

Chapter 3 DEVELOPMENTS IN AGRICULTURE AND MANUFACTURING: 1920-1940

Agriculture

The onset of the First World War in Europe brought unprecedented prosperity to American farmers. As agricultural production in Europe declined, the demand for American agricultural exports rose, leading to rising farm product prices and incomes. In response to this, American farmers expanded production by moving onto marginal farmland, such as Wisconsin cutover property on the edge of the woods and hilly terrain in the Ozark and Appalachian regions. They also increased output by purchasing more machinery, such as tractors, plows, mowers, and threshers. The price of farmland, particularly marginal farmland, rose in response to the increased demand, and the debt of American farmers increased substantially.

This expansion of American agriculture continued past the end of the First World War as farm exports to Europe and farm prices initially remained high. However, agriculture production in Europe recovered much faster than most observers

had anticipated. Even before the onset of a short depression in 1920, farm exports and farm product prices had begun to fall. During the depression, farm prices virtually collapsed. From 1920 to 1921, the consumer price index fell 11.3 percent, the wholesale price index fell 45.9 percent, and the farm products price index fell 53.3 percent.¹

Average net income per farm fell over 83 percent in current dollars and, though rising in the twenties, never recovered the relative levels of 1919 and 1920. Farm mortgage foreclosures rose and stayed at historically high levels for the entire decade of the 1920s. As Figure 3.1 shows, the value of farmland and buildings fell throughout the twenties and, for the first time in American history, the number of cultivated acres actually declined as farmers pulled back from the marginal farmland brought into production during the war. Rather than indicators of a general depression in agriculture in the twenties, these were the results of the financial commitments made by overoptimistic American farmers during and directly after the war. The

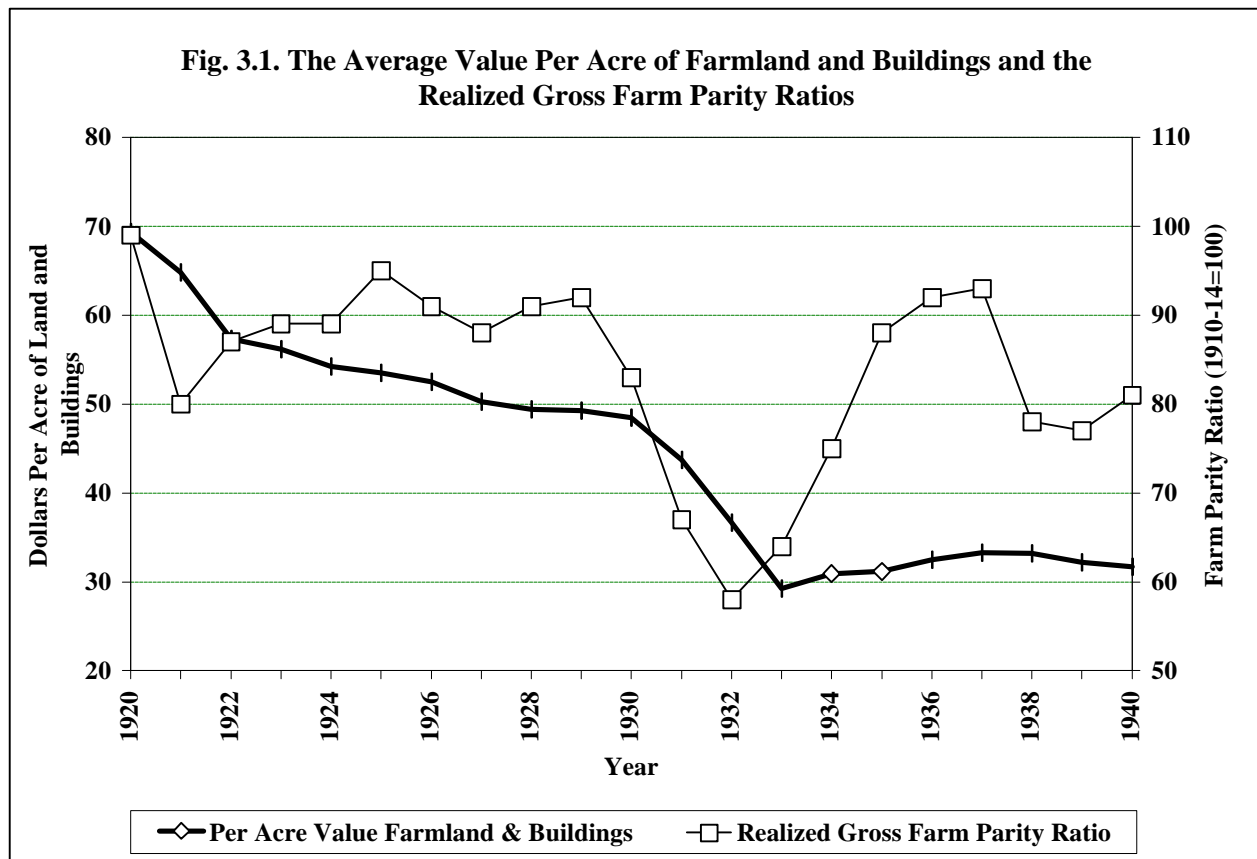


Fig. 3.2. The Average Net Income per Farm and the Ratio of Farm to Nonfarm Incomes



foreclosures were generally on second mortgages rather than on first mortgages as in the early 1930s.²

The onset of the Great Depression in 1929 plunged American agriculture into a severe depression. The prices of some farm products had weakened in 1928 and 1929 and this had provided the impetus for the Hawley-Smoot Tariff of early 1930. The combination of the domestic depression and contracting world trade sharply decreased farm exports, and farm product prices plummeted, as the parity price ratio fell from 92 in 1929 to 67 in 1931. The average value per acre of farmland and buildings fell from \$49.25 in 1929 to \$29.28 in 1933, and gross and net farm income fell 54 and 66.8 percent from 1929 to 1932, respectively. Average net income per farm fell from \$945 in 1929 to \$304 in 1932. Farm mortgage foreclosures, which had been historically high at 14.7 per thousand in 1929, rose to an astounding 38.8 per thousand in 1933. (See Figures 3.1 to 3.3.)

