBLEM

The farm sector has experienced remarkable technological progress. Yet seldom does a day pass without a reminder that agriculture is in "crisis," and the family farm is an endangered species. The classic concerns about the health of agriculture include low and unstable incomes, volatile and falling prices, long bouts of financial distress, the concentration of agricultural production, the loss of independence resulting from increasing commercialization and debt burdens, and, more generally, the decline in the rural way of life. Before the reader writes a check to the next Willie Nelson Farm Aid benefit, it would be useful to ask what are the economic realities of the "Farm Problem" and how have they changed over time? To address these issues we will look at the history of farm prices and incomes, the decline in the number of farms, and the changing structure of agriculture. An assessment of the causes of the farm problem, including such issues as the impact of technological change on farm income and employment, depends critically on the elasticity of demand for agricultural products. This section thus concludes with an analysis of this important but tricky question. In the next section we will examine the political response to the farm crisis, beginning in the early 1920s.

Prices and Income

Agricultural prices and incomes have been highly volatile and generally declining in relative terms since World War I. Figure 12.4 shows changes in the parity ratio, measuring movements in the prices received by farmers relative to prices paid. Overall, the ratio dropped by one-half between 1910 and 1990. It moved in favor of agriculture up to 1918 before falling

[23] See Everett M. Rogers, *Diffusion of Innovations*, 3rd ed. (New York, 1983) and Paul A. David, "The Mechanization of Reaping in the Ante-Bellum Midwest," in Henry Rosovsky, ed., *Industrialization in Two Systems: Essays in Honor of Alexander Gerschenkron* (New York, 1966), 3–39.

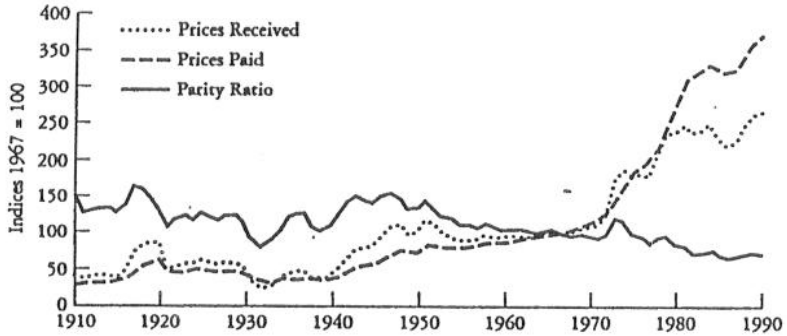

Figure 12.4. Indices of prices received and paid by farmers, 1910–1990. Source: U.S. Bureau of the Census, *Historical Statistics of the United State, Colonial Times to 1970* (Washington, D.C., 1976), 488–89; *Economic Report of the President, 1991* (Washington, D.C., 1991), 398.

sharply during 1920–1922 and 1929–1932. Agriculture's terms of trade recovered after 1933 and rose significantly during World War II. In the post-1945 period the ratio fell steadily, interrupted only by the agricultural prosperity associated with the "food crisis" of 1973–1974. This short boom, like the World War I period, led to a large expansion in debt; when prices fell, high debt levels added significantly to farmer distress, straining rural credit institutions.

Since 1910 real gross agricultural income has grown at a rate only one-fifth as rapidly as GNP. And farm income net of production expenses has fallen to three-quarters of its 1910 level. The slow growth in gross farm income has occurred despite – some would say because of – a substantial long-run increase in farm output. As a result, the farm sector's share in national income has fallen from 20.5 percent in 1909 to 9.7 percent in 1939 and to 1.8 in 1982. The slower growth of aggregate income was associated in the 1920s through 1950s with lagging levels of per capita income in agriculture. Figure 12.5 shows the per capita income level of the nation's farm population relative to that of the non-farm population from 1910 to 1983. In the 1930s the ratio of farm to non-farm per capita income hovered around 40 percent. After 1940, the gap began to close; by the 1970s per capita farm and non-farm incomes were nearly equal.[24]

[24] USDA, *Agricultural Statistics 1967* (Washington, D.C., 1967), 573; *Agricultural Statistics 1984* (Washington, D.C., 1984), 418; U.S. Bureau of Agricultural Economics, *Farm Income Situation*, FIS-142 (1949), 10. The series from 1934 to 1983 shows the ratio of disposable personal income per capita of the farm population relative to that of the non-farm population. The series from 1910 to 1948 is the ratio of per capita net income of the farm population derived from farming relative to the per capita income of the non-farm population. The non-farm income earned by the farm population, which made up about one-third of the total income of farmers in the 1930s when data first became available, is included in the income of the non-farm population. Consequently, the ratio is too low. Nonetheless, the movement of the series is probably indicative of relative income movements in the earlier period.

The data are for the nation as a whole, but regional data, first available for 1955, suggest the ratio for the North is close to that for the United States. See Robert H. Masucci, "Regional Differences in Per Capita Farm and Nonfarm Income," *Agricultural Economics Research* 12 (1960), 1–6.

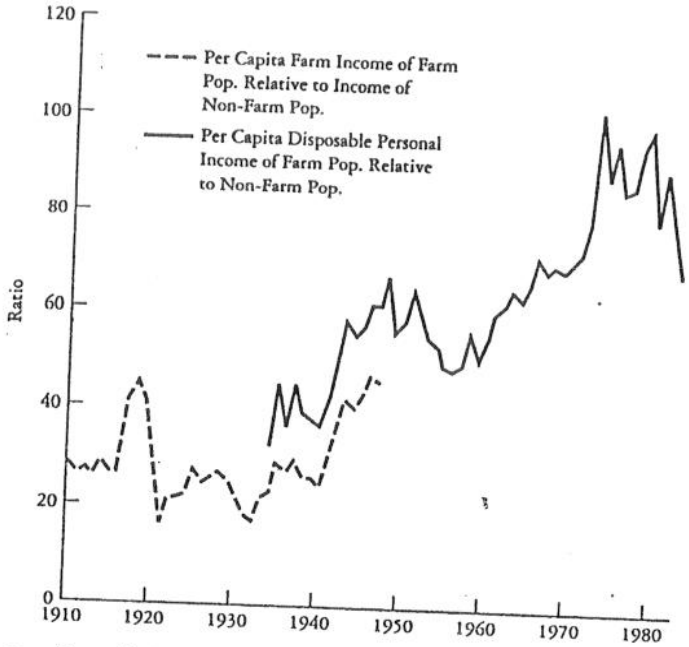

Figure 12.5. Per capita income of U.S. farm population relative to non-farm population, 1910–1983. Source: *Agricultural Statistics, 1967*, 573; *1984*, 418; U.S. Bureau of Agricultural Economics, *Farm Income Situation* (July–Aug., 1949), 10; USDA, *Major Statistical Series of the U.S. Department of Agriculture: How They Are Constructed and Used, Vol. 3, Gross and Net Farm Income*, Agricultural Handbook No. 118 (Washington, D.C., 1957), 2–5, 78–79.

