2

Status and Problems Under Growth

OUR PURPOSE in this chapter is to further summarize the developing and prospective status of American agriculture. We delve into detail only far enough to bring the various facets of the current commerical farm problem into quantitative perspective. The broad economic and social framework in which the industry must now perform was indicated in the previous chapter. We now go back far enough into the data to show how certain variables in the total economic development complex help give shape to current changes in the structure of agriculture, and how these, along with developmental and compensation policies for the industry, have modified or expanded the industry in respect to resource use, factor demand, commodity supply, resource return, family incomes and relative magnitude in the national economy. Also, we wish to point out how the industry has changed, both internally and in respect to other parts of the economy, in response to stimuli from within agriculture and from the outside, as reflected in markets which connect it with industries furnishing resources to it and buying commodities from it. In the latter respect, labor is an important commodity which has been produced in agriculture and marketed elsewhere in the nation's economy.

Historically and world-wide, agriculture has certain outstanding uniformity. A first major uniformity has been the persistent tendency for low per capita income and underemployment or low value productivity of labor to prevail in agriculture. While low value productivities arise from somewhat different specific reasons, we find this relative under-

employment of agriculture to exist in the United States, Canada and similar highly developed countries just as it does in Japan, India, Brazil, Germany, Poland, Russia and other countries at various stages in the economic development ladder. A second major uniformity revolves around the supply of food. It ordinarily is at one extreme or the other; either scarce, causing societies to allocate a large portion of their income to it, or abundant, causing prices and resource returns in agriculture to be depressed. The problem is supply in both instances, with a desire to accelerate the supply function in the one case and to restrain it in the other. The first is largely a problem of consumers, the second largely of producers. The U.S. farm problem is more one of producers.

THE TWO PROBLEMS OF SUPPLY

The uniformity which revolves around commodity supply, in the sense that it is small and a consumer problem in one case and is large and a producer problem in the other, prevails again because of the origin of man's desires and its reflection through price and income elasticities of demand. He has one set of desires which have biological origin. Food is one of these, and until it is reasonably attained, he places high priority on filling it. Income elasticities of demand are relatively great and a large portion of income and human effort must be allocated to food. In this extreme is India. Wants of psychological origin have small marginal urgency and the drive to alleviate hunger pangs outweighs the drive to see one's psychiatrist, to overcome the misery of choosing between the many alternatives in goods and use of nonworking time.

But after hunger is met and the fear of obesity arises, the marginal urgency of food and the price and income elasticities of demand drop low. The psychiatrist, to aid the consumer in his frustration, takes on greater marginal value than labor used to produce food, and farm producers find output straining against a market of little resiliency. In this extreme is the United States.

Never is it likely that a nation of two-car families will allow itself to be chronically undernourished. Investment will be made to keep food supply pressing against fairly inelastic requirements. This investment will be largely in improved technology. But should the "unlikely and worst" happen, and all secrets and potential of nature be exhausted, great opportunity in keeping well-fed still exist. First, wealthy societies are educated and have the knowledge, communication and means for birth control. If the "worst" happened, population and supply of consumers would and could be restrcted, to draw food demand back to food supply, and lessen food prices and still allow affluence in consumption. But also the degree of opulence in other directions could be lessened. For example, a portion of the resources allocated to producing second cars, home freezers, zippers for cigarette packages, and artichokes could be reallocated to potatoes and beef steak. Life would remain reasonably comfortable under consumption patterns and commodity

supplies which only allowed variety and abundance in food, plain rather than colored television, one car per family, automatic washers and ordinary refrigerators, with metal for second cars and backyard broilers shifted to tractors and irrigation equipment.

For these reasons, food scarcity and hunger are not in sight for the United States even with a much larger population in the second half of the twentieth century. But most important, the secrets of nature are not fully exploited and agricultural supply can be moved further to the right by introduction of new technology (and the resources it represents), rather than by injecting large additional amounts of conventional resources representing existing technology, the two being equivalent means of moving the supply function to the right. The status of economic development will keep consumer real incomes high and the elasticities of food demand low.

This supply problem is the opposite of that in India where national economic development has been tardy and diets cannot be improved readily in the short run by restraints on population. Knowledge and communication are too small and incomes are too low to allow wide exercise or purchase of the means of birth control. Neither can resources be reallocated in significant amounts from other major consumption industries because a very small fraction of families consume autos, telephones, newspapers, electricity, stoves, door knobs, windows, floors, shoes and other run-of-the-mill consumer commodities of Western World. Societies such as India will invest in new technology to move the supply function to the right. The direct problem is supply, just as it is in the United States; the more basic problem is state of economic development, just as it is in the United States.

The two states of consumption patterns are less than 100 years apart in the United States, or in the United States as compared to India. In the 1860's important segments of American society also lived in earthen or sod houses without floors, although most enjoyed the luxury of hinged doors, windows, sets of dishes and chimneys. They, too, in economic isolation from other sectors of society, depended on the year's somewhat unpredictable supply of crops for grain to grind or sorghum to press. They did not worry about obesity. But economic progress has been rapid and this state of development has been completely wiped from the scene. The problem of U.S. agriculture and farm families will continue to be on the opposite side; namely, largeness of supply.

This problem will persist because American society will continue to invest heavily in resources and resource supply conditions which lead to increase in commodity supply. Perhaps it also will do so because it is wealthy enough to allow continuation of relative surpluses. The problem will persist in India as long as it cannot invest sufficiently in increasing food supply. One important economic and political problem of the world is: Can the food supply functions of different regions be added, with similar aggregation of demand functions, allowing equation of these aggregate functions in a manner to allow real prices of food to be lowered

in less advanced countries and increased in advanced countries? Optimally this economic alternative in food supply aggregation needs to be examined against the alternative of aggregation in resource supply, particularly capital. Flexibility does not exist for wide aggregation in either manner at present. Hence, we return to a more inward examination of American agriculture within its predominant national setting, returning later to pose analysis of international aggregation needs and possibilities in food supply and demand.

RELATIVE MAGNITUDE OF AGRICULTURE

Agriculture is the dominating industry in primitive societies and less developed nations. This is true in the marginal importance which consumers attach to food, the proportion of national resources devoted to agriculture and portion of national income generated by farming. With economic progress and rise in per capita incomes, all of these magnitudes decline. A path in economic development is traced, with a smaller proportion of population on farms, with capital and labor of agriculture declining as a portion of the total and with income from farming being reduced as a fraction of national income. In short, economies "grow away" from agriculture as they progress—a structural change not always understood by those who try to maintain the historic ratio of agricultural to national economy.

Indifference Maps Underlying Proportionate Resource Allocation

The shift in relative importance of agriculture is a "natural law," since consumers first are biological phenomena with wants expressed accordingly. It is this rather than abandonment of agriculture by society which causes a decline in the relative importance of the industry with economic growth. The indifference map which relates food, particularly in quantity aspect, and other goods and services generally is of the nature in Figure 2.1. At extremely low level of income and small consumption, the indifference curve approaches u_1, food having great urgency in the sense that the marginal rate of substitution of other commodities for it is low or even zero. At a higher level of income, as illustrated by contour u_2, food begins to lose some urgency, the indifference curve departing more greatly from zero slope. But moving between income (budget lines) or utility levels paralleling u_1 and u_2, income elasticity of demand is high. The expansion of food consumption with greater income moves up the vertical axis until it approaches u_2, and little or no added income is allocated to nonfood commodities. With satisfaction of hunger, at least in food quantity and low-cost calories, the expansion paths relating proportionate expenditure on food and other commodities take the nature of mn, curving rightward and becoming horizontal (or perhaps sloping slightly negatively) at high income levels.