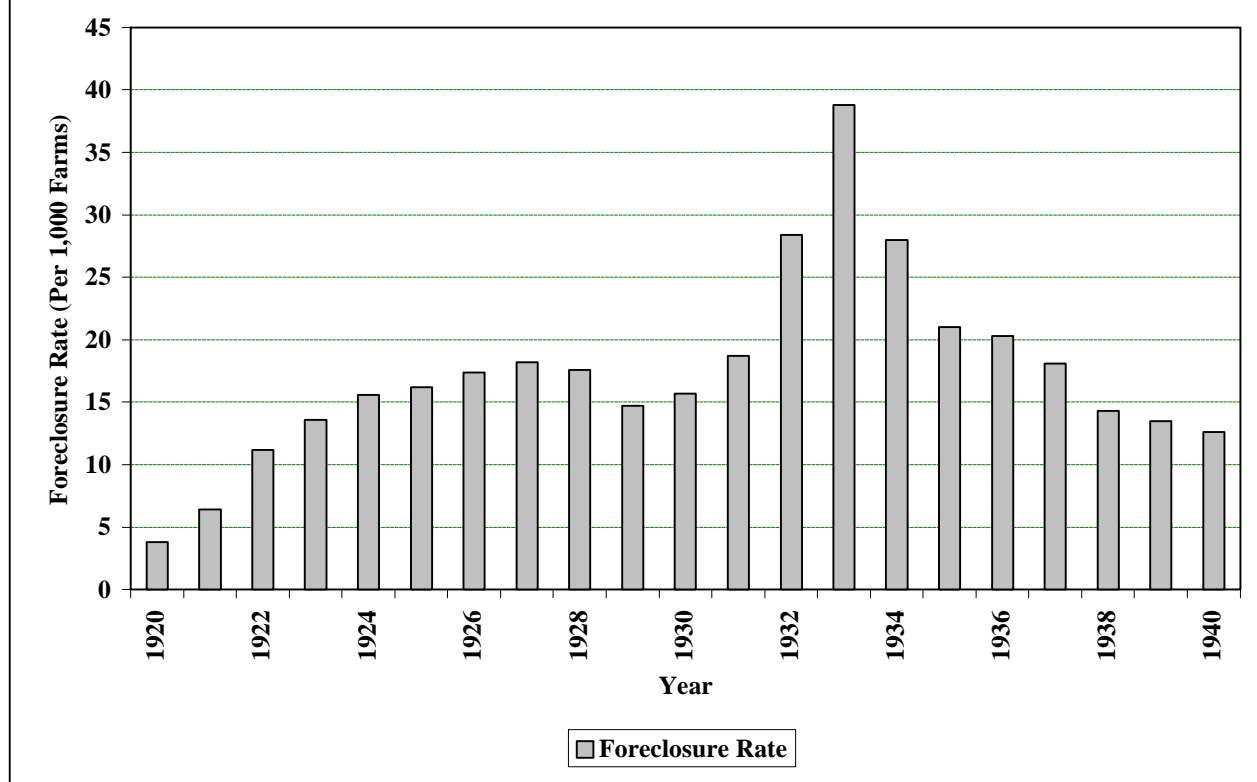
Many farmers fiercely protested the depressed prices and the mortgage foreclosure crisis. Milk was dumped into the streets rather than sold at the prevailing low prices, and “holidays,” or strikes, during which no agricultural products were to be brought to market and sold, were declared. As the depression continued, more and more farmers became delinquent on their mortgages, and the

number of foreclosures soared. Sporadic incidents of violence began to accompany the foreclosure sales in late 1932 and 1933, and farmers stopped a few sales.³

The economic distress in the farming sector led 25 states to enact farm foreclosure moratoria between 1932 and 1934.⁴The Supreme Court upheld the constitutionality of this legislation in 1934 when it ruled in favor of the Minnesota statute.⁵ Lee Alston’s research indicates that this assistance came at the expense of the creditors (who were prohibited from foreclosing) as well as prospective borrowers. Private lenders reacted to the moratoria by rationing mortgage loans through a tightening of eligibility requirements and by raising mortgage interest rates more in states where moratoria had been enacted.⁶

The federal government soon developed more direct ways to alleviate the farmers’ distress. The Roosevelt administration’s first step in 1933 was to attempt to reduce the supply of some agricultural products through the “plow-up” and “kill” campaigns.⁷Over 6,000,000 pigs and 220,000 soon-to-farrow sows were destroyed to reduce the potential oversupply of pork.⁸About one quarter of the cotton crop, or 10,000,000 acres, were plowed under, as were 12,000 acres of tobacco. In California the growers were paid to let cling peaches rot in the orchard.⁹Two Agricultural Adjustment Acts attempted to raise prices by limiting production and

Fig. 3.3. Farm Mortgage Foreclosure Rates



imposing price supports, though the severe droughts of 1934 and 1936 probably had more effect in temporarily raising prices.¹⁰

A Declining Sector

A major difficulty in analyzing the interwar agricultural sector lies in separating the effects of the 1920-21 and 1929-33 depressions from those that arose because agriculture was in decline overall. Economic growth as a whole plus rising productivity in farming required a shift of resources, particularly labor, out of agriculture. The market induces labor to voluntarily move from one sector to another through income differentials, suggesting that even in the absence of the effects of the depressions, farm incomes would have been lower than nonfarm incomes so as to bring about this migration.

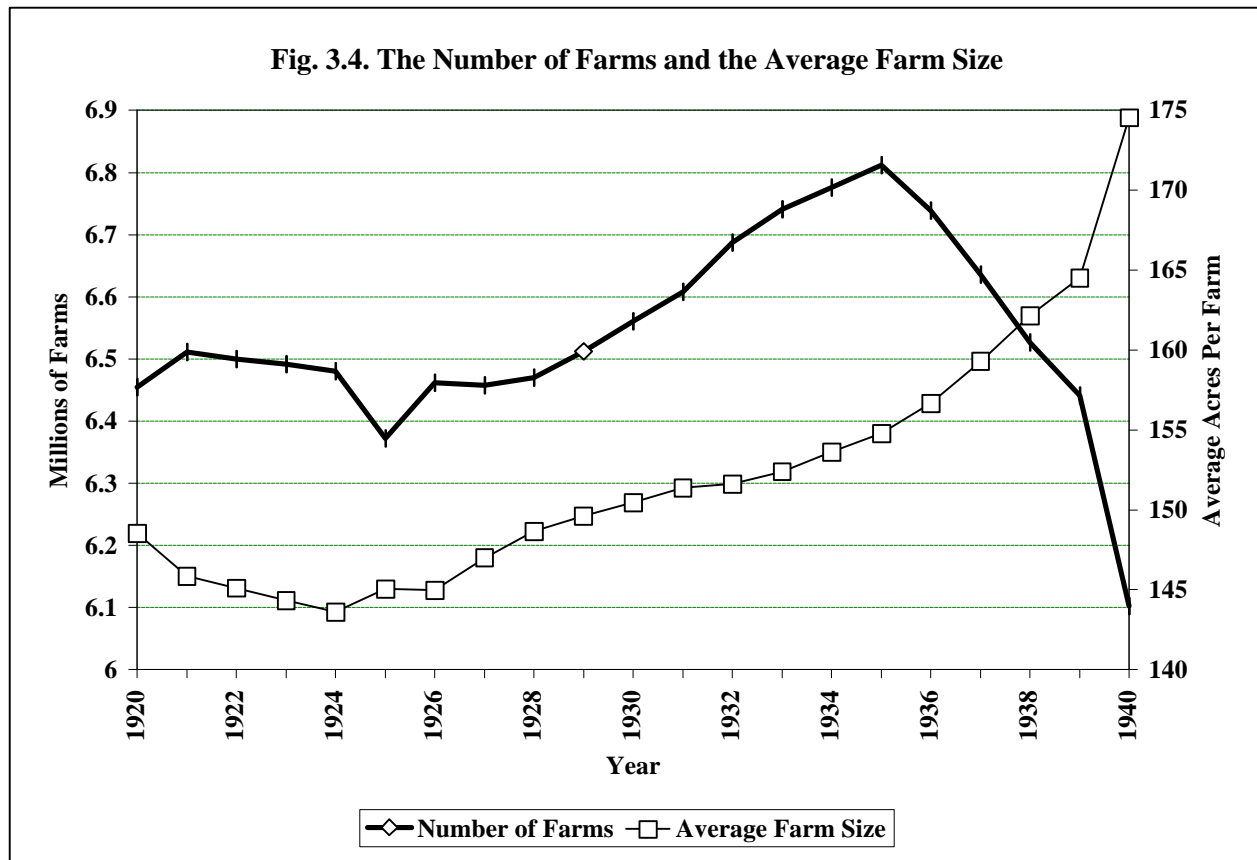
Farm employment fell throughout the interwar period—especially after 1935. There was little change in the number of farms during the 1920s but as people moved back to the farms during the depression, the number of farms increased. After 1936 the number of farms once again began to fall. The average farm size was roughly constant from 1919 through 1926 at about 144 to 145 acres. In 1927 farm sizes began to increase; by 1940 the average farm had grown to 174 acres. (See Figure 3.4.)