The Farm Population

The convergence of farm and non-farm incomes was largely due to an off-migration of farm population and a decline in the number of farms. Table 12.3 shows the downward course of the number of farms and farm population in the North from 1910 to 1987. The decline was slow until the

Table 12.3. *Northern farm population and number of farms (thousands)*

	Farm population	Number of farms
1890	14,048	2,729
1900	15,649	3,120
1910	15,420	3,268
1920	14,911	3,247
1930	14,165	3,071
1940	14,147	3,095
1950	11,152	2,746
1960	8,475	2,065
1970	5,958	1,569
1980	4,612	1,438
1987	3,556	1,264

Source: U.S. Bureau of the Census, *Rural and Rural Farm Population 1987*, CPR P-26, No. 61 (Washington, D.C., 1988), 9; *Historical Statistics* 458–59; USDA *Agricultural Statistics 1981* (Washington, D.C., 1981), 416 and *Agricultural Statistics 1988* (Washington, D.C., 1988), 372.

1940s and rapid thereafter. Between 1940 and 1987, the northern farm population contracted by 11 million people, reducing its share of the region's population from 15.6 percent to 2.2 percent. As millions of farm residents left the land and the per capita resource base of the remaining population increased, the relative income of farm families increased. The national farm income figures also increased because millions of impoverished and poorly educated southern sharecroppers, black and white, exited from agriculture. For these and other reasons, by the 1970s and 1980s farm family income generally equaled or exceeded that of non-farm families.

Why was movement off the farm so slow before World War II? There are several reasons. First, farming was a career choice, which once made, was not easily changed. The reduction in the number of northern farm operators in the post–World War II period was due almost entirely to a decline in the number of people entering farming (especially the young), not to an increase in the rate of exit. Second, changing occupations, at least before the improvements in rural transportation and communications systems, meant changing residences as well. This also slowed the movement out of farming. Finally, during the interwar period, growth in off-farm employment opportunities was weak. For example, the number of jobs in manufacturing stagnated during the 1920s and sharply declined in the 1930s. So even if conditions down on the farm were bad, it was not a good time to leave. During and after World War II, non-farm employment expanded, rapidly drawing millions of people off the farm.

Most northern off-farm migrants found higher paying, more productive jobs out of agriculture. Indeed, some observers have argued that agriculture's major contribution to U.S. economic growth since World War II has not been the increase in farm output but rather the additional non-farm income generated by the workers who left farming.[25] As great as the off-farm migration has been, it has not led to general rural depopulation. Due to a tripling of the non-farm rural population in this century, the northern rural population has expanded. In most rural areas, the farm population is now a minority. Whereas in 1900 the farm share of the northern rural population was over 60 percent, in 1980 it was a mere 13 percent.[26] Rural life is no longer synonymous with farming.

Farm Structure

Accompanying the decline in the farm population was a decline in the number of farms and major changes in farm structure, including dramatic increases in farm scale and commercialization. Between 1940 and 1987, the number of northern farms fell by 2 million. Since the agricultural land base has remained roughly constant, the average size of farms increased from 210 to 541 acres over this period. Table 12.4 shows the changing number and importance of northern farms in various product sales categories (defined in 1982 dollars) between 1950 and 1982. The percentage of farms that annually sold at least $100,000 worth of products increased six times, and their share of annual sales almost tripled. In 1982, these 222,000 northern farms accounted for 72 percent of all annual sales, and together with the 259,000 farms in the $40,000 to $99,999 class yielded almost 90 percent of gross product sales. The percentage of farms in this mid-sized group also increased, but their market share fell by more than one-third. American agriculture has become polarized, with the

[25] Lester C. Thurow, "Agricultural Institutions and Arrangements Under Fire," 199–218, in N. Schaller (compiler), *Proceedings of Phase I Workshop*, Social Science Agricultural Agenda Project (Minneapolis: Spring Hill Conference Center, June 9–11, 1987).

[26] *Rural and Rural Farm Population 1987*, 9.

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Table 12.4. *Northern farm size distribution in 1950 and 1982 (in 1982 dollars)*

Gross sales per farm	Number of farms (1,000s)		Percentage of farms		Annual gross sales ($1,000,000s)		Percentage of all farms' gross sales	
	1950	1982	1950	1982	1950	1982	1950	1982
over 100,000	75	222	2.7	16.5	17,778	68,404	26.8	72.4
40,000–100,000	302	259	11.1	19.3	18,212	16,246	27.5	17.2
20,000–40,000	569	173	20.9	12.9	16,807	5,049	25.4	5.3
10,000–20,000	558	157	20.5	11.7	8,644	2,271	13.0	2.4
less than 10,000	1,220	533	44.6	39.7	4,816	2,552	6.8	2.7
all farms	2,728	1,344	100.0	100.0	66,257	94,522	100.0	100.0

Sources: U.S. Bureau of the Census, *Census of Agriculture: 1954, Vol. II, General Report*. (Washington, D.C., 1956), 1162–216; *1982 Census of Agriculture, Vol. I, Geographic Area Series, Part 51, United States* (Washington, D.C., 1984), 148–54.

concentration of production on large commercial farms on one end and the existence of a large number of rural residences and hobby farms on the other.

For decades, most of these small farms have not been commercially viable; and, as a group, they actually lost money from farming in the 1980s. The USDA and the Census Bureau continue to classify even the smallest of these as farms largely for political reasons.[27] The largest farm class shown in the Census of 1950 was "$25,000 and above;" this would be about $100,000 (and above) in 1982 dollars. But, by modern standards, a farm with only $100,000 in annual gross sales is a relatively modest operation. Table 12.5 provides an overview of farm structure for 1988 (in 1988 dollars) for the entire United States and allows for an analysis of more sales categories. The USDA listed 2,197,000 farms. Of these, 14.7 percent, or 323,000 farms, had cash receipts of $100,000 or more, accounting for 76.6 percent of all farm receipts; 106,000 of these operations had sales over $250,000 (4.9 percent of all farms) and accounted for 54.6 percent of all receipts. At the top were 30,000 mega-farms with receipts of $500,000 or more (1.4 percent of all farms) that accounted for 36.6 percent of total receipts. Net farm income was even more skewed, with these mega-farms capturing 43.3 percent. At the bottom were farms with receipts of less than $20,000, which as a group lost money farming. The general picture for the North alone would be roughly the same – about 2 percent of all farms generate one-half of net farm income while one-half of all farms typically lose money from farming.