The first great stride in civilizations, the foundation stone of economic development, occurs at the point where the isocline breaks away from

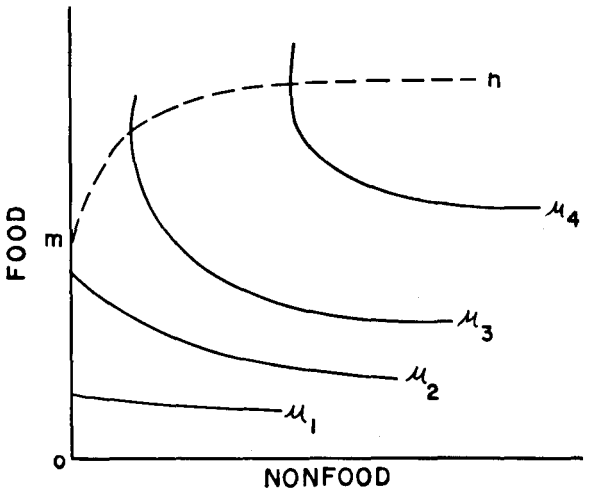

Fig. 2.1. Indifference Map With Food.

the vertical axis. Up to this point, the *om* section of the isocline, resources are still absorbed by agriculture as income increases. But at *m*, the trek from the farm has begun. With the expansion path eventually curving away from the food axis, or even if it is linear with positive slope intersecting the food axis at *m*, a declining proportion of consumers' expenditures on food is indicated.

If man's income is sufficiently high, as for indifference curves u_3 and u_4, a further increase in income will not cause him to consume more food, all of the income increment being allocated to other goods and the income elasticity being zero. Or, for indifference curves corresponding to high incomes or budget lines, the indifference curve effectively approaches a 90 degree angle, or a corner around which the budget line can swing without changing the relative mix of food and nonfood goods represented by a given indifference curve or level of welfare. The swing of the budget line, of course, is a reflection of the price of food relative to nonfood goods. Food price can decrease greatly, causing a corresponding increase in the slope of the budget line, without causing more than a slight swing of the consumer budget in the direction of a larger absolute intake of food. The price elasticity of demand is extremely low at this level of income. Or, stated conversely, food price must drop greatly, and slope of the budget line must increase extremely to cause even a small increase in food intake.

The slope of the indifference curve, corresponding to budget or income lines of higher location in the plane, is the quantitative indication of consumer's preference in respect to allocation and reward of resources for agriculture as he grows richer. When the mix of goods approaches portions of indifference curves with little or zero slope, priority is high for allocation of more resources to agriculture. In market economies,

farm resources will be rewarded favorably under these conditions, particularly if they are in short supply. But when the mix approaches the vertical or "highly sloped" portions of the indifference curves, low marginal priority is placed on resources used for food. Those so engaged will be penalized in income if they are in surplus supply. Man may eventually reach a level of income and wealth where price and income elasticities of demand for food expenditures in aggregate drop to zero, as they are for air. Although man will scream and fight if his quantity of air is suddenly denied, he will pay no positive price for more than he now possesses. This has not yet happened for food, even in the United States, and price and income elasticities are not yet constants even though agriculture economists mainly have constrained them thus in measurements. Engel placed the income elasticity of demand for food around .7 in the 1880's. It now is much lower in the United States, and will decline further.

The U.S. farm industry is in the midst of a growth problem stemming from rapid economic and technological development and the phenomena illustrated in Figure 2.1. Pressure on income has been severe since 1950. However, the basic problem is of earlier origin. It began as early as the 1920's when farm income was low relative to nonfarm income. Then depression and war came along to obscure the basic problem and its consequences. But it returned in a magnitude which would have occurred more than two decades earlier, had there not been these two major disruptions, and had national economic growth continued unabated after World War I. It is a reflection of the simple growth model which we have begun to outline; of supply which is increasing rapidly and demand which grows in more retarded fashion.

FARM INCOME SQUEEZE

Agriculture in a wealthy, growing economy will generally be faced with a cost-price squeeze and a "dampening down" of income. The reason is: As incomes of consumers increase, food no longer becomes their major concern. They want more home appliances, better housing, television sets, recreation, travel and education. As the American consumer's income increases, it doesn't buy any more pounds of food, but simply changes the composition from fats, starchy foods and low-cost carbohydrates to more fresh vegetables, better cuts of meat, and fresh and canned fruit. Food consumed per person, measured in pounds, hasn't increased since 1920. For each 10 percent increase in incomes of consumers in recent decades, expenditures on food have increased by 1.5 percent or less, with most of this representing demand for improved quality and more processing and retailing services incorporated with food. The consumer doesn't consume a greater physical quantity of food. He consumes it in a different form and in a more convenient package. There is a limit to the size of his stomach; it does not stretch with his income, but he can stretch greatly the quantity of services he uses with food.

But in contrast, his expenditures increase rapidly on many nonfarm products as his income grows. With each 10 percent increase in income, his expenditures on items such as automobilies, clothing, recreation, home appliances, education and travel increase by 10 percent or more. In other words, as national income progresses and we become a wealthier nation, the consumer wants little if any more food, but much more of other goods and services. This situation will continue, aside from temporary setbacks, as national and per family income continues to increase. "Good living" no longer is characterized simply by getting enough food, clothing and shelter for subsistence.

Consumers express their wishes through prices paid in the market. As incomes increase, they are unwilling to place premium prices on farm products, but hold them down, indicating need for food mainly as there are more persons to feed. In contrast they pay prices as high or higher than previously for other products which they "prize" as incomes grow. In bidding higher prices for nonfarm goods and services, the consumer also bids up the cost of steel, labor, petroleum and other materials which produce the "more luxury" goods, although other market variables and forces aid this process. Consequently, the cost of tractors, lumber, fuel, fertilizer and other cost items of the farm is kept up. Since he wants materials used elsewhere, he causes the farmer to compete at a higher level of prices for materials which can either go into nonfarm products, or can be used as implements for farming.

This, then, is a cause of the farm price squeeze. The consumer says that he has a higher income and wishes relatively more of the nation's resources used for nonfarm goods, and fewer for farm goods. He wishes, as reflected in the market, labor transferred from farm accordingly. This cost-price squeeze, with the American consumer saying that too many people and resources are in agriculture, had already started in the 1920's. It is possible because of rapid economic progress and shift in food supply which outpaces demand growth.

The Longer Basis

This is the picture at the beginning of the 1960's. But to understand the deeper foundation upon which it rests, and the inherent difficulty in bringing economic balance to agriculture, it is useful to obtain longer-run perspective in quantities. Table 2.1 indicates the change which has taken place in relation of agriculture to the national economy over several decades. The pattern of change largely reflects that postulated in Figure 2.1. While the farm labor force increased with national economic growth up to 1910, it still declined in portion of the national total. The rapid decline in relative part of labor force in agriculture came, of course, after 1920 as technology favored the substitution of capital for labor and increased labor productivity, and as national growth caused income elasticities of demand for nonfarm goods to submerge those of the farm sector.

While capital in agriculture increased continuously, except for depression pause, it also declined almost continuously as a portion of the na-

TABLE 2.1

U.S. FARM RESOURCES AND INCOME AS PROPORTION OF NATION

Year	Labor Force*		Capital*		Net Product* or Income		Agriculture as Percent of Nation		
	Nation	Farm	Nation	Farm	Nation	Farm	Labor	Capital	Income
1820	2.9	2.1	—	—	.9	.3	71.8	—	34.4
1840	5.4	3.7	—	—	1.6	.5	68.6	—	34.6
1860	10.5	6.2	16.1	8.0	4.1	1.3	58.9	55.6	30.8
1880	17.4	8.6	43.6	12.2	6.6	1.4	49.4	27.9	20.7
1890	23.3	9.9	65.0	16.1	9.6	1.5	42.7	24.7	15.8
1900	29.1	10.9	87.7	20.4	14.6	3.0	37.5	23.3	20.9
1910	37.4	11.6	152.0	43.3	25.6	5.6	31.0	28.5	21.7
1920	42.4	11.4	374.4	83.8	79.1	10.6	27.0	22.4	13.4
1930	48.8	10.5	410.1	60.5	75.7	4.3	21.5	14.8	5.6
1940	55.6	9.5	424.2	43.9	81.9	4.6	17.2	10.4	5.6
1950	63.1	7.5	1,054.7	107.4	241.9	14.0	11.9	10.2	5.6
1960	68.4	4.5	—	—	416.9	12.0	6.7	9.1	2.9

* Million for labor and billion for capital and income. Income figures are disposable consumer's income and net income from farming. Farm capital includes land.