The continuous substitution of tractor power for horse and mule power released hay and oats acreage to grow crops for human consumption. Though cotton and tobacco continued as the primary crops in the south, the relative production of cotton continued to shift to the west as production in Arkansas, Missouri, Oklahoma, Texas, New Mexico, Arizona, and California increased. As quotas reduced immigration and incomes rose, the demand for cereal grains declined, and the demand for fruits, vegetables, and dairy products grew. Refrigeration and faster freight shipments expanded the milk sheds further from metropolitan areas. Wisconsin and other North Central states began to ship cream and cheeses to the Atlantic Coast. Due to transportation improvements, specialized truck farms and the citrus industry became more important in California and Florida.¹¹

The decline of the agricultural sector in the interwar period was closely related to the highly inelastic income elasticity of demand for many farm products, particularly cereal grains, pork, and cotton. As incomes grew, the demand for these staples grew much more slowly. At the same time, rising land and labor productivity was increasing the supplies of staples, causing real prices to fall.

Table 3.1 presents selected agricultural productivity statistics for these years. Those data

Fig. 3.4. The Number of Farms and the Average Farm Size



indicate that there were greater gains in labor productivity than in land productivity (or per acre yields). Per acre yields in wheat and hay actually decreased between 1915-19 and 1935-39. These productivity increases, which released resources from the agricultural sector, were the result of technological improvements in agriculture.

Technological Improvements In Agricultural Production

In many ways the adoption of the tractor in the interwar period symbolizes the technological changes that occurred in the agricultural sector. This changeover in the power source that farmers used had far-reaching consequences and altered the organization of the farm and the farmers' lifestyle. The adoption of the tractor was land saving (by releasing acreage previously used to produce crops for workstock) and labor saving. At the same time it increased the risks of farming because farmers were now much more exposed to the marketplace. They could not produce their own fuel for tractors as they had for the workstock. Rather, this had to be purchased from other suppliers. Repair and replacement parts also had to be purchased, and sometimes the repairs had to be undertaken by specialized mechanics. The purchase of a tractor also commonly required the purchase of new

complementary machines; therefore, the decision to purchase a tractor was not an isolated one.¹²

The gasoline-powered tractor had been improving since its introduction in 1892. Generally the improvements involved making it lighter, more powerful, and more dependable through replaceable parts, higher-grade steel, ball and roller bearings and many other changes. These also reduced the need for routine maintenance. The introduction of the two-cylinder engine made the large, heavy flywheel less important, but it remained on tractors because it provided a source of versatile belt power for washing machines, grinding mills, power saws, water pumps, and so on.

The first small tractor, the Fordson, appeared in 1917. In 1922 International Harvester introduced a row-crop tractor with small tricycle front wheels and width-adjustable rear wheels so that tractors could plant, cultivate, and harvest row crops such as corn. It also pioneered the power takeoff that allowed implements to operate at constant speeds independently of the speed at which the tractor and implement were moving. Power was transferred from the tractor engine to the implement through drive shafts with universal joints. In 1929 Allis-Chalmers introduced a rubber-tire tractor. The rubber tires with large raised cleats dug flexibly into the earth, giving better traction and pulling power and allowing it to

TABLE 3.1.
SELECTED AGRICULTURAL PRODUCTIVITY STATISTICS, 1915-1939.
 (Annual Averages)

Period	Labor-Hours Per Unit							Per Acre Yields			
	Wheat 100 Bush.)	Corn 100 (Bush)	Cotton (Bales)	Hay (Tons)	Milk (Cwt)	Beef (Cwt)	Hogs (Cwt)	Wheat (Bush.)	Corn (Bush.)	Cotton (Lbs.)	Hay (Ton)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1915-19	98	132	299	10.4	3.7	4.5	3.6	13.9	25.9	168	1.2
1920-24	90	122	296	10.2	3.6	4.5	3.5	13.8	26.8	155	1.2
1925-29	74	115	268	9.8	3.3	4.3	3.3	14.1	26.3	171	1.2
1930-34	70	123	252	9.5	3.4	4.3	3.2	13.5	23.0	184	1.0
1935-39	67	108	209	9.1	3.4	4.2	3.2	13.2	26.1	226	1.2
Percent Change											
1915-19 to											
1935-39	-31.6	-18.2	-30.1	-12.5	-8.1	-6.7	-11.1	-5.0	0.8	34.5	-0.8

Source: *Historical Statistics of the United States: Colonial Times to 1970* (Washington: U.S. Government Printing Office, 1976).

travel on surfaced roads, something that tractors with spade lug metal tires could not do. Rubber-tired tractors were more comfortable, faster, decreased fuel consumption by 10 to 20 percent, and reduced repair costs.

These changes resulted in more and more farmers purchasing and using tractors, but the rate of adoption varied sharply across the United States. By 1940, 50 to 60 percent of the farms in the North Central states had tractors. Adoption was slower in California, where in 1939 only 33 percent of the farms used tractors, and much slower in the south.¹³ This relatively slow adoption rate seems puzzling because studies showed that farming costs were lower with tractors than horses or mules for most of the relevant farm sizes in the thirties.¹⁴ However, there were some rational reasons why farmers were reluctant to adopt a tractor-based technology.

The costs associated with the tractor involved cash outlays, whereas much of the costs associated with horses and mules were opportunity costs not involving cash. During the depression, many farmers reduced their risks by sticking with horses and mules whose fuel they could provide.¹⁵ As mentioned, the change to tractor power involved a considerable increase in the commercialization of the farm. In the south many farms were too small to utilize a tractor.¹⁶ The smaller size of farms and lag in mechanization in the south reflected the annual labor contract implicit in the sharecropping or share

tenancy arrangement. Mechanization would have required consolidating the small tenant farms, and hiring labor, but with very thin labor markets and an extremely seasonal demand, plantation owners found it was much easier to establish yearly labor contracts through sharecropping arrangements.¹⁷ There was a rapid resumption of tractor purchases beginning in 1934 as the New Deal programs reduced farmers' debt burdens and guaranteed production costs and crop prices, freeing farmers from the strategies of minimizing cash outlays for safety against price collapses and thereby making investment in the more efficient tractors more attractive.¹⁸

In the cornbelt the purchase of a tractor was also dependent on the development of hybrid seed corn and mechanical corn pickers.¹⁹ In the late 1930s hybrid seed corn was perfected and began to be marketed by commercial seed companies. The rate of adoption of hybrid seed corn was determined by its profitability, so it was adopted most quickly by farmers in the corn belt where more corn was planted and the increase in production and profits was largest.²⁰ Though experiments dated back to the 1890s it took until the 1930s to create varieties that "stood straight on strong root systems and produced ears at a uniform height on strong shanks" and ripened more uniformly so that mechanical corn pickers could be used.²¹

The first practical pickers dated from the early 1900s but the early machines were far from satisfactory and were used only by the very large

farms. In the late 1920s and early 1930s two-row corn pickers were developed that operated off of the power takeoff. The Great Depression slowed sales, but by 1937 sales of these mechanical corn pickers surpassed the sales figures of the late 1920s.²²

The tractor, corn picker, and hybrid seed corn came together to raise labor and land productivity in corn production in the late 1930s. As Allan Bogue notes, “Not until the development of the general-purpose tractor with power take-off did an efficient mechanical picker become possible. That machine, however, was not cost efficient for some Corn Belt farmers until hybrid corn minimized the loss of grain experienced in mechanical picking.”²³

These changes in Corn Belt farming also brought on other changes. Because the tractor, mechanical corn picker, and hybrid seed corn were labor saving, they allowed an individual farmer to farm more land, and farm sizes began to increase to take advantage of this. In addition the use of “itinerant or local labor” during the picking season diminished sharply because of the mechanical picker’s ability to pick all of the farmer’s corn.²⁴

These changes were, by no means, limited to corn production. Tractor development helped alter grain harvesting as the binder was improved and quickly was adapted to the power takeoff in the early 1920s. Milking machines first appeared in 1905 and continued to be developed and adopted during the interwar period. Estimates suggested that on dairy farms these machines saved an average of 28 hours of labor per cow per year.