Table 12.5 also provides evidence on the sources of farmer income by various farm classes. In 1988 America's mega-farmers on average received $40,238 in direct government payments, earned $27,891 in off-farm income, and had a net cash income of $762,830 from farming operations, yielding an average total income of $830,959. At the other end of the scale, small farmers (with sales less then $40,000) were not doing too badly thanks to their non-farm income. This group averaged $1,988 from farming but topped this off with $1,697 in government payments and $26,434 in off-farm income, for a total income of $30,119. This compares quite favorably to the median income of $33,742 for all American families in 1988.[28] A more detailed look at the group of farmers in the under

[27] In the 1980s leaders within the USDA proposed, without success, dropping all farms with sales under $5,000. Continuation of a host of farm-related subsidies, such as funding for rural mail delivery, farm-to-market roads, and county agents, requires only that there be farmers on the books, not that they actually grow much.

[28] *Economic Report of the President 1991* (Washington, D.C., 1991), 320.

Table 12.5. *1988 Farm structure: annual cash receipts per farm*

	$500,000 and over	$250,000 to $499,999	$100,000 to $249,999	$40,000 to $99,999	$20,000 to $39,999	$10,000 to $19,999	$5,000 to $9,999	Less than $5,000	All farms
Farms (thousands)	30	76	216	320	251	274	279	751	2,197
Percentage of farms	1.4	3.5	9.8	14.6	11.4	12.5	12.7	34.2	100.0
Percentage of cash receipts	36.6	18.0	22.0	13.6	4.7	2.6	1.4	1.0	100.0
Percentage of total net farm income	43.3	19.9	21.6	11.2	3.3	1.4	0.6	−1.4	100.0
Percentage of direct govern. payments	8.4	16.9	31.5	24.9	9.9	4.4	1.9	1.9	100.0
Average direct govern. payment	40,238	31,978	21,118	11,283	5,730	2,331	1,010	374	1,697
Average off-farm income	27,891	16,254	17,657	14,679	19,420	20,743	25,283	31,280	26,434
Average total cash income[a]	830,959	201,338	102,946	51,214	35,378	27,484	27,818	30,178	30,119

[a]Includes net cash income from farming, direct government payments, and off-farm income.

Source: U.S. Economic Research Service, *Economic Indicators of the Farm Sector: National Financial Summary*, 1988 (Washington, D.C., 1989), 39–52.

$40,000 sales class reveals that the total incomes of those selling less than $5,000 was very close to those in the $20,000 to $40,000 sales range, because of compensating differences in off-farm income.

As the data on non-farm income indicate, a key feature of the changing northern agricultural structure has been an increase in the relative importance of part-time farmers. The proportion of farm operators working 200 or more days off-farm increased from about 7 percent in 1929 to over 30 percent in 1982, while the proportion not reporting any off-farm work fell from over 70 percent to about 50 percent. The proportion of farm operators working an intermediate amount (50–199 days) off the farm had remained small, only about 10 percent total, suggesting that there have been strong pressures to specialize. Much has been made of the rise of the part-time farmer, but the absolute numbers indicate that the trend is best interpreted as a decrease in the number of full-time operators. The absolute number of part-time farmers in the North has been roughly stable since World War II, while the number of full-time farmers has fallen by two-thirds.

The overall decline in the number of farmers and the rising scale of operations, in part, reflect an increasing division of labor. Many tasks that were once done by farmers are now performed by firms producing goods and services bought by farmers and by firms processing farm products. As examples on the input side, around World War I northern farmers typically produced about 60 percent of their own food and fuel. As Table 12.6

Table 12.6. *Percentage of farms reporting selected livestock and crops, 1910 and 1982*

	1910	1982
Chickens	87.8	9.6
Dairy Cows	80.8	14.7
Horses	73.8	18.6
Swine	68.4	14.7
Corn	75.7	31.9
Fruit Orchards	48.4	5.5

Source: U.S. Bureau of the Census, *1920 Census of Agriculture* 542, 565, 596, 607, 738, 821, 862, and *1982 Census of Agriculture, Vol. 1, Part 51* (Washington, D.C.: 1984), viii, 11.

indicates, in 1910 most American farmers produced their own milk, eggs, chickens, and corn. In recent years most farmers have found it more economical and more convenient to buy these items from someone else. Although many social critics bemoan the farmers' loss of self-sufficiency, the decision not to raise chickens for the family or tend a small corn patch is almost surely a matter of free choice and not compulsion. More generally the ratio of purchased to non-purchased inputs increased over six times since 1910. A similar increase in the division of labor has occurred on the output side as packagers, fast-food chains, truckers, and refrigerated warehouses absorb a growing share of the consumer's food dollar; since 1913 the farmer's share has fallen from about 50 percent to 23 percent.

As a means of maintaining some control over their inputs and marketing activities many farmers turned to cooperatives in the first decades of the twentieth century. The organization of new cooperatives peaked in 1920, with the formation of about two thousand marketing and purchasing associations. At that time, co-ops handled about 10 to 15 percent of all farm produce. In 1985, farmer co-ops continued to play a major role in the farm economy, accounting for more than 25 percent of farm marketing and purchasing.[29]

The Demand for Farm Products

Why has the relative size of the farm sector contracted? Why have farm prices and incomes been so unstable? Have the technological changes discussed above eased these problems or made them worse? The answers to these questions depend critically on the nature of demand for agricultural products.

Textbook treatments of the demand for agricultural goods are sharply divided between two fundamentally different views. The more traditional and "pessimistic" viewpoint treats demand as price-inelastic and slowly growing. These characteristics are thought to follow from Engel's Law. If demand is price-inelastic, shifts in supply that increase farm output would result in disproportionately lower prices. This would lower farm income, and unless fully offset by lower costs, it would also decrease farm welfare.

[29] W. C. Funk, *What the Farm Contributes Directly to the Farmer's Living*, USDA Farmers' Bull. No. 635 (1914), 1–21; USDA *Yearbook, 1922* (Washington, D.C., 1923), 999. U.S. Economic Research Service, *Changes in Farm Production and Efficiency, 1980*, Stat. Bull. No. 679, 64–65; *Economic Indicators of the Farm Sector: Production and Efficiency Statistics*, 1989, 37; James H. Shideler, *Farm Crisis, 1919–1923* (Berkeley, 1957), 91; and Willard W. Cochrane, *The Development of American Agriculture: A Historical Analysis* (Minneapolis, 1979), 114.

Thus, technological progress may hurt the farm sector, although individual farmers, who were early adapters, might well benefit. There are several other important implications. First, random shifts in supply, due, for example, to weather, would result in highly volatile food prices and farm income. Second, the demand for farm products would not keep pace with per capita income growth, leading to a secular decline in the relative size of the agricultural sector. Third, this would be a relatively favorable environment for government commodity policies. Programs that restrict output would have a large impact on farm prices and income, without greatly distorting consumer behavior.