Source: Historical Statistics of the United States. Colonial Times to 1957, Series F 22–33 and USDA Statistics.

tional capital. But most striking is the decline in net income of farming as a proportion of disposable consumer income, a trend more or less paralleled in gross product of the two aggregate sectors. With the farm labor force now considerably less than 10 percent of the national total and net income less than 5 percent, income depression in agriculture even stands to have minor impact on national employment and income. This proposition was verified in the 1950's as farm income declined and national income grew. Demeter, goddess of agriculture, viewing her empirical importance in 1850 or before, could not have guessed her proportionate role in society could drop so low. But neither did her court show her the picture in Figure 2.1. By 1980 her share of labor force is likely to be less than 5 percent of total and her share of net income less than 2 percent. Agriculture is becoming so small in the total economy that aside from scientific sophistication, the estimator of demand relations scarcely needs to include an equation with directional effect from farm income to national income, and certainly not from farm commodity price to national income. By 1995, he may be at intersection of expansion path *omn* and curve u_4 in Figure 2.1, and thus able to predict commodity price, at a given point in time, as a function of output alone and demand quantity as a function of population, leaving out directional effect of national income on commodity price and being highly accurate with a single, simple equation.

But Figure 2.1 not only projects changes in economic shape as economic development progresses, it also projects changes in the shape of society itself and the relative political strength of different occupational

sectors. Time provides an interesting chain with links in the sequence: biology→economic→political. The shift in the proportion of resources and income of agriculture follows a path linked to the extent to which biological preferences are filled and consumer outlays shift in large proportion to other commodities.

Linked to this shift in proportion of economy represented by agriculture is a shift in occupational distribution of population and the political strength of agriculture. While rural congressmen may fight vigorously to preserve their district, the expansion path in Figure 2.1 cannot be bent the other way, man having greater psychological than biological capacity for goods. Even in Russia, with sufficient progress and to the extent that collective farms prevail more for political purposes and to keep a large peasantry under control than to attain scale economies, economic development might likewise call for lifting a particular structure attached to rural life. Far up the isocline, the majority of resources will be in city and industry; the individualistic peasant can be given a larger plot of soil, or the collective for social control can be abandoned, because he will be outmanned and cannot win a revolution, even if he could start one.

At the summit of the consumption function, paths cross algebraically and ideologically. Attainment of high levels of economic development, and if the consumption function has an apex, the expansion paths, from whatever origin and direction, must cross or intersect. Hence, a common set of desires or good and service mix is indicated. Man can never attain this level but different societies will have greater uniformity in values and motives as they move towards it. Consumption at high levels thus is a logical, both in politics and mathematics, means of eliminating international ideological conflict.

The empirical shaping of this third link in economic and social development is indicated in Table 2.2. Populations and households of the nation were roundly 50 percent farm in 1850. By 1960 they were less than 10 percent and are headed towards 5 percent by 1975. Farm policy legislation will not reflect any overpowering political strength of agriculture in 1980. Instead, it will be an expression of society's economic sympathy for the industry, or its desire for togetherness to provide agriculture with the economic and social mechanisms for guaranteeing level and lessening instability of income which prevails elsewhere in the economy.

In one manner, the data on national shares of resources and income in agriculture overstate the decline in relative magnitude and importance; in another way they do not. In respect to the first, technological change in agriculture has caused the substitution of inputs fabricated off the farm for those which formerly were produced on the farm. The resources for power are now found in cities and tractor plants rather than in oat fields and on farms. Chemicals, fertilizers and many other inputs represent similar shifts in origin. Too, some processing of outputs has now shifted to marketing firms. Few farms have churns, producing prints of

TABLE 2.2

SHARE OF FARM POPULATION AND HOUSEHOLDS IN THE NATION

Year	Population (million)			Households (million)		
	Nation	Farm	Farm as Percent of Nation	Nation	Farm	Farm as Percent of Nation
1840	17.1	9.0	52.6	—	—	—
1850	23.3	11.7	50.2	—	—	—
1860	31.5	15.1	48.1	—	—	—
1870	39.9	18.4	46.0	—	—	—
1880	50.3	23.0	45.7	—	—	—
1890	63.1	26.4	41.8	12.7	4.8	37.6
1900	76.1	29.4	38.7	16.0	5.7	35.6
1910	91.9	32.1	34.9	20.2	6.1	30.2
1920	105.7	31.6	29.9	24.5	6.8	27.7
1930	122.4	30.2	24.7	30.0	6.6	22.1
1940	131.8	30.5	23.2	35.2	7.1	20.4
1950	151.1	25.1	16.6	43.6	5.7	13.4
1960	179.3	21.2	11.3	52.2	4.1	7.8
1975*	244.9	15.0	6.2	—	—	—

Source: Historical Statistics of the United States Colonial Times to 1957. Series A 1–3, Statistical Abstract of the United States, 1960 and Agricultural Statistics, 1955 and 1960.

butter to be exchanged for groceries. But even if the nonfarm inputs are added, agriculture is still a declining portion of national economy, in the manner of the "consumer cross-section" in Figure 2.1.

In respect to the second point, the political strength of agriculture is not similarly represented by aggregation of laborers in tractor plants and farm operators. Workers in tractor plants are more likely to vote with automobile workers than with farmers. The management and lobbying representatives of industries producing farm inputs more nearly see a connection with agriculture. They may vote or pressure with agriculture for policies which will increase their sales of inputs; for example, in payments to subsidize lime and fertilizer. But some may press in opposite directions of farm groups; for example, in high price supports and large storages. But politically, at the polls, their number is much fewer than the number of horses and mules which they replaced—the owners of the latter doing the voting, of course.

Share of Expenditures on Food

Consumers have little understanding of the extent to which development of agriculture has reduced the real cost of food and the proportion of the budget going to it. This is true because food is no longer the major input of the goods and services carried away from the supermarket. Increasingly, purchases at the grocery are for packaging, freezing and similar services; or the substitution of frozen vegetables and fruits for canned ones, or canned form for dried form and exotic foods for plain foods. Services in foods are substitutes for maids in the household and the general trend will continue.

Today's housewife does not wish, in the manner of her great grand

mother, to develop muscles, by pushing buttons on electric stoves and automatic washers and dryers. She wants to develop intellect in the manner of graduate students, and to do her part in leadership to solve community and international problems. The Indian housewife would like a little more millet or rice, or even a scythe to replace her sickle. A Russian housewife would like more than two rooms for six people. But economic development in the United States allows a different pattern of choice for most consumers.

While the income elasticity of demand for food is low, that for the services which go with food is much higher. Income elasticity of demand for expenditures on food at retail has been in the level of .15 in the recent decade, including both the food and service components. However, the services with food have an income elasticity ranging from .6 to 1.2, depending on whether they refer simply to services incorporated with food consumed in homes or to food eaten away from home. With higher income elasticities for services than for food, even the total of the food processing and marketing complex gradually declines in proportion that is purely agriculture as indicated in Table 2.3. Farmers and agricultural administrators sometimes pose the problem of agriculture as that of "the declining share of the consumer's dollar to the farmer." As the last column of the table suggests, this proportion declines as the housewife attaches greater marginal urgency to the package containing food, the dishes which serve it or the mechanization which cooks it, than to the food itself. The Research and Marketing Act of 1949 was passed largely to head the farmer's share of the consumer's dollar back towards the levels of earlier decades. Marketing research was initiated to accomplish as much, but the fight is an uphill one against the income expansion path illustrated in Figure 2.1. The most certain, and perhaps the only, way of attaining this rollback would be to return per capita incomes to the 1900 level. Not many people would favor this means.