Technological innovations in plants and animals also raised productivity. Hybrid seed corn increased yields from an average of 40 bushels per acre to 100 to 120 bushels per acre. New varieties of wheat were developed from the hardy Russian and Turkish wheat varieties which had been imported. The U.S. Department of Agriculture’s Experiment Stations took the lead in developing wheat varieties for different regions. For example, in the Columbia River Basin new varieties raised yields from an average of 19.1 bushels per acre in 1913-22 to 23.1 bushels per acre in 1933-42.²⁵ New hog breeds produced more meat²⁶ and new methods of swine sanitation sharply increased the survival rate of piglets.²⁷ Insemination of dairy cattle developed in the late 1930s, allowing bulls of proven ability to impregnate many more cows. This contributed to an average increase of nearly 14 percent in milk production per cow between 1937 and 1947.²⁸ An effective serum for hog cholera was developed,²⁹ and the federal government led the way in the testing and eradication of bovine tuberculosis and brucellosis. The development and use of sulfa drugs in the late 1930s helped control animal bacterial infections.³⁰

Prior to the Second World War, a number of pesticides to control animal disease were developed, including cattle dips and disinfectants. By the mid-1920s a vaccine for “blackleg,” an infectious, usually fatal disease that particularly struck young cattle, was completed. The cattle tick, which carried Texas Fever, was largely controlled through inspections.³¹

These productivity developments began to come together in the late thirties. The increasing adoption of the tractor and other implements allowed farmers to farm increasingly larger farms, and farm employment began to fall more swiftly. The new hybrid varieties of seed corn, wheat, and other grains began raising yields more rapidly at the very end of the thirties. These changes were the initial results of a revolution in agricultural productivity that would come to fruition after the Second World War.

Federal Agricultural Programs in the Interwar Period

Though there was substantial agricultural discontent in the period from the Civil War to late 1890s, the period from then to the onset of the First World War was relatively free from overt farmers’ complaints. In later years farmers dubbed the 1910-14 period as agriculture’s “golden years” and used the prices of farm crops and farm inputs in that period as a standard by which to judge crop and input prices in later years. The problems which arose in the agricultural sector during the twenties once again led to insistent demands by farmers for government to alleviate their distress.

Though there were increasing calls for direct federal government intervention to limit production and raise farm prices, this was not used until Roosevelt took office. Rather, there was a reliance upon the traditional method to aid injured groups—tariffs, and upon the “sanctioning and promotion of cooperative marketing associations.”³² In 1921 Congress attempted to control the grain exchanges and compel merchants and stockyards to charge “reasonable rates,” with the Packers and Stockyards Act and the Grain Futures Act. In 1922 Congress passed the Capper-Volstead Act to promote agricultural cooperatives and the Fordney-McCumber Tariff to impose high duties on most agricultural imports. The Cooperative Marketing Act of 1924 did not bolster failing cooperatives as it was supposed to do.³³

Twice between 1924 and 1928 Congress passed “McNary-Haugan” bills, but President Calvin Coolidge vetoed both. The McNary-Haugan bills proposed to establish “fair” exchange values (based on the 1910-14 period) for each product and to maintain them through tariffs and a private corporation that would be chartered by the

government and could buy enough of each commodity to keep its price up to the computed fair level.³⁴ The revenues were to come from taxes imposed on farmers. The Hoover administration passed the Hawley-Smoot tariff in 1930 and an Agricultural Marketing Act in 1929. This act committed the federal government to a policy of stabilizing farm prices through several nongovernment institutions but these failed during the depression.

Under Roosevelt's new Democratic administration, there was a change in the federal government's agricultural policies. The Agricultural Adjustment Act of 1933 was a resurrected form of the McNary-Haugan bills. Its purpose was to restore "parity prices" such as had existed in 1910-14. The AAA required the department of agriculture to determine the total acreage of major crops and then subdivide this into first state and then individual farm allotments on the basis of each farm's recent history. Farmers were paid to cut acreage through a "benefit payment" or an "adjustment payment"; the payments were financed by a processing tax imposed on the first processors of any product. In 1936 the AAA was declared unconstitutional because the processing tax was an attempt to regulate intrastate agricultural production, a power reserved for the states. Congress then passed the Soil Conservation and Domestic Allotment Act to replace it. This act changed the basis for making acreage allotments so that soil conservation was being encouraged. The act attempted to restore parity prices by reducing crop production rather than acreage, but 1937 production levels were still quite high.

In 1938 a new (or second) Agricultural Adjustment Act was passed. New acreage allotments were created while maintaining the Soil Conservation and Domestic Allotment Act. A Commodity Credit Corporation (CCC) had been established in 1933 to make nonrecourse loans on agricultural commodities. If the price of the commodity fell, the farmer let the CCC take title to the stored commodity, thus canceling the debt and the interest owed. If the price rose, the farmer sold the commodity, paid back the debt and interest, and kept the profit. The loan rate became, in effect, the minimum price. From 1933 to 1937 the CCC carried out its operations with only vague price objectives. The new AAA of 1938 increased the power of the CCC and made it mandatory that loans be extended on corn, wheat, and cotton at rates between 52 and 75 percent of parity. The AAA also established a Federal Crop Insurance Corporation, under which farmers were insured for an amount up to a specific percentage of their normal yield.

Marketing quotas became important after 1936. With these the secretary of agriculture was empowered to set upper limits on the quantities to be sold of certain crops. If the current supply of a basic commodity exceeded a "reserve supply," a referendum was held. If two thirds of the qualified producers approved, a quota was assigned to each grower, and farmers who marketed amounts in excess of the quota were subject to a penalty or a fine on the excess sold. After 1937 marketing agreements also became a part of the federal government's agricultural policies. They were implemented primarily in the production of fruits and vegetables and in the chief milk-producing areas. The marketing agreements were made between the producers and processors of the agricultural products, and the contractual agreement was refereed by a representative of the department of agriculture. The marketing agreement set minimum prices, total quantities to be marketed, and the allotments of marketings among producers.

In an effort to stimulate the demand for agricultural commodities in the late 1930s the federal government implemented a food stamp plan for low-income families, a school lunch program allowing public schools to purchase surplus food commodities at subsidized prices, and an export subsidy program.

The Results of Agricultural Programs

Generally these programs addressed the supply of agricultural commodities because not much could be done with demand. For most agricultural products the demand was both price and income inelastic. If the supply of wheat, corn, rye, cotton, and so on, could be reduced, the inelastic demand would cause the total revenues received by farmers to increase as the price increased. The problem had always been to get the farmers to cooperate in reducing output because each individual farmer had a strong incentive to expand production to take advantage of the higher price due to the reduced supply from other farmers. The programs used different methods in an attempt to achieve this. The AAA's approach was to use the Commodity Credit Corporation to guarantee farmers minimum prices as long as they reduced output. Marketing quotas forced farmers to market no more than their assigned quotas, whereas marketing agreements also required producers to limit production. The CCC and marketing agreements could accumulate inventories when necessary to implement the minimum prices.

The programs, however, were not effective. Surpluses began to accumulate at a startling rate, and if the Second World War had not intervened, the government would have had to face the programs'

TABLE 3.2. REGIONAL MANUFACTURING EMPLOYMENT.