The second and more "optimistic" view of demand generates radically different implications. Its proponents argue that for most northern staples, the United States is a small player in a large world market. Consequently, prices are determined in international markets, and the demand for U.S. products is highly elastic. Thus, increases in supply would result in both higher U.S. farm exports and higher farm income. Technological progress would enhance the international competitiveness of U.S. farmers and expand the size of the sector (relative to the counterfactual world without productivity growth).[30] Furthermore, this would be a very unfavorable environment for government farm-support programs. Commodity programs could price U.S. producers out of world markets and might result in U.S. taxpayers subsidizing foreign producers as well as U.S. growers.

The domestic demand for food products is almost surely price- and income-inelastic. Early statistical studies from the interwar years generated price-elasticity estimates of around −0.2 and income-elasticity estimates of about 0.3, numbers which soon became cemented into the conventional wisdom. Of course, the elasticities of individual farm products vary considerably. Over the past eighty years there have been shifts among the food groups associated with increasing per capita income, health concerns, and advertising, but little increase in per capita food consumption or caloric intake. Growth in total domestic demand has been due almost entirely to population growth, which has slowed from about 2 percent per year around 1910 to 1 percent today.

But, domestic demand is only part of the story. Figure 12.6 shows export sales as a percentage of corn and wheat production between 1910

[30] The effect of technological change on farm welfare depends on how the supply curve shifts as well as the elasticity of demand. Even if demand is elastic, a shift in supply that increases the elasticity of supply may reduce the producer surplus accruing to agriculture. Whether or not demand is elastic, consumers would benefit from productivity growth and would be hurt by output restrictions.

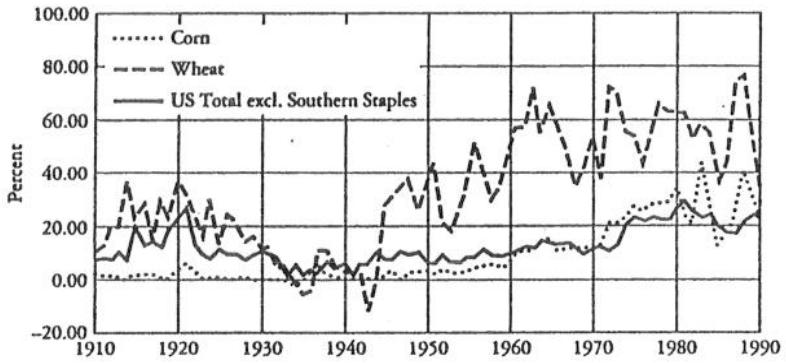

Figure 12.6. Net export share of Northern farm products, 1910–1990. Source: *Historical Statistics*, 482, 897–8; *Agricultural Statistics*, 1967, 1–2, 34–5; 1977, 4, 29, 575–6; 1980, 566–7; 1984, 513–9; 1989, 511; 1991, 389, 482–92.

and 1990. It also shows the ratio of agricultural exports to farm cash receipts (excluding the Southern staples – cotton, cottonseed, and tobacco – from both the numerator and denominator). Exports were increasingly important up to 1921, but then foreign markets withered. By the mid-1930s, the United States was a net importer of corn and wheat. We will look at the causes of this dramatic change in normal U.S. trade patterns in the next section. The export market recovered in the post–World War II period and soared in the 1970s and 1980s, when export sales accounted for about one-quarter of cash receipts.

The changing importance of the foreign market creates fundamental problems for our understanding of agricultural demand. Estimating U.S. export demand elasticities has proved notoriously difficult. Almost fifty years of careful empirical work has yet to yield anything resembling an informed consensus based on a solid theoretical and empirical foundation. Contemporary estimates of the price-elasticity of export demand for American wheat in the short run (1–2 years) range between highly inelastic figures such as −0.1 and elastic figures such as −3.1. The median estimate is −0.5. The results are highly sensitive to the technique used.[31]

[31] Direct econometric estimation of the relationship between prices and net exports tends to yield low elasticities, whereas synthetic or calculation methods (for example, using the weighted sum of the domestic demands and supplies of other countries) tend to lead to high estimates. U.S. Economic Research Service, *Embargoes, Surplus Disposal, and U.S. Agriculture*, Agricultural Economic Report No. 564 (Washington, D.C., 1986), Section 6, 21; Colin A. Carter and Walter H. Gardiner, *Elasticities in International Agricultural Trade* (Boulder, 1988), 30–55.

There is agreement on three points. First, over the long run (3–5 years), export demand tends to become more elastic. For U.S. wheat, the estimated absolute value of long-run price-elasticities are often greater than unity. Second, export elasticities are highly dependent on the international policy environment. Increased intervention by foreign governments, through protection and market boards, tends to reduce the elasticities. Third, elasticities vary in different time periods, due to changes in international competition and in the institutional environment. Over time, opinion among agricultural economists has subtly shifted from elasticity "pessimism" to "optimism." This may be a response to a perceived increase in the demand elasticity since the dark days of the collapse of the international market in the 1930s. This shift in opinion probably also reflects a growing disgust with the government commodity programs that the "pessimistic" view helps justify.[32]

FARM POLICY

The history of government intervention in the farm sector is a story of both spectacular successes and costly failures. There are six commonly accepted economic rationales for formulating a reasonable farm policy; U.S. policies have typically done a poor job of meeting three of these criteria. The first rationale is to provide food security in case of war or trade disruptions. This is not relevant to a nation with abundant agricultural resources such as the United States. The second is to help overcome the free rider problem and capital constraints associated with basic and applied research and farm extension work.[33] Here, as we have seen, government has been enormously successful in promoting rapid productivity growth. But these research policies may have exacerbated the overproduction and structural problems that the support and stabilization programs were supposed to mitigate. A third rationale is to provide infrastructure to lower transportation and communication barriers in order to promote a more efficient allocation of factors of production. As noted above, government programs made a significant contribution toward integrating the farm into

[32] For a longer discussion of the elasticity controversy, see Carter and Gardiner (1988) and Bruce L. Gardner, "Changing Economic Perspectives on the Farm Problem," *Journal of Economic Literature* 30 (1992), 64–67, 84–85.

[33] The free rider problem arises when economic agents can benefit from a service without having to pay for it. In such situations individual agents have an incentive not to pay, which in turn leads to a suboptimal supply of the service in question.

the national economy (although it is unclear whether the benefits of these programs exceeded the costs).

A fourth rationale is to overcome market failures, in particular, externalities and capital constraints that contribute to excessive depletion of agricultural resources. Federal conservation policies have had some successes (at a cost), but all too often they are simply guises for limiting production. The fifth rationale for intervention stems from the absence of adequate insurance markets, along with the volatility of farm prices and output. This variability creates risks for farmers and may justify income stabilization and insurance programs. Finally, rapid changes in economic conditions, especially a drop in farm prices, may trap many farm families in poverty, generating a need for income and employment policies.