GROWTH IN OUTPUT

In the absence of a large breakthrough in foreign markets and as consumers become wealthy, the extent of the opportunity for expansion by U.S. agriculture is tied largely to growth in population. Farm price and

TABLE 2.3

ALLOCATION OF CONSUMER EXPENDITURE FOR SPECIFIED COMMODITIES

Year	Percent of Total Consumer Expenditures				Percent of Consumer's Food Dollar to the Farmer
	Food	Housing	Medicine	Recreation	
1910	34.0	19.3	2.7	3.0	44.0
1920	33.3	15.2	3.0	3.6	43.0
1930	27.4	15.2	4.8	5.6	39.0
1940	30.9	12.6	4.9	5.2	40.0
1950	30.6	10.5	5.0	5.8	39.1
1960	24.7	12.9	5.5	6.0	38.6

income problems arise in about the extent to which growth in supply exceeds growth in demand; or, domestically, in extent that growth in farm output exceeds growth in population. Because of low demand elasticities for farm products, a slight excess in growth of output causes severe depression of farm prices, incomes and factor returns. The supply curve has indeed shifted to the right more rapidly than the demand function, over recent decades, as illustrated in Figure 2.2.

In the 1950's, output grew at a rate of 2.5 percent per annum. Over the 20 years, 1941–60, it grew at the rate of 2.3 percent per year. Population grew at a rate of 2.3 percent during the 1950's and at the rate of 1.7 percent over the two decades. While the rate of population increase slightly exceeded output growth between 1920 and 1930, demand still pressed on supply because export markets had receded and demand elasticities turned low at this time. The excess rate of production increase has been small, with annual output exceeding total uses (domestic market and surplus disposal) by only about 6 percent for grains and 2 percent in total during the late 1950's and early 1960's. This excess depressed prices greatly, however, to the extent that price supports allowed downward flexibility.

Over a longer period of time, a rate of increase in output which exceeds population increase causes chronic depression of income and pressure towards relaxation of resources used in the industry. Transfer of resources from agriculture would lessen or remove the depression of inincomes and resource returns, even with somewhat lower equilibrium prices for farm commodities. However, mobility of many resources in agriculture is low in the short run. This is true of labor with community attachments and skills oriented to agriculture, to buildings and machinery with low reservation prices or salvage values, and particularly to land which has little alternative in nonfarm use and has large time and transfer costs in shift from wheat to grass or from cotton to forestry.

While the threat of larger populations is suggested as a reason for rapid increase in the productivity of agriculture, it appears unlikely that population can outpace agriculture's ability to extend output through the 1970's, and certainly not in the 1960's. Should population ever begin to press on supply, farm income and resource returns will benefit, because of the low price elasticity of demand for food, should the supply elasticity be low for resources which might be drawn into agriculture. It is unlikely, however, that population will press on food supply in the United States during the sixties or seventies. The nation has too many natural resources which still are ineffectively utilized. It is rich and has many more of other resources that could be transferred into agriculture should the real price of food begin to rise. As mentioned previously, labor and steel could be transferred from autos and refrigerators to build more fertilizer plants or dams and irrigation equipment. Also, there is much slack in the distribution of resources to foods themselves. More chicken and less beef consumed would allow more meat from a given grain supply. If we ate wheat and oats as fancy breakfast foods and

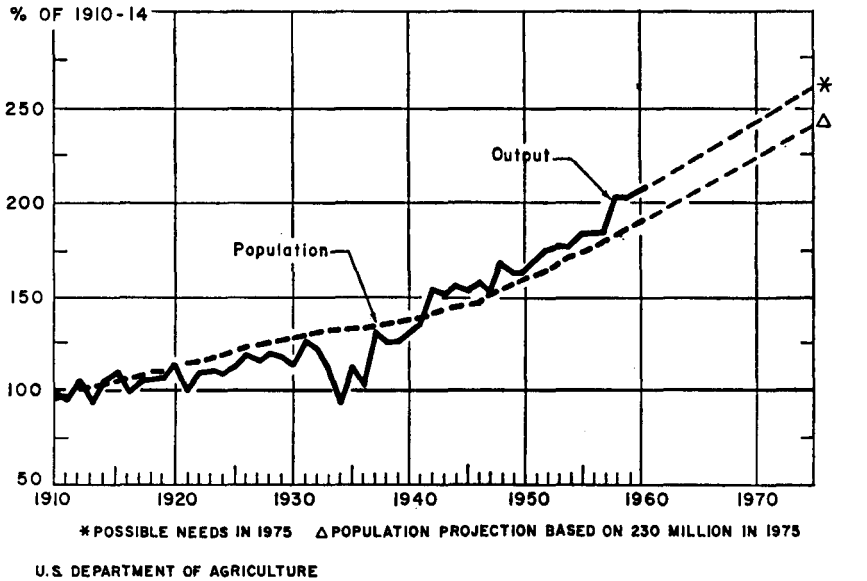

Fig. 2.2. U.S. Agricultural Production and Population, 1910–60, and Projections, 1960–75.

cocktail snacks we could get more calories and energies than when they are used as inputs for animals. The pricing system would draw resource allocation rapidly in these directions, should demand grow sufficiently to cause food prices to rise sharply against prices of nonfood commodities.

Even with a continuing "grading up" of the human diet, we can continue to produce abundantly for the next decade by upgrading the diets of animals and by using more fertilizer, improved varieties and general technical advance already known and in sight. Also, soil scientists indicate that a large acreage can, with heavier fertilization, be shifted from rotations to continuous cropping with greater output resulting from land resources. Recent projections, proven to be accurate in recent years, provide empirical footing for this statement.[1] Barton and Roger's early projections (see Figure 2.2) show estimated growth in total use of U.S. farm products of around 50 percent from 1956–57 to 1975 and estimated production which can match this increase, given the current excess rate of growth in output beyond domestic consumption. (Also see the "upsurge" in rate of growth shown in Figure 16.1.) Their more recent projections suggest that a population of 230 million persons and some increase in exports by 1975 would require somewhat more than a 35 percent increase in food output.[2]

[1] G. T. Barton and R. O. Rogers, *Farm Output; Past Changes and Projected Needs*, Agr. Info. Bul. No. 162, USDA.

[2] R. O. Rogers and G. T. Barton, *Our Farm Production Potential, 1975*, Agr. Info. Bul. No. 233, USDA.

However, this increase could be met by an increase of 20 million acres of cropland under one set of conditions and with a decline in cropland under a second set of conditions. Both conditions assume only technical knowledge already existing. Certainly new technology will be added to the current stock during this period. (See the investment figure for research in Chapter 16.) Analysis by Black and Bonnen indicates similarly.[3] Aside from unexpected war or extreme change in population growth, and on the basis of technology now known, the current rate of growth in output evidently can stay well ahead of growth in population and demand through the 1970's.

Ratio of Supply and Demand Increase

American society, affluent and with a high level of per capita income, is not likely to let absolute scarcity of food arise. The important question for the next decade is not: Can output be increased faster than population, at declining real price of food? Instead the basic policy question is: At what rate should supply be allowed to increase if consumers are to benefit sufficiently and farmers are not to sacrifice as a result of progress in agriculture? Different levels of prices, incomes and resource returns in agriculture will prevail, depending on the rate at which "supply shifters" are injected into the industry. The major supply shifters are new technology and lower real prices for factors, the latter reflecting the nature of shifts in supply functions for resources used in agriculture. Whether greater output, from lower factor prices or increased resource productivity, increases or decreases net income of agriculture in the short run will depend on the rate of increase in supply relative to demand.