<u>Region</u>	<u>Shares of Manufacturing Employment</u>		
	<u>1920</u>	<u>1930</u>	<u>1940</u>
New England	12.73%	10.48%	11.10%
Middle Atlantic	29.74	28.15	28.73
East North Central	24.74	25.59	27.90
West North Central	7.51	7.11	5.28
South Atlantic	9.37	10.37	11.96
East South Central	4.08	4.48	4.60
West South Central	4.59	5.40	3.83
Mountain	1.77	1.81	0.97
Pacific	5.45	6.61	5.62

Sources: Harvey S. Perloff, Edgar S. Dunn, Jr., Eric E. Lampard, and Richard F. Muth, *Regions, Resources, and Economic Growth* (Baltimore: The Johns Hopkins Press, 1960).

internal contradictions in the 1940s. As it was, these were only postponed to the 1950s.

The ultimate aim of the programs was to raise the incomes of the *existing number* of farmers up to a targeted level and reduce the variability of agricultural prices and farm incomes. If successful, the programs would have largely maintained the existing farm population. However, as we have seen, the long decline of the agricultural sector required a reallocation of resources out of agriculture. The federal agricultural programs were incompatible with these trends, especially as agricultural productivity gains began to accelerate at the end of the thirties.

Manufacturing

Agriculture was not the only sector experiencing difficulties in the interwar period. Other industries, such as textiles, boots and shoes, and coal mining, also experienced trying times, particularly in the twenties. However, at the same time that these industries were declining, other industries, such as electrical appliances, automobiles, and construction, were growing rapidly. With the crushing depression of the thirties, all of these sectors experienced varying degrees of contraction. The simultaneous existence of growing and declining industries has been common to all eras because economic growth and technological progress never affect all sectors in the same way. In general, in manufacturing there was a rapid rate of growth of productivity during the twenties, and, to a lesser extent, in the thirties. The rise of real wages due to immigration restrictions and the slower growth of the resident population spurred this. Transportation improvements and communications advances were also responsible. These developments brought about differential

growth in the various manufacturing sectors in the interwar United States.

Manufacturing's Importance

Because of the historic pattern of economic development in the United States, the northeast was the first area to really develop a manufacturing base. In the late nineteenth century and twentieth century, the other regions began to create manufacturing bases, resulting in a relative westward and southern shift of manufacturing activity. As Table 3.2 shows, this trend continued in the 1920s as the New England and Middle Atlantic regions' shares of manufacturing employment fell while all of the other regions—excluding the West North Central region—gained. The depressed 1930s altered this as the Eastern areas—the New England, Middle Atlantic, East North Central, South Atlantic, and East South Central regions—gained while all other lost shares of manufacturing employment.

Table 3.3 presents data on the relative sizes of broadly defined industries in the interwar period and ranks those industries by their relative sizes in 1939.³⁵ As can be seen there was considerable variation in the growth of the industries and shifts in their ranking during the period. The largest broadly defined industries are, not surprisingly, food and kindred products; textile mill products; those producing and fabricating primary metals; machinery production; and chemicals. When industries are more narrowly defined, the automobile industry, which ranked third in manufacturing value added in 1919, ranked first by the mid-1920s and held its lead except for a few years during the nadir of the Great Depression.

Productivity Developments

TABLE 3.3.
MANUFACTURING VALUE ADDED: SELECTED INDUSTRIES AND YEARS.
(Millions of Constant Dollars*)

<u>Rank</u>	<u>Industry</u>	<u>1921</u>	<u>1929</u>	<u>1939</u>	<u>Percent Inflation Adjusted Growth 1921-39</u>
1	Food and Kindred Products	\$2,120	\$3,340	\$3,485	72.94%
2	Primary Metal Industries	n.a.	n.a.	2,169	n.a.
3	Machinery, Except Electrical	n.a.	n.a.	2,037	n.a.
4	Chemicals and Allied Products	834	1,737	1,819	101.22
5	Textile Mill Products	1,824	2,321	1,818	22.91
6	Transportation Equipment	n.a.	n.a.	1,773	n.a.
7	Printing and Publishing	1,306	2,233	1,765	53.35
8	Fabricated Metal Industries	n.a.	n.a.	1,401	n.a.
9	Apparel and Other Textile Products	1,408	1,927	1,386	21.66
10	Electrical Equipment and Supplies	547	1,389	941	77.49
11	Paper and Allied Products	392	782	888	105.01
12	Stone, Clay, and Glass Products	605	1,054	856	57.94
13	Lumber and Wood Products	853	1,322	731	7.80
14	Petroleum and Coal Products	430	829	697	71.54
15	Leather and Leather Products	610	774	583	18.71
16	Furniture and Fixtures	347	615	418	41.85
17	Rubber and Plastics Products N.E.C.	327	539	406	44.88
18	Tobacco Manufactures	n.a.	n.a.	350	n.a.
19	Instruments and Related Products	189	301	333	79.88

*Value-added dollar figures deflated by the GNP Implicit Price Deflator, 1958=100. N.E.C. indicates Not Elsewhere Classified.

Source: *Historical Statistics of the United States: Colonial Times to 1970* (Washington, D.C.: U.S. Government Printing Office, 1976).

Technological changes during the twenties and thirties tended to raise the productivity of the existing capital through replacement of critical types of capital equipment with superior equipment and through changes in management methods.³⁶ Some changes, such as the standardization of parts and processes and the reduction of the number of styles and designs, raised the productivity of both capital and labor. Modern management techniques, first introduced by Frederick W. Taylor, were introduced on a wider scale.

One of the important forces contributing to mass production and increased productivity was the transfer to electric power.³⁷ By 1929 about 70 percent of manufacturing activity relied on electricity, compared to roughly 30 percent in 1914. An increasing number of factories were buying their power from electric utilities. In 1909, 64 percent of the electric motor capacity in manufacturing establishments used electricity generated on the factory site; by 1919, 57 percent of the electricity

used in manufacturing was purchased from independent electric utilities.³⁸

The shift from coal to oil and natural gas and from raw unprocessed energy in the forms of coal and waterpower to processed energy in the form of internal combustion fuel and electricity increased thermal efficiency. After the First World War energy consumption relative to GNP fell, there was a sharp increase in the growth rate of output per labor-hour, and the output per unit of capital input once again began rising. In manufacturing, steam provided 80 percent of the mechanical drive capacity in 1900, but electricity provided over 50 percent by 1920 and 78 percent by 1929.³⁹

Warren Devine, Jr. reports that at the time the most important result of the adoption of electricity was that it would be an indirect "lever to increase production."⁴⁰ There were a number of ways in which this occurred. Electricity brought about an increased flow of production by allowing new flexibility in the design of buildings and the

arrangement of machines. In this way it maximized throughput. Electric cranes were an “inestimable boon” to production because with adequate headroom they could operate anywhere in a plant, something that mechanical power transmission to overhead cranes did not allow. Electricity made possible the use of portable power tools that could be taken anywhere in the factory. Electricity brought about improved illumination, ventilation, and cleanliness in the plants, dramatically improving working conditions. It improved the control of machines since there was no longer belt slippage with overhead line shafts and belt transmission, and there were less limitations on the operating speeds of machines. Finally, it made plant expansion much easier than when overhead shafts and belts had been relied upon for operating power.