U.S. farm policies have been poorly designed to address either of the last two major objectives. Under the fifth rationale, the policy goal should be to stabilize income, but because of the negative correlation between price and quantity, price stabilization programs are not the appropriate tools. In addition to trying to stabilize prices, the actual programs have also increased farm income at a great cost to taxpayers and consumers and with considerable inefficiency. These programs generally have not significantly increased the incomes of the rural poor in accordance with the sixth goal. Price supports and cash subsidies are correlated with the amount produced and, thus, little ends up in the pockets of the poor.[34]

Responses to the Crisis of the 1920s and 1930s

How did we come to this situation? Farmers have always been complaining, but it was only in the 1920s and 1930s that the federal government began to respond. America's World War I experience with government control of the economy created a model and helped legitimize interventionist policies. At the same time, farmers became better organized as the populist protests of an earlier age gave way to a more businesslike call for "orderly marketing," trade associations, and protective tariffs. Three major forces – the co-op movement, the Farm Bureau, and the farm bloc in Congress – dominated the agricultural policy scene in the 1920s. The 1920–1921 farm crisis spawned a national campaign to form cooperatives in basic commodities such as wheat and livestock. The plan called for producers of each commodity to sign legally binding contracts to sell all their

[34] David M. G. Newbery and Joseph E. Stiglitz, *The Theory of Commodity Price Stabilization: A Study in the Economics of Risk* (New York, 1981), 12–46; Charles L. Schultze, *The Distribution of Farm Subsidies: Who Gets the Benefits?* (Washington, D.C., 1971), 60.

output to the co-op for several (typically five) years. If a high percentage of producers agreed, the co-op could act as a monopolist, limiting supply and, thereby, increasing prices and farm income. The surpluses withheld from the market would either be destroyed or dumped overseas. The co-op could also help increase demand by advertising and developing new markets.

The whole scheme depended on preventing foreign imports, avoiding federal antitrust actions, and overcoming the free rider problem (while it is collectively in the interest of farmers to restrict output, it is not in the interest of any individual to do so alone). The first two problems were addressed by a series of tariff acts and partial exemption from antitrust prosecution under the Capper-Volstead Act of 1922. The federal government actively encouraged the movement through highly favorable tax treatment granted in the 1922 act, as well as other assistance under the 1926 Cooperative Marketing Act and the 1929 Agricultural Marketing Act. But the free rider problem was a harder nut to crack. Grandiose attempts to monopolize commodity trade, such as the United States Grain Growers, Inc., never attracted enough members to influence prices. By 1924 it was clear that the Sapiro voluntary cooperative movement had failed, but the general idea of "orderly marketing" was now singed into the minds of many farm leaders and farm bloc congressmen.

In 1921 the newly organized "farm bloc" in Congress steered through several bills regulating middlemen and subsidizing loans to farmers. But the main initiative was the "Equity for Agriculture" plan sponsored by Senator Charles McNary and Congressman Gilbert Haugen. Versions of a McNary-Haugen bill were introduced into Congress every year from 1924 to 1928. The concept was to separate the domestic and export markets through tariffs. Domestic "parity prices" would be set, based on the favorable 1905–1914 relationship between farm and non-farm prices. Taking wheat as an example, the legislation would have set the 1923 price at $1.53 a bushel instead of the actual price of $0.92. A newly created federal agricultural export corporation would sell on the world market what the domestic market failed to buy at the parity price, charging farmers a small "equalization fee" to cover the export losses.

The most ingenious aspect of this plan was that it did not cost the taxpayers anything. Its most obvious flaws were the absence of production restrictions to limit surpluses and the likelihood that dumping would have triggered trade wars. The initial bills received the strong support of USDA Secretary Henry C. Wallace but divided the farm lobby, with the Farm Bureau and many co-op leaders opposed. Bills were defeated in the House

in 1924 and 1926 and never came to a vote in 1925. A continuation of the agricultural depression, a broadening of coverage, and an intense lobbying campaign increased support. In 1927 and in 1928, the bills passed both houses of Congress but were vetoed by President Coolidge, who deemed them un-American. In 1928 the Senate failed by a scant four votes to override.[35]

McNary-Haugenism set the stage for subsequent government intervention in the 1930s. The notions that the market prices of agricultural products were not "fair" and that the government should set things straight were gaining converts. Even opponents of McNary-Haugenism, such as Herbert Hoover, sought non-market solutions to the farm problem that would give farmers more of the food dollar. Embodying this view, the Agricultural Marketing Act of 1929 created the Federal Farm Board, with a $500 million fund to buy and store commodities in order to raise prices. Almost immediately the Farm Board was in trouble, as nominal farm prices fell over 50 percent between 1929 and 1932. The Board accumulated huge stocks of commodities, bidding up U.S. prices, discouraging exports, and encouraging even more overproduction. With its funds exhausted, the Board unloaded its stocks, shocking commodity markets. In 1933, the Federal Farm Board was abolished.[36]

The agricultural situation was grave in March 1933, when Roosevelt entered the White House; farm income had collapsed, foreclosures were commonplace, and rural banks and farm suppliers were in distress. In all but the most conservative quarters, there was the consensus that drastic action was needed. The first step was a set of emergency credit acts to stem the tide of foreclosures. But the main thrust was to restrict production. The Agricultural Adjustment Act (AAA), signed on May 12, became the foundation for FDR's agricultural relief programs. The ultimate goal was to raise the purchasing power of most agricultural products to their. 1909–1914 parity ratio. Seven "basic" commodities (wheat, cotton, rice, field corn, hogs, tobacco, and dairy products) were originally eligible for production controls (eight other commodities were added by 1935).

[35] Murray R. Benedict, *Farm Policies of the United States, 1790–1950: A Study of Their Origins and Development* (New York, 1953), 194–98, 216–31; Joseph G. Knapp, *The Advance of American Cooperative Enterprise, 1920–1945* (Danville, 1973), 6–16; Shideler, *Farm Crisis* 76–117.

[36] Shideler, *Farm Crisis*, 270, 389; Benedict, *Farm Policies*, 198, 239–66; Cochrane, *Development of American Agriculture*, 116–21; and Clifton B. Luttrell, *The High Cost of Farm Welfare* (Washington D.C., 1989), 6–11; David E. Hamilton, *From New Day to New Deal: American Farm Policy From Hoover to Roosevelt, 1928–33* (Chapel Hill, 1991), 26–49, 89–108.

The federal government guaranteed prices by granting farmers "nonrecourse loans" secured by commodities stored with the Commodity Credit Corporation (also established in 1933). The farmer could forfeit the commodities and keep the loan money if the price fell below the support level or reclaim the produce and repay the loan if the price rose above. In addition, farmers could contract with the government to remove land from production in return for a "benefit payment" for the foregone output. Over 25 percent of the nation's corn growers, over 60 percent of the hog producers, and over 40 percent of all wheat growers signed contracts. In the two leading wheat-growing states, Kansas and North Dakota, over 90 percent of all growers joined the program. To pay for these programs, the AAA levied a processing tax on farm products intended for the domestic market. Since for many products production was already underway, the AAA paid farmers to plow up acreage and slaughter piglets and pregnant sows. The destruction of 6 million baby pigs against a backdrop of massive unemployment and soup kitchens caused a public outcry, ending the slaughter program.