With an income elasticity of demand which is effectively zero at the farm level, price and income for an agriculture can be maintained only if the rate of increase in supply is equal to that of demand. Turning to a simple algebraic form, to simplify the analysis and to refrain from leadening the analysis, we illustrate this point below. (Again, to keep the example more "manageable," we concern ourselves only with shift in the supply function and not with changes in its slope.)

In equation (2.1) we suppose a short-run demand function of the nature explained for equation (1.3) where $e = .4$.[4] Equation (2.2) is the industry production function, with X and Z magnitudes of two categories

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[3] See J. T. Bonnen, *American Agriculture in 1965. Policy for American Agriculture and the Relation to Economic Growth and Stability,* Joint Economic Report, 85th Congress. Also see R. P. Christensen, S. E. Johnson, and R. Baumann, *Production Prospects for Wheat Feed and Livestock,* ARS 43-115, USDA, 1959.

[4] c may be considered to include the aggregate effect of other variables at given level; or $c = (I, P_n, N, T)$ where I is per capita income, P_n is the price of other commodities, N is population and T is other variables causing demand to change, etc. In later chapters we examine changes which relate to alteration in the slope and elasticity of production and supply functions. Our analysis of the production function to simply cause it to shift rightward and take supply in the same direction has its counterpart effect in factor price changes which shift output in the same manner.

of resource inputs. (See the footnote discussion of equations 1.1–1.5 for discussion of the methodology and illustrations; as well as indication of relationship of firm and industry functions.) However, we suppose that one, Z, is fixed in the short run with the production function in (2.3) resulting.

$$Q_d = cP^{-.4} \tag{2.1}$$

$$Q_p = aX^{.8}Z^{.2} \tag{2.2}$$

$$Q_p = \pi X^{.8} \tag{2.3}$$

$$Q_s = .4\pi^5 P_x^{-4} P^4 \tag{2.4}$$

$$cP^{-.4} = .4\pi^5 P_x^{-4} P^4 \tag{2.5}$$

$$P_1 = 1.23c^{.23}\pi^{-1.14}P_x^{.91} \tag{2.6}$$

$$Q_1 = .92c^{.91}\pi^{.45}P_x^{-.36} \tag{2.7}$$

$$R_1 = (P_1Q_1) - (\pi^{-1.25}P_xQ_1^{1.25}) \tag{2.8}$$

Leaving aside temporarily the effects of uncertainty and institutions, static supply function in (2.4) is derived by setting $P_x(dQ_p/dX)^{-1}$ from (2.3) equal to P, product price, and solving for supply quantity, Q_s. Equating demand and supply in (2.5) and solving for short-run equilibrium quantities, we express price and output respectively in (2.6) and (2.7). Short-run industry profit above fixed costs is (2.8). Now if demand shifts "horizontally" by multiplication of (2.1) by λ and supply by multiplication of the production function is (2.3) by Γ, the new equilibrium price, P_2, is (2.9) and the new equilibrium output is (2.10).

$$P_2 = \frac{\lambda^{.23}}{\Gamma^{1.14}} P_1 \tag{2.9}$$

$$Q_2 = \lambda^{.91}\Gamma^{.45}Q_1 \tag{2.10}$$

$$\lambda = \Gamma^5 \tag{2.11}$$

Price will decline if λ, the demand shifter, is smaller than the magnitude indicated in (2.11). Quite obviously, this general condition held true for farm products in aggregate over the decade of the 1950's, and on into the 1960's. The new short-run industry profit (net above fixed costs) is that in (2.12). With shift of the demand function by λ and shift of the

$$R_2 = \frac{\lambda^{1.15}}{\Gamma^{.68}} R_1 \tag{2.12}$$

$$\lambda = \Gamma^{.59} \tag{2.13}$$

production function by Γ, revenue in the second period, R_2, will not be greater than that in the first period unless the demand shifter has a value larger than that indicated in (2.13). It does not have to be so large as to maintain price because technical change lowers per unit costs.

Observation of American agriculture of the last decade would indicate that the shift coefficient for supply has been so large relative to the coefficient for demand that price and net revenue have both declined. Of course, other coefficients have changed so that the shifts have not been alone in a "horizontal" direction. We illustrate some of these types of changes (e.g., in the coefficients attaching to prices in the demand function and to the production function) at a later point. Gross revenue has been maintained for commodities such as corn, wheat and cotton only through government price support programs. Net revenue has declined because of the upward movement of factor prices, total costs increasing for this reason and because a larger proportion of purchased inputs are used.

Income Trends

The rates of change indicated in Figure 2.2 and the relationships illustrated in equations (2.1) through (2.10) have been operative in U.S. agriculture for the last decade. Net income of agriculture has declined in face of greater output, growing national income, increased population and decline in value of the dollar. Increased physical efficiency and greater output, a solution frequently posed by agriculturists, is not the answer to this aggregate income problem. It alone never will be a short-run answer in a market where price elasticities are extremely less than unity. This point is emphasized in Table 2.4. Net income of agriculture declined greatly after 1951 and per capita income of persons in agriculture also declined, even though farm population declined by 16 percent between 1950 and 1960. Income of farm persons did not fall lower, on average, only because of increased off-farm work of farm people, with the total income from the two sources in 1959 being just about equal to the 1951 level.

TABLE 2.4

INDICES AND VALUES OF SPECIFIED INCOMES AND OUTPUT SERIES

Year	Index of Agricultural Output (1940=100)	National Income (billion)	Net Income From Agriculture (billion)	Per Capita Income		
				Nonfarm	Farm from agriculture	Farm from all sources
1940	100	$ 82	$ 4.6	$ 685	$174	$ 262
1945	116	181	12.4	1,312	554	720
1950	123	242	14.0	1,585	626	838
1951	127	279	16.3	1,763	751	983
1952	132	292	15.3	1,849	711	962
1953	133	306	13.3	1,902	666	931
1954	133	302	12.7	1,849	660	916
1955	138	330	11.8	1,975	610	883
1956	139	351	11.6	2,073	600	897
1957	139	367	11.8	2,102	665	933
1958	150	368	14.0	2,066	768	1,043
1959	153	400	11.8	2,216	609	960
1960	158	418	12.0	2,290	622	986

Source: Economic Report of the President, 1960 and USDA Outlook Charts, 1960.

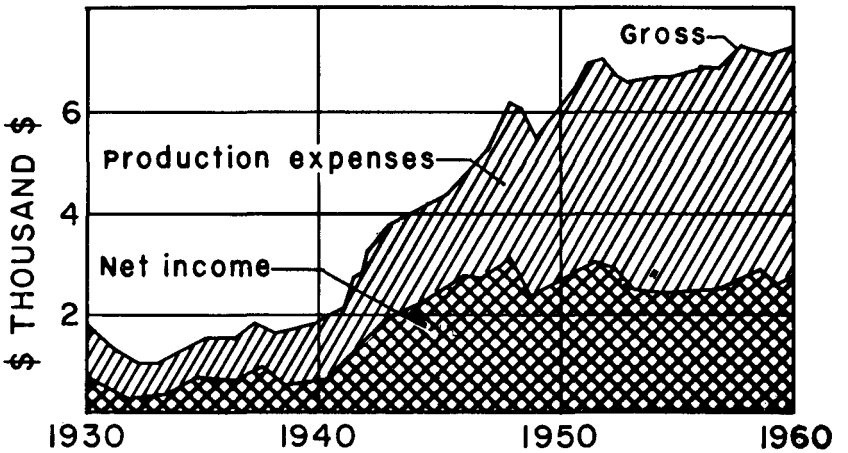

Fig. 2.3. Trends in Gross and Net Income and Production Expenses of Agriculture (Source: USDA Outlook Charts).