The mechanization of American manufacturing accelerated in the 1920s, and this led to a much more rapid growth of productivity in manufacturing compared to earlier decades and to other sectors at that time. There were several forces that promoted mechanization. One was the rapidly expanding aggregate demand during the prosperous twenties. Another was the technological developments in new machines and processes, of which electrification played an important part. Finally, Harry Jerome and, later, Harry Oshima both suggest that the price of unskilled labor began to rise as immigration sharply declined with new immigration laws and falling population growth.⁴¹ This accelerated the mechanization of the nation’s factories

Technological changes during this period can be documented for a number of individual industries. In bituminous coal mining, labor productivity rose when mechanical loading devices reduced the labor required from 24 to 50 percent. The burst of paved road construction in the twenties led to the development of a finishing machine to smooth the surface of cement highways, and this reduced the labor requirement from 40 to 60 percent. Productivity in road construction was further increased by mechanical pavers that spread centrally mixed materials. These replaced the roadside dump and wheelbarrow methods of spreading the cement.⁴² The glass in electric light bulbs was made by new machines, which cut the number of labor-hours required for their manufacture by nearly half. New machines to produce cigarettes and cigars, for warp_tying in textile production, and for pressing clothes in clothing shops also cut labor-hours. The Banbury mixer reduced the labor input in the production of automobile tires by half, and output per worker of inner tubes increased about four times with a new production method.⁴³ However, as Daniel

Nelson points out, the continuing advances were the “cumulative process resulting from a vast number of successive small changes.”⁴⁴ Because of these continuing advances in the quality of the tires and in the manufacturing of tires, between 1910 and 1930 “tire costs per thousand miles of driving fell from \$9.39 to \$0.65.”⁴⁵

John Lorant has documented other technological advances that occurred in American manufacturing during the twenties.⁴⁶ For example, the organic chemical industry developed rapidly due to the introduction of the Weizman fermentation process. In a similar fashion, nearly half of the productivity advances in the paper industry were due to the “increasingly sophisticated applications of electric power and paper manufacturing processes,” especially the fourdrinier paper-making machines. As Avi Cohen has shown the continuing advances in these machines were the result of evolutionary changes to the basic machine.⁴⁷ Mechanization in many types of mass-production industries raised the productivity of labor and capital. In the glass industry, automatic feeding and other types of fully automatic production raised the efficiency of the production of glass containers, window glass, and pressed glass.⁴⁸ Giedion reported that the production of bread was “automatized” in all stages during the 1920s.⁴⁹

Though not directly bringing about productivity increases in manufacturing processes, developments in the management of manufacturing firms, particularly the largest ones, also significantly affected their structure and operation. Alfred D. Chandler, Jr., has argued that the structure of a firm must follow its strategy.⁵⁰ Until the First World War most industrial firms were centralized, single-division firms even when becoming vertically integrated. When this began to change the management of the large industrial firms had to change accordingly.

Because of these changes in the size and structure of the firm during the First World War, E. I. du Pont de Nemours and Company was led to adopt a strategy of diversifying into the production of largely unrelated product lines. The firm found that the centralized, divisional structure that had served it so well was not suited to this strategy, and its poor business performance led its executives to develop between 1919 and 1921 a decentralized, multidivisional structure that boosted it to the first rank among American industrial firms.

General Motors had a somewhat different problem. By 1920 it was already decentralized into separate divisions. In fact, there was so much decentralization that those divisions essentially remained separate companies and there was little

coordination between the operating divisions. A financial crisis at the end of 1920 ousted W. C. Durant and brought in the du Ponts and Alfred Sloan. Sloan, who had seen the problems at GM but had been unable to convince Durant to make changes, began reorganizing the management of the company. Over the next several years Sloan and other GM executives developed the general office for a decentralized, multidivisional firm.

Though facing related problems at nearly the same time, GM and du Pont developed their decentralized, multidivisional organizations separately. As other manufacturing firms began to diversify, GM and du Pont became the models for reorganizing the management of the firms. In many industrial firms these reorganizations were not completed until well after the Second World War.⁵¹

Competition, Monopoly, and the Government

The rise of big businesses, which accelerated in the postbellum period and particularly during the first great turn-of-the-century merger wave, continued in the interwar period. Between 1925 and 1939 the share of manufacturing assets held by the 100 largest corporations rose from 34.5 to 41.9 percent.⁵² As a public policy, the concern with monopolies diminished in the 1920s even though firms were growing larger. But the growing size of businesses was one of the convenient scapegoats upon which to blame the Great Depression. The Roosevelt administration's first response was to take advantage of the large size of firms by establishing government-organized and -directed cartels under the umbrella of the NIRA. Failing this, the New Dealers then began an attack to break up the larger firms by using the antitrust laws.

However, the rise of large manufacturing firms in the interwar period is not so easily interpreted as an attempt to monopolize their industries. Some of the growth came about through vertical integration by the more successful manufacturing firms. Backward integration was generally an attempt to ensure a smooth supply of raw materials where that supply was not plentiful and was dispersed and firms "feared that raw materials might become controlled by competitors or independent suppliers."⁵³ Forward integration was an offensive tactic employed when manufacturers found that the existing distribution network proved inadequate. Livesay and Porter suggested a number of reasons why firms chose to integrate forward. In some cases they had to provide the mass distribution facilities to handle their much larger outputs; especially when the product was a new one. The complexity of some new products required technical expertise that the existing distribution system could

not provide. In other cases "the high unit costs of products required consumer credit which exceeded financial capabilities of independent distributors."⁵⁴ Forward integration into wholesaling was more common than forward integration into retailing. The producers of automobiles, petroleum, typewriters, sewing machines, and harvesters were typical of those manufacturers that integrated all the way into retailing.⁵⁵

In some cases, increases in industry concentration arose as a natural process of industrial maturation. In the automobile industry, Henry Ford's invention in 1913 of the moving assembly line—a technological innovation that changed most manufacturing—lent itself to larger factories and firms. Of the several thousand companies that had produced cars prior to 1920, 120 were still doing so then, but Ford and General Motors were the clear leaders, together producing nearly 70 percent of the cars. During the twenties, several other companies, such as Durant, Willys, and Studebaker, missed their opportunity to become more important producers, and Chrysler, formed in early 1925, became the third most important producer by 1930. Many went out of business and by 1929 only 44 companies were still producing cars.

The Great Depression decimated the industry. Dozens of minor firms went out of business. Ford struggled through by relying on its huge stockpile of cash accumulated prior to the mid-1920s, while Chrysler actually grew. By 1940, only eight companies still produced cars—GM, Ford, and Chrysler had about 85 percent of the market, while Willys, Studebaker, Nash, Hudson, and Packard shared the remainder. The rising concentration in this industry was not due to attempts to monopolize. As the industry matured, growing economies of scale in factory production and vertical integration, as well as the advantages of a widespread dealer network, led to a dramatic decrease in the number of viable firms.⁵⁶

It was a similar story in the tire industry. The increasing concentration and growth of firms was driven by scale economies in production and retailing and by the devastating effects of the depressions in the thirties. Although there were 190 firms in 1919, 5 firms dominated the industry—Goodyear, B. F. Goodrich, Firestone, U.S. Rubber, and Fisk, followed by Miller Rubber, General Tire and Rubber, and Kelly-Springfield. During the twenties, 166 firms left the industry while 66 entered. The share of the 5 largest firms rose from 50 percent in 1921 to 75 percent in 1937. During the depressed thirties, there was fierce price competition, and many firms exited the industry. By 1937 there were 30 firms, but the average employment per factory was 4.41 times as large as in 1921, and the average

factory produced 6.87 times as many tires as in 1921.⁵⁷

The steel industry was already highly concentrated by 1920 as U.S. Steel had around 50 percent of the market. But U. S. Steel's market share declined through the twenties and thirties as several smaller firms competed and grew to become known as Little Steel, the next six largest integrated producers after U. S. Steel. Jonathan Baker has argued that the evidence is consistent with "the assumption that competition was a dominant strategy for steel manufacturers" during the depression. However, the initiation of the National Recovery Administration (NRA) codes in 1933 required the firms to cooperate rather than compete, and Baker argues that this constituted a training period; from 1935 to 1939 the firms were cooperating in price and output policies. Thus the behavior in the steel industry became more monopolistic in the late 1930s after federal policies had initially forced this to occur.⁵⁸

Mergers. A number of the larger firms grew by merger during this period, and the second great merger wave in American industry occurred during the last half of the 1920s.⁵⁹ Figure 3.9 shows two series on mergers during the interwar period. The FTC series included many of the smaller mergers, but not their value. The series constructed by Carl Eis only includes the larger mergers and ends in 1930, but it also includes their value.