Between 1932 and 1935 nominal farm income and prices increased substantially, but the AAA's impact is unclear. The severe drought in the Great Plains and changes in international markets also significantly affected farm income. The programs did have many deleterious and unanticipated effects. The AAA was a bureaucratic nightmare; huge quantities of information had to be collected, thousands of contracts written, numerous appeals heard, etc. There were great incentives for farmers to overstate their base year production, and no doubt many did so. The details of these programs were administered at the local level, and there were charges of serious inequities favoring prominent farmers.[37] Numerous other problems arose. Land withdrawn from the production of basic commodities, such as corn, was often shifted into unregulated uses, such as pasture for cattle, thereby hurting the existing producers. Farmers tended to place their worst land into the government programs while intensifying production on the remaining land. Price support programs also hurt U.S. agricultural exports and encouraged restrictive trade policies at home and abroad.

The U.S. government was not alone in subsidizing agriculture; indeed, the activist policies of foreign nations make up an important element of the environment in which U.S. policy took shape. As an example, when the United States formulated its grain policies in the 1920s and 1930s,

[37] Theodore Saloutos, *The Farmer and the New Deal* (Ames, 1982), 73–6, 87–113.

virtually all wheat exporters and importers were already intervening aggressively. Following the failed attempts of Canadian farmers to cartelize the wheat trade in the 1920s, the Dominion government developed price stabilization and stockpiling programs and monopolized all exports, dumping surpluses abroad. Argentina and Australia also opted for subsidy programs and dumping. Agricultural subsidies, and not inherently wiser leadership, led these nations to expand their export shares during the Depression. In fact, it would be hard to find a more perverse policy than Australia's "grow more wheat campaign" of 1930, that spurred its farmers to produce record quantities of grain for export in the face of already glutted world markets. The result was financial disaster and enormous political turmoil. The early 1930s also witnessed the reemergence of the USSR in the wheat trade, as its exports soared to rival those of Argentina, the United States, and Australia.

The importing nations also intervened. Beginning in the mid-1920s Germany, Italy, and France began re-establishing their traditional barriers to agricultural trade, heavily subsidizing domestic production. Smaller nations followed suit, and by the early 1930s prohibitive tariffs and high domestic content provisions effectively closed many continental markets. Even Great Britain abandoned free trade in the 1930s, discriminating in favor of Commonwealth members. The combined effect of all these changes was dramatic. The volume of the world wheat trade fell by almost 45 percent from 1928 to 1935. Over this period the United States shifted from being a net exporter of 140 million bushels to a net importer of 31 million bushels of wheat.[38] The farm policies of Hoover and FDR, along with the Dust Bowl, no doubt contributed to the decline of U.S. exports; but another major culprit was the disintegration of world trade, the rise of protectionism, and the dumping activities of other commodity exporters. These international events help explain why relying on the world market as a vehicle for raising U.S. farm income in the early 1930s did not appear promising to New Dealers.

In January 1936, the U.S. Supreme Court declared the processing tax of the Agricultural Adjustment Act unconstitutional, but government

[38] Wilfred Malenbaum, *The World Wheat Economy, 1885–1939* (Cambridge, MA, 1953), 13–17, 154–170; Paul de Hevesy, *World Wheat Planning and Economic Planning in General* (London, 1940), 331–58, 375–93, Appendixes 9, 18, and 33; Jimmye S. Hillman, "Policy Issues Relevant to United States Agricultural Trade," in Alex F. McCalla and Timothy E. Josling, *Imperfect Markets in Agricultural Trade* (Montclair, 1981), 113–27; C. B. Schedvin, *Australia and the Great Depression: A Study of Economic Development and Policy in the 1920s and 1930s* (Sydney, 1970), 140–53; Michael Tracy, *Government and Agriculture in Western Europe, 1880–1988*, 3rd ed. (New York, 1989), 119–43, 149–61, 163–78, and 181–89.

intervention continued under the Soil Conservation Act (1936) and the second Agricultural Adjustment Act (1938). The second AAA became the organic legislation for many farm support programs over the next several decades. The New Deal also added other crops, created marketing control boards for speciality crops, allowed farmers to renegotiate contracts and reacquire farmsteads lost to banks, and subsidized credit, crop insurance, and exports.[39]

The Post–World War II Record

In recent decades debate over the wisdom and need for commodity programs has grown. In 1949 USDA Secretary Brannan proposed a major streamlining of the programs, replacing price subsidies with direct income payments and setting a maximum amount any one farmer could receive. These proposals failed because large commercial farmers opposed limits on subsidies and feared that income support payments would be more visible and thus attract more public criticism. High price supports led to embarrassing accumulations of surplus stocks through the 1950s and early 1960s. One response was the Agricultural Trade Development and Assistance Act of 1954. The act heavily subsidized the export of surplus commodities to foreign countries as part of the overall foreign aid programs. Although this program is generally seen as a humanitarian effort, many critics have noted that its longer run impact may have been counterproductive because it increased many nations' dependency on food imports by undercutting indigenous producers. In any case, U.S. surpluses continued.

In the early 1960s there was a significant shift away from commodity loans and stockpiling toward voluntary acreage diversion programs and direct price support payments. Now, in addition to a loan program with the government taking physical possession of crops, participating farmers could opt to sell on the open market and receive a "deficiency payment" covering the difference between the market price and a previously announced official "support price." To qualify, farmers had to contract before planting and agree to idle or "set-aside" a share, typically 10 to 20 percent of their base acreage. Over the 1960s the government let the loan rate fall relative to the support price, causing government surpluses to

[39] See Wayne Rasmussen and Gladys L. Baker, *Price-Support and Adjustment Programs from 1933 through 1978: A Short History*, U.S. Economic Research Service (Washington, D.C., 1979), and Bruce L. Gardner, " Why, How, and Consequences of Agricultural Policies: United States," in *Agricultural Protectionism in the Industrialized World*, Fred H. Sanderson, ed., (Washington D.C., 1990), 19–63.

decline and direct payment costs to increase. The Agricultural Act of 1965 solidified these changes and brought new commodities under the federal umbrella. In the late 1970s and early 1980s increases in the loan rate relative to support prices led to a renewed buildup of agricultural stocks. In response to revelations that some farmers were receiving support checks in excess of $1 million, the 1970 Agricultural Act put a $55,000 per crop cap on the direct payments to one individual producing feed grains, wheat, and upland cotton. Predictably, large-scale farmers often divided their businesses among family members or took other measures to end run the intent of the law.