The income problem is a relative one. Money and real income of agriculture is high compared to other countries and with that of two decades back. (See Figures 3.5 and 3.6.) But U.S. farmers have not, in aggregate, been realizing the gain in money and real income continuing for the rest of the economy. Some sectors of agriculture have realized a large reduction in both. Net farm income has lagged behind the national economy more than has gross income of agriculture. All economic quantities have moved up with inflation, but decline in value of money has not offset the effect of greater output and inelastic demand in gross farm income. As mentioned previously, costs have risen due to inflation of all factor prices and a growing proportion of purchased inputs used in the industry. As Figure 2.3 illustrates, net income has extended over a plateau as production expenses take a larger bite out of gross income. Under growth and rising per capita real incomes, a problem exists when a major group does not realize significant gain from this general forward press. As Figure 2.4 shows, the purchasing power of farmers' net income has actually declined over the last decade. The monetary impact has fallen harder on commercial or high production farms than on small and low production farms. This point is illustrated in Figure 2.5, in comparison of farms with more and less than $2,500 in gross value of sales. Income from farm sources has decreased much more for the former than for the latter. Total family income of low production farms has actually increased with greater income from off-farm sources, the dominating element of income for the group. It is true, of course, that $2,500 is a low gross sales and a true commercial farm could have only small income at this volume.

The contrast of Figure 2.5 would be even greater if we separated the two groups at gross income of $7,500; a larger proportion of farmers with sales between $2,500 and $7,500 having off-farm work than those with

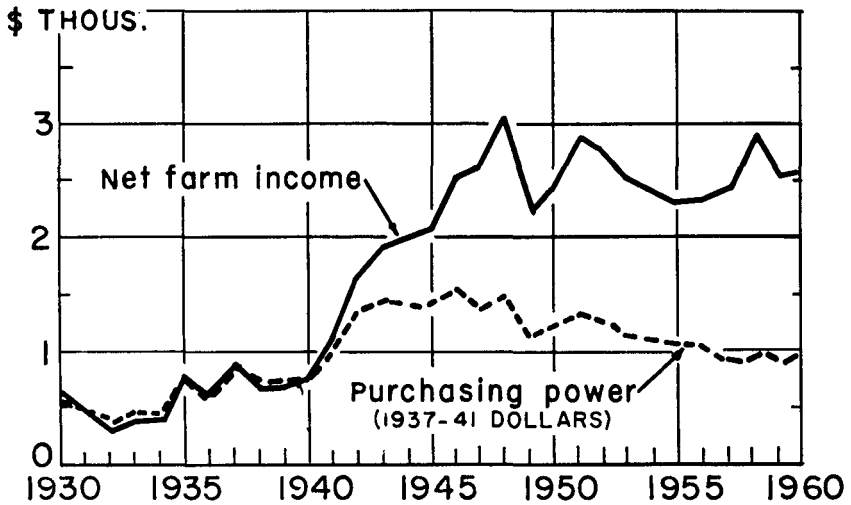

Fig. 2.4. Farm Operators' Net Income Per Farm and Its Purchasing Power (Source: USDA).

greater volume. But historically, persons of the lowest income strata of agriculture have gained only meagerly from national economic progress.

RESOURCE ADJUSTMENTS

The answer to the income problem would seem simple. A recent Secretary of Agriculture suggested some elementary arithmetic: divide the declining numerator, total farm income, by a declining denominator,

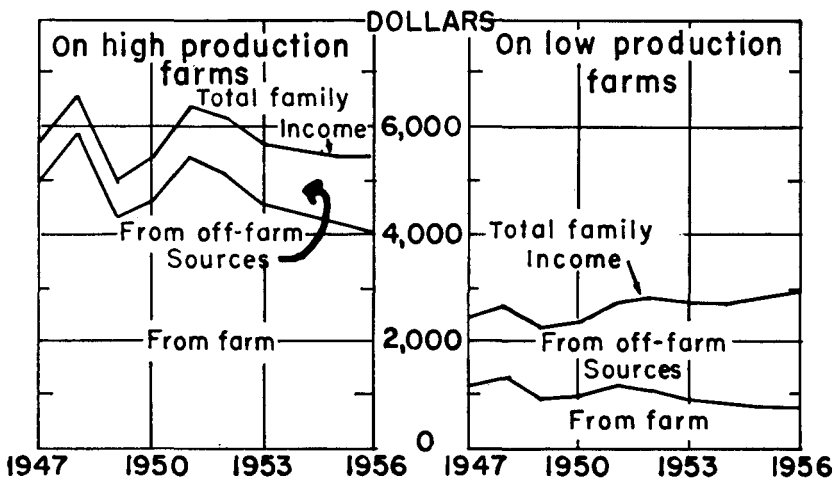

Fig. 2.5. Average Income of High Production (Gross Sales of $2,500 or More) and Low Production (Less Than $2,500 Sales) Farm Operator Families (Source: USDA).

TABLE 2.5

NUMBER OF FARMS BY SIZE OF ACREAGE GROUP, UNITED STATES, SPECIFIED YEARS, 1930–59

Item	1930	1940	1945	1950	1954	1959
Number of farms (thousands):						
Under 10 acres	359	506	595	485	484	240
10 to 49 acres	2,000	1,780	1,654	1,478	1,213	811
50 to 99 acres	1,371	1,291	1,157	1,048	864	657
100 to 179 acres	1,388*	1,279	1,200	1,103	953	771
180 to 259 acres	476*	517	493	487	464	414
260 to 499 acres	451	459	473	478	482	471
500 to 999 acres	160	164	174	182	192	200
1,000 acres and over	81	101	113	121	130	136
All census farms	6,289	6,097	5,859	5,382	4,782	3,704
Average size of farm (acres):						
All census farms	157	174	195	215	242	302
Commercial farms†	—‡	220	255	300	336	371

Source: Jackson V. McElveen, *Family Farms in a Changing Economy*, Agriculture Information Bulletin No. 171, Agricultural Research Service, USDA, March 1957, and Bureau of Census.

* Corrected for comparability with more recent census data.

† Census class I–IV farms, except that farms on which operator did 100 days or more of off-farm work or on which family nonfarm income exceeded farm sales were excluded from class V as well as class VI. Also excludes abnormal farms.

‡ Not available.

number of farms, and increase the per farm income quotient. Given knowledge of variables and relationships which enter into supply and equilibrium price, the structural answer also would seem simple: reduce inputs, contract output and improve prices and income. The Secretary's suggestion implies qualitatively these changes which might be suggested by economists.

Agriculture has made some very large structural adjustments since 1940. Some of these, as migration of labor from farms, have been truly remarkable but have not been great enough to arrest the downturn in income, or to cause real income to push upward to levels of important nonfarm sectors. The number of census farms declined by 2.2 million or around 40 percent between 1945 and 1959. However, as can be determined from Table 2.5, the greatest part of this decline has come from smaller farms, those of less than 179 acres in size. The number of farms larger than this has remained relatively constant in the last 15 years, with some reduction below 260 acres and an increase from those with larger acreage. The total product of American agriculture can still be produced with many fewer farms.

As Table 2.6 shows, less than 30 percent of farms fell in classes I, II and III in 1954 but produced nearly 80 percent of the value of agricultural products; adding class IV, 44 percent of all farms produced 91 percent of output. The 25 percent of commercial farms falling in classes V and VI and the 30.4 percent of part-time, residential and abnormal farms could easily disappear, with food needs of the nation being met because the latter produce such a small portion of output. But the bite

TABLE 2.6

ECONOMIC CLASSIFICATION OF FARMS, UNITED STATES, 1954

Economic Class	Sales Per Farm	Number of Farms (*thousands*)	Percentage of All Farms	Percentage of Value of Products Sold
"Commercial" farms				
Class I	$25,000 and over	134	2.8	31.3
Class II	$10,000 to $24,999	449	9.4	26.9
Class III	$ 5,000 to $ 9,999	707	14.8	20.5
Class IV	$ 2,500 to $ 4,999	812	17.0	12.1
Subtotal		2,102	44.0	90.8
Class V	$ 1,200 to $ 2,499	763	16.0	5.7
Class VI	$ 250 to $ 1,199*	462	9.7	1.4
Subtotal		1,225	25.7	7.1
All "commercial"		3,327	69.7	97.9
Part-time	$ 250 to $ 1,199*	575	12.0	1.4
Residential	Under $250	878	18.4	.3
Abnormal†		3	.1	.3
Subtotal		1,455	30.4	2.0
All farms		4,782	100.0	100.0

* Farms with sales from $250 to $1,199 are classified as part-time if the operator worked off the farm 100 days or more or if the family's nonfarm income exceeded the value of farm products sold.