This second great merger wave coincided with the stock market boom of the twenties and has been called "merger for oligopoly" rather than merger for monopoly.⁶⁰ The second merger wave created many larger firms that ranked below the industry leaders. Much of the activity in the second merger wave occurred in the banking and public utilities industries.⁶¹ In manufacturing and mining, the effects on industrial structure were less striking. Eis found that while mergers took place in almost all industries, they were concentrated in a smaller number of them, particularly petroleum, primary metals, and food products.⁶²

Government Policy. The federal government's antitrust policies toward business varied sharply during the interwar period. In the 1920s there was relatively little activity by the Justice Department, but after the Great Depression the New Dealers tried to take advantage of big business to make business exempt from the antitrust laws and cartelize industries under government supervision. Failing that, the Roosevelt administration moved to break up big business by an expanded application of the antitrust laws.

With the passage of the FTC and Clayton Acts in 1914 to supplement the 1890 Sherman Act,

the cornerstones of American antitrust law were complete. Though minor amendments were later enacted, the primary changes after that came in the enforcement of the laws and in swings in judicial decisions. Their two primary areas of application were in the areas of overt behavior, such as horizontal and vertical price-fixing, and in market structure, such as mergers and dominant firms.

Price-fixing continued to be considered illegal throughout the period, but there was no major judicial activity regarding it in the 1920s other than the Trenton Potteries decision in 1927. In that decision 20 individuals and 23 corporations were found guilty of conspiring to fix the prices of bathroom bowls. The evidence in the case suggested that the firms were not very successful at doing so, but the court found that they were guilty nevertheless; their success, or lack thereof, was not held to be a factor in the decision.⁶³ Though criticized by some, the decision was precedent setting in that it prohibited explicit pricing conspiracies per se.⁶⁴

The Justice Department had achieved success in dismantling Standard Oil and American Tobacco in 1911 through decisions that the firms had *unreasonably* restrained trade. These were essentially the same points used in court decisions against the Powder Trust in 1911, the thread trust in 1913, Eastman Kodak in 1915, the glucose and cornstarch trust in 1916, and the anthracite railroads in 1920.⁶⁵ The criterion of an *unreasonable* restraint of trade was used in the 1916 and 1918 decisions that found the American Can Company and the United Shoe Machinery Company innocent of violating the Sherman Act; it was also clearly enunciated in the 1920 U. S. Steel decision.⁶⁶ This became known as the *rule of reason standard* in antitrust policy.

Merger policy had been defined in the 1914 Clayton Act to prohibit only the acquisition of one corporation's *stock* by another corporation. Firms then shifted to the outright purchase of a competitor's assets. A series of court decisions in the twenties and thirties further reduced the possibilities of Justice Department actions against mergers. "Only fifteen mergers were order dissolved through antitrust actions between 1914 and 1950, and ten of the orders were accomplished under the Sherman Act rather than Clayton Act proceedings."⁶⁷

During the Great Depression, big businesses and their behavior came to be widely viewed as one of its major causes. Once Roosevelt took office in 1933, his administration moved to address the problem.⁶⁸ The first attempt was the National Recovery Administration which was formed by Title I of the National Industrial Recovery Act (NIRA) signed on June 16, 1933, where industry codes—enacted to bring about a rational order for

cooperative behavior—became monopolistic devices to organize industry cartels. Ellis Hawley says, “The practical effect of the NRA, then, was to allow the erection, extension, and fortification of private monopolistic arrangements, particularly for groups that already possessed a fairly high degree of integration and monopoly power.”⁶⁹

Within a short time, dissension within the NRA and external criticism was rife. Small businesses criticized the NRA codes as having been drawn up by and protective of big businesses at the expense of small businesses. In some industries the codes became objects of great internal dispute, while in others they were so complex as to be unenforceable. Compliance with the codes varied sharply among industries. Labor, the planners, and the antitrusters all condemned the NRA. By early 1935 there was growing doubt that Congress would vote to extend the two-year charter of the NIRA. The Supreme Court’s *Schechter* decision in May of 1935, which ruled the NIRA unconstitutional, made congressional action on extending the NIRA a moot point.

With the NRA dead and facing a rising chorus of criticism from industrialists and their organizations, the Roosevelt administration’s strategies toward business began to change. National economic planning disappeared, except for a few industries such as coal and crude oil production. In transportation, planning via the federal government’s regulatory agencies was extended to the airline and interstate trucking industries.⁷⁰

As Roosevelt’s war of words with big business continued, his administration’s policies began to swing toward the programs that the antitrusters proposed as a means to reestablish a competitive economy. During 1936 and the first part of 1937, this trend slowly developed in several directions. New laws were drafted to control banks and financial institutions, to control the securities markets via the SEC, and to raise taxes to redistribute income. Under Robert Jackson, the Antitrust Division of the Justice Department began to initiate more antitrust cases. With the depression of 1937-38 the anti-big business attitude in Washington increased, and the antitrust program began to grow more rapidly. In speeches in late 1937 and early 1938, Jackson attacked big business as causing the 1937 contraction through their monopolistic pricing tactics. In 1938 Congress created the Temporary National Economic Committee to examine the monopoly question, and the committee commissioned a number of academic studies of various aspects of monopoly power in the United States.

In March of 1938, Roosevelt appointed Jackson to a loftier position, and Thurman Arnold left

the Yale Law School to head the Antitrust Division. Under Arnold the number of antitrust cases initiated rose from 5, 7, and 10 cases in 1936, 1937, and 1938, respectively, to 31 in 1939, 65 in 1940, and 71 in 1941.⁷¹ Much of Arnold’s antitrust program was aimed at bringing about price flexibility because he had become convinced that inflexible prices were the major cause of the contractions and the slow recovery—an assumption of dubious validity. Hawley argues that Arnold’s antitrust campaign made no real effort to alter the underlying economic structures or break up going concerns, and, as a result, the “program had little success in achieving its avowed goals.”⁷²

Interwar Manufacturing

American manufacturing bore the brunt of the economic turbulence in the interwar period. Exuberant and growing in the twenties, it was the epitome of the business orientation of American society. The depression’s downturn fell like a sledgehammer on manufacturing, and this was where the fingers pointed when the government and other groups searched for an easy explanation of the contraction. It neither deserved the applause of the twenties nor the scorn of the thirties, but the sheer size and visibility of the firms made it an easy target.

During the New Deal, manufacturers were in a quandary as to which strategies to pursue as the administration vacillated between programs. From a formal promotion of cartels, the administration moved to regulation and then to a stated desire to break up large businesses, though its actions never fully followed its words. The Wagner Act forced manufacturing firms to recognize and bargain with labor unions, thus permanently changing labor-management relations. The most important result of the Jackson-Arnold antitrust initiative of the late thirties, the Alcoa decision overturning the rule of reason, would not occur until 1945, but it would then influence antitrust activity well into the 1970s.

On the whole, American manufacturing at the end of the thirties still was the envy of the world. It would not be until the 1960s and 1970s that foreign manufacturing of such basic products as steel, automobiles, and electrical appliances would overtake America’s lead.