There have been numerous other program changes, but one of the most important was the Payment in Kind (PIK) experiment of 1983. The lack of political resolve to lower high support prices and loan rates in the early 1980s led to growing stockpiles of wheat, feed grains, and cotton. PIK added to the already existing acreage reduction programs, allowing farmers to withdraw an additional 10–30 percent of their base acreage in exchange for title to commodities in the Commodity Credit Corporation stockpiles. The result was one of the largest acreage reduction programs in U.S. history, idling 20 percent of U.S. cropland (77 million acres); PIK was also one of the most expensive programs ($78 billion dollars), with many farmers receiving commodities valued at hundreds of thousands of dollars. Most observers consider PIK a failure because the stock reductions were only temporary and because the sudden and drastic cut in land cultivated seriously harmed many farm suppliers and workers. The Food Security Act of 1985 recognized that lowering price supports and especially loan rates were necessary to reduce the accumulation of stocks and increase American export competitiveness.

A Critical Look

In the 1980s President Reagan campaigned on a platform of getting government off the peoples' backs, championing deregulation and welfare reform. But this philosophy was not applied to welfare programs for wealthy farms. Some cows are, indeed, sacred. The mid-1980s were the costliest years ever in American farm-policy history, with federal outlays on price support programs averaging over $20 billion a year in 1986–1988. This was only part of the story, because farmers also benefited from higher prices paid by consumers. These programs created inefficiencies with substantial deadweight loss. Over the period 1984–1987 one set

of estimates suggests that American farmers received an average annual gain of $12.8 billion. The average cost to the federal government was $13.8 billion a year, and American consumers lost another $5.8 billion annually, for a total cost of $19.6 billion. This means that the programs cost domestic consumers and taxpayers about $1.53 for every dollar received by farmers. A key point is that the rural poor and struggling family farmers saw little of this largesse, while large operators often struck it rich. Estimates for specific commodities indicate that in 1983, on average, U.S. sugar growers received about $70,000 each in total benefits, and in 1989 rice farmers received an average of about $45,000 each – some individuals, of course, received far larger sums. Results of this sort are not new; economists have generated similar findings for decades, but somehow the support programs have remained relatively immune from the budget axe.[40]

It is understandable how 25 percent of the population, many suffering extreme financial distress in the 1930s, might convince the federal government to grant them economic relief. It is less obvious how the 2 percent of the population remaining on farms continues to receive such special treatment. The problem gets more complicated as one looks closer. First, a large proportion of the benefits go to a relatively few wealthy farmers. Secondly, large segments of American agriculture have no programs and rely on the market to direct resources and allocate profits. Corn and wheat have programs, but soybeans and potatoes do not; rice, sugar, and milk producers all receive large amounts, but fruit, vegetable, chicken, and egg farmers are left out. Any general explanation of the political economy of agricultural subsidies will not only have to deal with such commodity differences but will also have to take into account that subsidies are a worldwide phenomenon. As a general rule, poor countries with high percentages of their populations in agriculture tend to tax their farmers. But, as development progresses and countries get richer and the relative size of the agricultural population shrinks, there is a reversal of policy, with farmers receiving subsidies.[41]

[40] The difference between the sum of the cost to taxpayers and consumers and the benefits received by farmers is called the deadweight loss. These estimates depended crucially on estimates of the elasticity of supply and demand. As noted above, such estimates are in dispute; see Gardner, "Changing Economic Perspectives," 89.

[41] Kym Anderson and Yujiro Hayami, *The Political Economy of Agricultural Protection* (Sydney, 1986); Bruce L. Gardner, "Causes of U.S. Farm Commodity Programs," *Journal of Political Economy* 95 (1987), 290–310; Peter H. Lindert, "Historical Patterns in Agricultural Policy," in C. Peter Timmer, ed., *Agriculture and the State* (Ithaca, 1991).

Table 12.7. *Producer subsidies as a percentage of the total value of farm output, 1990*

	Percentage
Australia	11
Austria	46
Canada	41
European Common Market	48
Finland	72
Japan	68
New Zealand	5
Norway	77
Sweden	59
Switzerland	78
United States	30

Source: OECD, *Agricultural Policies, Markets and Trade: Monitoring and Outlook, 1991* (Paris, 1991), 9–29.

Since World War II there has been a general movement toward freer trade, but agriculture remains a major stumbling block because most industrial nations still choose to protect their farmers. In 1990 the percentage of gross farm income that resulted from government protection and subsidies varied from about 5 percent in New Zealand to 78 percent in Switzerland. (See Table 12.7.) The level of subsidies in the United States (about 30 percent) is well below that of many of its trading partners, including Japan and most Western European nations. It is an interesting, but unresolved, question how a small and declining segment of the population has managed to secure subsidies in virtually every industrialized nation, representing a broad range of political and national traditions.

Recent attempts to explain the pattern and level of agricultural subsidies, employing Olson's theory of collective action and Becker's theory of efficient redistribution, to date have borne little fruit.[42] There appears to be a path dependency that these theories fail to capture. History has shown that subsidies, once introduced, become entitlements that are almost

[42] Mancur Olson, *The Logic of Collective Action* (Cambridge, MA, 1965); Gary S. Becker, "A Theory of Competition Among Pressure Groups for Political Influence," *Quarterly Journal of Economics* 98 (1983), 371–400; James T. Bonnen and William P. Browne, "Why is Agricultural Policy So Difficult to Reform," in Carol S. Kramer, ed., *The Political Economy of U.S. Agriculture: Challenges for the 1990s* (Washington, D.C., 1989), 7–36.

impossible to abolish, even during periods of prosperity. In addition, farm producer groups have consistently opted for indirect payments that purportedly address larger social goals, such as conservation or alleviating rural poverty; direct payments would be more efficient, but they are too visible and more likely to be opposed. Across the industrialized countries, consumers and taxpayers appear to be willing to pay a high price to appease farmer demands and ostensibly to enhance "food security" and to preserve "a traditional way of life."

In the mid-1990s there were signs that the support for farm subsidies was beginning to crack. In response to ideological shifts in favor of a reliance on market forces rather than government intervention, the Federal Agricultural Improvement and Reform Act (FAIR) was passed in 1996. This bill ushered in important changes in farm policy by increasing the role of market forces in planting decisions and reducing the distortions inherent in the previous commodity programs. Over a span of seven years, the act scheduled small and gradual decreases in the level of subsidy payments to farmers. Payments continued in accordance with the law's intent in 1996 and 1997 when farm prices were high, but when prices collapsed in 1998 the federal government increased payments by 50 percent. Once again short run political expediency stifled plans for a general overhaul of a long outdated subsidy program. But there was a distinct difference from past episodes. By 1998 almost all price support programs had been abolished and the federal government had resorted to simply passing out cash to "qualified farmers," a group that included many recipients who no longer were active farmers, but who qualified because their land had received payments in an earlier period. Many observers think that this new transparency in the farm subsidy program will help galvanize opposition and speed up the eventual demise of farm subsidies.