† Public and private institutional farms, etc.

Source: 1954 Census of Agriculture.

could go much deeper. Scale economies and underemployed resources of typical commercial farms undoubtedly are great enough that a third of these 1.5 million farms could be removed from the scene, with the farm output produced abundantly by a remaining 1 million commercial farms. In 1959, 795,000 farms with sales over $10,000 (32.8 percent of commercial farms) had 71.9 percent of the sales of all farms. The 1,449,000 farms with sales over $5,000 (59.8 percent of commercial farms) had 97.1 percent of the sales of all farms.

There is still much slack in farm numbers and sizes, but withdrawal of small farms adds only slightly to income of true commercial farms. The resources and income of the former are small and add little but "magnitude of average" for large farms. The fact that the greatest decline has been in small farms magnifies the change in per acre size of commercial farms indicated in Table 2.5 between 1940 and 1959. Yet, it is still true that sizable changes in commercial farm size have taken place, especially in specialized grain producing and arid regions. This trend can continue because farms of typical size in corn and wheat regions especially have underemployed labor and machine resources and their high mechanization allows some further cost economies. Under pressure, American consumers could be fed, with some commodity ex-

ported and supply pressure still existing, with two million or fewer of all farms and a million of commercial farms.

Change in Labor Resources

Two of the more dramatic changes in American agriculture since 1940 have been a decline by a third in the total labor input and an increase of 50 percent in the total output. Obviously, some fairly marked reductions in the labor force have taken place without causing agricultural output to decline. As will be explained later, these changes were possible because of the great surplus capacity, or underemployment, of specific capital and labor resources in agriculture. In fact, if simple empirical inferences were to be drawn from trends of the past two decades, the conclusion would likely be that further reductions in the labor force and in the number of farms will take place while output of farm products will increase. Regression and correlation coefficients for the data of Figure 2.6 need not be derived to make such predictions. Figure 2.6 is not presented as a naive model containing all variables which explain increases in agricultural output. Obviously, numerous other

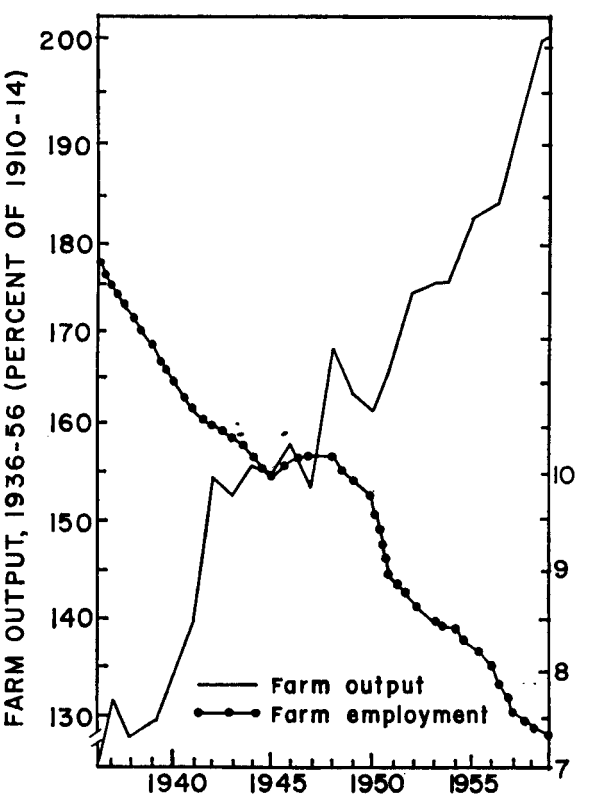

Fig. 2.6. Index Numbers of Farm Output and Total Farm Employment, United States, 1936–59.

variables affected output during the period. Two of importance were (1) greater inputs of certain capital items (representing known techniques) such as farm machinery, livestock numbers, fertilizer in particular areas, etc., and (2) inputs of particular capital items (representing newly developed techniques) such as the host of new crop varieties, insecticides, antibiotics, livestock breeds, and other innovations introduced during the period. But along with these changes other developments, (a) decreases in the farm population and labor force and (b) decrease in farm numbers and consequent increase in farm size, also allowed or brought about increased output.

It is well agreed that, relatively, income of agriculture is low because growth in output outpaced growth in demand during the 1950's. Furthermore, since agriculture obviously has a surplus labor force, it would seem that returns on resources in agriculture, in the long run, can be best put on a par with those in other industries by maintaining a growing number of nonfarm employment opportunities and by reducing the total farm labor input and population in agriculture. The solution of the agricultural problem, therefore, appears simple: Reduce the labor force, shrink output enough to equilibrate agricultural supply and food demand, and, as a consequence, raise resource returns.

This pat solution, in about the cause-effect sequence outlined, is re-

TABLE 2.7

VALUE OF FARM ASSETS, UNITED STATES AND PER FARM AVERAGE, 1940–58

Year	U.S. Value of Physical Farm Assets (current dollars in billions)	Value of Assets Used in Production			
		Per farm		Per worker	
		Current dollars	*1947–49 dollars*	*Current dollars*	*1947–49 dollars*
1940	$ 48.8	$ 6,094	$13,118	$ 3,413	$ 7,347
1941	50.3	6,340	13,444	3,634	7,706
1942	57.1	7,449	14,076	4,330	8,183
1943	65.8	8,934	14,748	5,176	8,549
1944	73.9	10,328	15,042	5,933	8,644
1945	80.2	11,346	15,100	6,625	8,817
1946	88.4	12,435	15,151	7,370	8,980
1947	92.6	14,154	15,364	8,072	8,762
1948	103.0	15,906	15,509	8,890	8,669
1949	109.0	17,144	16,480	9,466	9,100
1950	107.1	16,979	16,979	9,625	9,625
1951	124.8	20,434	17,742	11,394	9,893
1952	139.5	23,206	18,428	13,178	10,465
1953	136.0	22,946	19,009	13,313	11,028
1954	131.9	22,592	19,631	13,256	11,518
1955	135.8	23,806	20,287	14,018	11,957
1956	138.4	25,096	21,091	14,885	12,530
1957	146.0	27,203	22,499	16,880	13,363
1958	155.4	29,600	22,042	18,477	13,831
1959	171.0	33,455	23,165	20,598	14,229
1960	203.6	34,648	23,921	21,303	14,707

Source: USDA Statistics (Agricultural Outlook Charts, 1959 and 1960).

tailed widely, apparently as the immediate solution of the farm problem. We have no question about the long-run accuracy of the suggested adjustment and earlier-made similar suggestions.[5] There is, however, a question of whether the farm problem can be solved in a period of less than ten to fifteen years through this type of adjustment. Contrariwise, in important segments of American agriculture, a reduction per se in the farm population and total labor input promises to increase farm output.

The major structural change conventionally suggested for agriculture's problem, reduction in the labor force, is a long-run solution. It is not likely to solve the aggregate surplus problem of commercial farming in the next decade. Rapid progress towards a long-run objective of a labor force consistent with today's techniques and factor prices may well accentuate the very near-term surplus of farm products. Not only has farm employment declined greatly, but comparable changes have taken place in other aspects of the industry's resource structure and population. Capital per worker, measured in constant dollars, has nearly doubled since 1940. Although the situation differs by geographic region, capital assets per worker are about 50 percent greater in agriculture than in nonfarm industries. These changes represent some remarkable adjustments already in labor inputs and factor combinations for American agriculture. Still the rate and absolute magnitude of adjustment has not been great enough to lessen production or eliminate the farm problem.