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Notes

- ¹. Calculated from *Historical Statistics of the United States: Colonial Times to 1970* (Washington, D.C.: U.S. Government Printing Office, 1976), Series E-40, E-42, and E-135.
- ². H. Thomas Johnson, "Postwar Optimism and the Rural Financial Crisis," *Explorations in Economic History*, 11 (Winter 1973-74): 173-92. See also Lee J. Alston, "Farm Foreclosures in the United States During the Interwar Period," *The Journal of Economic History*, 43 (December 1983): 885-904.
- ³. Some farmers tried unsuccessfully to prevent a sale in Ashland County, Wisconsin, in December of 1932, but others were successful in stopping a sale in LeMars, Iowa, the next week and several more in the following weeks. In other cases farmers bid very low prices for a farm, stopping all other bidders, and then returned the farm to its original owner. For example, Lester Chandler reports that a farm in Shelby, Nebraska, that had been mortgaged for \$4,100 was purchased by neighbors for \$49.50 and then given back to the owner. Chandler, *America's Greatest Depression*, 65.
- ⁴. Lee J. Alston, "Farm Foreclosure Moratorium Legislation: A Lesson from the Past," *American Economic Review*, 74 (June 1984): 446.
- ⁵. It did not seem to bother the majority that this decision was in direct conflict with the Contracts Clause which prohibited government interference with valid contracts. For a discussion of this decision see Robert Higgs, *Crisis and Leviathan: Critical Episodes in the Growth of American Government* (New York: Oxford University Press, 1987): p. 180-83.
- ⁶. *Ibid.*, 451-56.
- ⁷. Broadus Mitchell, *Depression Decade: From New Era through New Deal, 1929-1941* (New York:

- Rinehart & Company, Inc., 1947) 191-97; Chandler, *America's Greatest Depression*, 218.
8. Chandler, *America's Greatest Depression*, p. 218.
9. Mitchell, *Depression Decade*, 190.
10. The production of crops such as wheat, corn, and cotton fell sharply, in fact, the United States imported wheat in 1935 and 1936. Beef production fell because of the loss of pasturage and feed grains. Because of the decrease in production, farm prices rose sharply and carryovers fell. Though production rose in 1937, prices remained high enough to provide farm incomes roughly equal to those received in the years from 1924 to 1929. Chandler, *America's Greatest Depression*, 217-18. Mitchell, *Depression Decade*, 202.
11. William N. Parker, "Agriculture," chapter 11 in Lance E. Davis, Richard A. Easterlin, William N. Parker, et al., *American Economic Growth: An Economist's History of the United States* (New York: Harper and Row, 1972), 376-82; Soule, *Prosperity Decade*, 235-40; Mitchell, *Depression Decade*, 217-20.
12. This and the following discussion draws upon these sources. Roy Burton Gray, *Development of the Agricultural Tractor in the United States*, 2 vols. (Washington, D.C.: U.S. Government Printing Office, 1954); Fred R. Jones and William H. Aldred, *Farm Power and Tractors*, 5th ed. (New York: McGraw-Hill, 1979); E. L. Barger et al., *Tractors and Their Power Units* (New York: John Wiley and Sons, 1952); C. H. Wendel, *Encyclopedia of American Tractors* (Sarasota, FL: Crestline Publishing Co., 1979); John T. Schlebecker, *Whereby We Thrive: A History of American Farming, 1607-1972* (Ames, IA: The Iowa State University Press, 1975).
13. The data come from the following studies. Robert E. Ankli, "Horses vs. Tractors on the Corn Belt," *Agricultural History*, 54 (January 1980): 134 and 147. Robert E. Ankli and Alan L. Olmstead, "The Adoption of the Gasoline Tractor in California," *Agricultural History*, 55 (July 1981): 215. Moses S. Musoke, "Mechanizing Cotton Production in the American South: The Tractor, 1915-1960," *Explorations in Economic History*, 18 (October 1981): Table 5, p. 264.
14. Ankli, "Horses vs. Tractors on the Corn Belt," and Ankli and Olmstead, "The Adoption of the Gasoline Tractor in California."
15. Sally Clarke, "New Deal Regulation and the Revolution in American Farm Productivity: A Case Study of the Diffusion of the Tractor in the Corn Belt, 1920-1940," *The Journal of Economic History*, 51 (March 1991): 105-15.
16. Ankli, "Horses vs. Tractors on the Corn Belt," 146-47; Ankli and Olmstead, "The Adoption of the Gasoline Tractor in California," 229; and Musoke, "Mechanizing Cotton Production in the American South," 366.
17. Warren Whatley, "Southern Agrarian Labor Contracts as Impediments to Cotton Mechanization," *The Journal of Economic History*, 87 (March 1987): 45-70.
18. Clarke, "New Deal Regulations and the Revolution in American Farm Productivity," 116.
19. Allan G. Bogue, "Changes in Mechanical and Plant Technology: The Corn Belt, 1910-1940," *The Journal of Economic History*, 43 (March 1983): 1-26.
20. Zvi Griliches, "Hybrid Corn: An Exploration in the Economics of Technological Change," *Econometrica*, 25 (October 1957): 501-22; "Research Costs and Social Returns: Hybrid Corn and Related Innovations," *Journal of Political Economy*, 66 (October 1958): 419-31; and "Hybrid Corn and the Economics of Innovation," *Science*, 132 (July 1960): 257-80.
21. Bogue, "Changes in Mechanical and Plant Technology," 10-12.
22. *Ibid.*, 16-17.
23. *Ibid.*, 21.
24. *Ibid.*
25. James Shepherd, "The Development of New Wheat Varieties in the Pacific Northwest," *Agricultural History*, 54 (January 1980): 62.
26. Schlebecker, *Whereby We Thrive*, 267-268.
27. Bogue, "Changes in Mechanical and Plant Technology," 2.
28. Schlebecker, *Whereby We Thrive*, 267-68.
29. Bogue, "Changes in Mechanical and Plant Technology," 2.
30. *Ibid.*, 267-74.
31. Charles Wood, "Science and Politics in the War on Cattle Diseases: The Kansas Experience, 1900-1940," *Agricultural History*, 54 (January 1980): 82-92.
32. Elizabeth Hoffman and Gary D. Liebcap, "Institutional Choice and the Development of U.S. Agricultural Policies in the 1920s," *The Journal of Economic History*, 51 (June 1991): 377.
33. *Ibid.*, 399-408.
34. This was similar to what the federal government had done during the First World War.
35. The rankings by production workers (not shown here) are very similar to those by value added.
36. George Soule, *Prosperity Decade: From War to Depression: 1917-1929* (New York: Holt, Rinehart, and Winston, 1947), chapter 7. John Lorant, "Technological Change in American Manufacturing During the 1920s," *The Journal of Economic History*, 33 (June 1967): 243-47. Warren D. Devine, Jr., "From Shafts to Wires: Historical Perspective on Electrification," *The Journal of Economic History*, 43 (June 1983): 347-72. Harry T. Oshima, "The Growth of U.S. Factor Productivity: The Significance of New Technologies in the Early Decades of the Twentieth Century," *The Journal of Economic History*, 44 (March 1984): 161-70.
37. Devine, "From Shafts to Wires."
38. Devine, "From Shafts to Wires," 369.
39. Devine, "From Shafts to Wires," 349.
40. *Ibid.*, 364. The rest of the discussion of these indirect effects draws upon this part of Devine's study.
41. Harry Jerome, *Mechanization in Industry* (New York: National Bureau of Economic Research, 1934): 367; and Oshima, "The Growth of U.S. Factor Productivity."
42. Soule, *Prosperity Decade*, 129.

- ⁴³ Jerome, *Mechanization in Industry*, 368-69.
- ⁴⁴ Daniel Nelson, "Mass Production and the U.S. Tire Industry," *The Journal of Economic History*, 48 (June 1987): 331-32.
- ⁴⁵ Nelson, "Mass Production and the U.S. Tire Industry," 331.
- ⁴⁶ Lorant, "Technological Change in American Manufacturing," 243-45.
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