THE FUTURE OF AGRICULTURE

Many of the changes in northern agriculture over the past eighty years have paralleled what has happened elsewhere in society. Other producers have seen their markets contract as new products, technologies, and sources of competition reshaped economic relationships. Other industries have also experienced technical and structural changes that have raised worker productivity and vastly increased the size of firms. Yet, outside of agriculture, there has been little support for efforts to preserve jobs or block new

technologies. Clearly, in the public eye, there is something different about farming. It is appealing to be one's own boss, to work hard in communion with nature to produce an essential commodity, and to carry on a tradition and a way of life. Even though many popular perceptions seem at odds with the facts of modern agriculture, the myth of the Jeffersonian farmer lives on.

The America that gave rise to this ideal was a place where ordinary people could easily acquire land and be independent. Working permanently under another's thumb was a foreign notion. As late as 1910 this ideal for organizing society still had some reality in northern agriculture. Today it is gone for all but a few, and no set of crop support programs will bring it back. Commodity programs have been a costly failure. They have not promoted the broad social purposes claimed of them and should be phased out. American farmers compete quite well in unsubsidized crops and if weaned from the federal programs could compete in most others.[43] Eliminating subsidies would lead to some substitutions – for example, if sugar prices were to fall to world levels, imports would displace much of the domestic production – and there would be some additional movement out of agriculture, continuing the long-term process of structural change.

Even with the enormous changes in agricultural structure, certain characteristics have endured. Despite the spread of corporate farming and hired labor, the basic unit of operation is still the family farm. Despite the government programs, many sectors of agriculture remain highly competitive and most farmers remain price-takers. Because farming requires detailed knowledge of local conditions, quick managerial response to changing situations, and effective supervision of a dispersed work force, a decentralized family form of management continues to offer advantages. In some activities, such as broiler-and-egg production and livestock feed lots, significant economies of scale offset these advantages, resulting in a highly concentrated structure more characteristic of manufacturing. Such concentration is not likely to become a general feature of American agriculture. It is important to recognize that even if there are future structural shifts, their economic and social impacts are likely to be small compared with those that already have occurred. There are only about one million viable commercial farmers in the United States today, so even if one-half went out of business over the next decade, the absolute number of people

[43] The concern for rural poverty is no longer primarily a farm issue and should be dealt with through general income maintenance and job training programs.

leaving agriculture would be relatively small, compared to the exodus of the 1945–1970 period.

The past eighty years have witnessed significant changes in the relationship between farmers and their natural environment. Fossil fuels for internal combustion engines have replaced farm-grown feed for horses, artificial irrigation has transformed the arid West, and a whole range of new chemicals have become part of the food production process. These changes have raised questions concerning the "environment sustainability" of current agricultural technologies and practices. Is it possible to continue employing these methods without fundamental change, and if not, how will this change take place? Critics of the agricultural establishment focus on topsoil erosion, groundwater contamination and depletion, the buildup of toxic residuals, the development of chemical resistance by pests, the dependence on non-renewable resources, such as petroleum, and urban encroachment onto "prime agricultural lands."

Some of these concerns are overblown, while others point to real problems. On the one hand, the loss of prime agricultural land to cities does not appear to be an issue that the market cannot handle. The dependence on petroleum and other non-renewable resources may become a problem in the very long run; by definition, society cannot continue using non-renewable resources at the present rate forever. But the immediate policy implications of this truism are far from clear.[44] Recognizing that predicting the future is inherently difficult, our reading is that this will not become serious in the next several decades. If problems begin to arise, numerous relatively small technical and economic adjustments, such as increased reliance on methanol, will occur without great difficulty. (This, incidentally, will increase the demand for agricultural products.) On the other hand, using present techniques, irrigation in the western United States is not sustainable at its current level, due to increasing salinity and decreasing reserves of ground water. Here, as well as with issues of erosion, toxic wastes, and pest resistance, there are often fundamental externality and common property resource problems, giving rise to a need

[44] Optimists argue that three forces – resource discovery, factor substitution, and most importantly, technological change – will almost surely come to the rescue. Pessimists doubt that such changes will come soon enough to prevent soaring production costs and serious dislocations. The optimists can point, with considerable justification, to an historical record that is literally crammed with "shortages" that were solved by economic and technical adjustments. The pessimists can point to civilizations that disappeared because they mismanaged the environment. We see no need for government action with respect to fossil fuels, apart perhaps for modest support for basic research and taxing fuel to account for pollution externalities or the national security costs of assuring supplies. These are national, not just agricultural, issues.

for collective action. This action can take several forms, including redefining and establishing property rights to provide incentives for more environmentally responsible behavior.[45]

The greatest future changes in the relationship between farmers and their environment most likely will come not from continued use of current practices but from scientific developments. There are strong indications that we are still in the infancy of the biological-genetic revolution. Genetic breakthroughs already available include growth hormones that can greatly increase the efficiency of feed use in animal production and genetic alterations that significantly increase plant tolerance to salinity and to temperature extremes and that enhance plant resistance to pests and diseases. This is new terrain, with the U.S. Patent Office first extending patent protection to genetically engineered plants in 1985 and to animals in 1988. Many assessments of this technology see almost unlimited possibilities – introducing whale genetic material to produce huge cows, developing plants capable of fixing their own nitrogen, and the cloning of animals to reproduce desirable traits, to name but a few. There are serious political, legal, and moral issues that need to be resolved, and the opposition to altering and patenting life forms is as strong as ever existed to any agricultural innovation. If the reality is anything like the rhetoric, there are apt to be benefits that will make those of hybrid corn seem minor. But, there also may be mistakes that make killer bees, kudzu, and DDT seem trivial. Besides increasing the efficiency of (roughly) existing crops and animals, the new genetic technologies offer the possibility of creating entirely new products and markets, redefining the frontiers of agriculture.[46] The future of American agriculture promises to be as dynamic and controversial as its past.

[45] Clive A. Edwards, et al., *Sustainable Agricultural Systems* (Ankeny, IA, 1990); John P. Reganold et al., "Sustainable Agriculture," *Scientific American* 262 (1990), 112–20.

[46] U.S. Office of Technology Assessment, *Technology, Public Policy, and the Changing Structure of American Agriculture*, OTA-F-285 (Washington, D.C., 1986); Chuck Hasselbrook and Gabriel Hegyes, *Choices for the Heartland: Alternative Directions in Biotechnology and Implications for Family Farming, Rural Community, and the Environment* (Ames, 1989); J. Persley, *Beyond Mendel's Garden: Biotechnology in the Services of World Agriculture* (Wallingford, England, 1990); L. Christopher Plein and David J. Webber, "Biotechnology and Agriculture in the Congressional Policy Arena," in Kramer, ed. *The Political Economy of U.S. Agriculture*. 179–200.

CHAPTER 12 (OLMSTEAD AND RHODE)

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