Changes in Capital

Increase in input of certain capital items for agriculture has been even more extreme. Machinery and equipment used by 1960 were three times that of 1940. Livestock and auxiliary resources were four times, and fertilizer was 5.5 times the 1940 figure. Total cropland remained almost constant, partly because of space restraints. Value in current dollars of physical assets used in production (Table 2.7) tripled and value per farm increased more than fourfold. However, total inputs for agriculture increased by only 15 percent because the reduction in labor was only slightly less than the increase in capital.

The change in resource structure of individual farms has been greater than, and somewhat different from, that of the industry. While the industry had a decline of nearly a third in labor inputs between the periods 1930–39 and 1950–58, labor input per farm declined by only about 10 percent. And while the industry experienced no important change in the acreage of cropland, input per farm increased by 40 percent in this period.

The indices of selected categories of inputs in Table 2.8 further emphasize differences in change of resource structure by the industry and the individual farm. Aggregate inputs of the industry increased by only

[5] Cf. Earl O. Heady, *Economics of Agricultural Production and Resource Use*, Prentice-Hall, New York, 1952, Chaps. 24–25.

TABLE 2.8

TOTAL U.S. AGRICULTURAL INPUTS AND INPUTS PER FARM FOR SELECTED RESOURCES AND PERIODS

Item	Aggregate U.S. (Millions)				Average Per Farm			
	1930–39	1940–49	1950–58	1959	1930–39	1940–49	1950–58	1959
Cropland (acre)	477	470	472	470	71.2	78.2	92.6	102.2
All land in farms (acre)	919	1,005	1,042	1,045	137.2	167.5	204.3	227.2
Workers (number)	12.3	10.4	8.5	7.4	1.8	1.7	1.7	1.6
Man hours used (hrs.)*	21.7	18.9	13.0	11.1	3,239	3,150	2,549	2,413
Aggregate inputs‡	100	109	111	110†	100	122	146	160†
Farm real estate‡	100	103	112	112†	100	115	147	163†
Machinery and equipment‡	100	156	266	274†	100	174	376	399†
Fertilizer and lime‡	100	248	474	536†	100	278	624	780†
Feed, seed, and livestock services‡	100	205	313	381†	100	229	412	555†
Paid inputs‡	100	133	160	167†	100	149	238	243†
Unpaid inputs‡	100	86	71	65†	100	96	94	95†

* Billions for U.S.
†1958.
‡ Index.
Source: USDA Statistics.

10 percent over the 20 year period 1930–39 through 1950–58. While the increase in capital forms such as fertilizer, machinery and livestock were large, the decline in labor inputs and the relative constancy of the large input represented by land tempered the aggregate increase. But, again, because of the decrease in number of farms, total inputs per farm increased by 60 percent in this period. Real estate input per farm increased by 63 percent by 1958, while the increase for the industry was only 12 percent. As an average, per farm use of inputs such as fertilizer, machinery, feed and livestock services increased twice as much as industry use of these same inputs. Between the periods 1930–39 and 1950–58, per farm use of paid inputs increased by 138 percent. The comparable figure for the industry was only 60 percent. The index of unpaid inputs, mainly labor, declined by 31 percent for the industry but by only 5 percent for the average farm.

Quite obviously, then, individual farms have capital and financing problems which are greater than those of the industry. The trends pointed out above for the past two decades will certainly continue for the next two, and at an increased rate if relatively full employment and ample employment opportunities are maintained. Continuance of these conditions and increased communication among farm and urban communities will speed up the tempo at which occupational and spatial migration will take place, thus providing the opportunity for remaining farms to expand in land input and total capital assets. Upcoming technology for agriculture will certainly encourage this direction. But even in the absence of new technology, the full adjustment potential growing out of currently known technology and existing resource prices will directly carry typical farms in the direction emphasized by Table 2.8. Capital requirements for farming are now much greater than at any previous time in history. By 1960, typical or modal farms in various regions had these total investments: Cornbelt cash grain, $100,000; Northern Plains sheep ranches and Southern Plains wheat farms,

$85,000; Northeast dairy farms, $31,000; Southern Piedmont cotton farms, $17,000. Large-scale (but not extremely large) farms had investments of two or three times these amounts.

Trends in use of more resources per farm have been highly universal over the United States. As the data in Table 2.9 show, typical commercial family farms in various regions use considerably more land and capital but somewhat less labor. In most cases, reduction in per farm labor input, on these commercial units, has been much smaller than for agricultural industry, and increase in nonreal estate capital has been much greater than the national aggregate. However, considerable variation has existed among types. Increase in per farm use of nonreal estate capital has been lower for cotton and tobacco farms, with the latter having an effective price and quota program over the 20 year period, in the South than for Cornbelt and Great Plains farms and ranches. Similarly, typical dairy farms increased use of capital by a greater proportion than southern cotton and tobacco farms.

However, the cotton farms in the Southeast decreased labor inputs

TABLE 2.9

COMPARISON OF INPUTS, 1937–41 AND 1959, FOR SPECIFIED TYPES OF FARMS IN THE U.S.

Type of Farm and Location	Land (acres)		Labor (days)		Nonreal Estate Capital ($)	
	1937–41	1959	1937–41	1959	1937–41	1959
Cotton:						
So. Piedmont	158	183	526	370	$ 1,010	$ 3,120
High Plains (Tex.)	258	404	431	320	2,530	8,140
Delta (small)	53*	58	375*	274	1,540*	3,640
Peanut-cotton	122*	163	404*	332	1,820*	4,000
Cornbelt:						
Hog-steer	178	208	425	403	6,280	22,530
Cash-grain	209	234	380	329	4,910	17,560
Dairy farms:						
Central northeast	176	217	533	433	4,100	16,200
Southern Minn.	135	156	482	393	3,460	15,030
Tobacco:						
Kentucky	110	118	438	391	1,540	5,390
Coastal plain (large)	170*	170	1,084*	851	6,630*	7,830
Coastal plain (small)	50*	50	381*	320	1,900*	2,060
Wheat:						
No. plains (corn)	427	506	374	388	3,220	21,940
So. plains	586	732	272	312	2,860	13,140
Washington (pea)	416	555	389	349	6,600	29,270
Cattle Ranches:						
Northern plains	3,322	4,240	412	388	9,090	26,260
Inter-mountain	1,573	1,725	487	499	14,050	45,310
Southwest	8,316*	11,090	395	337	26,460	28,100

* 1947–49 (1937–41 not available).

Source: *Farm Costs and Returns*, Agr. Info. Bul. 176, USDA (rev. 1959).

by a larger proportion than other types of farms over the nation. While the increase in capital and land inputs per farm has not been as rapid for farms in the Southeast over the past two decades, the rate of change may well catch up over the next two decades. Change has been tardy in the Southeast because of (1) lower wage rates tending to discourage the substitution of high capacity machinery for labor, (2) the relatively less favorable initial capital position of farms in the Southeast, (3) poorer school facilities and lack of communication for occupational migration and improved farm management and (4) the tendency of many abandoned farms to move into forestry rather than into the farm consolidation process.

However, if national economic growth continues at a rapid rate, with relatively greater tempo in the Southeast than in the Midwest and Plains areas, factor prices will encourage a more rapid substitution of capital for labor. Economic stability and favorable incomes also can encourage a more rapid rate of farm consolidation and enlargement in the future than in the past. However, the rate of increase in land and capital inputs needed per farm must be much more rapid and of greater relative magnitude if the income gaps, between the Southeast and (1) nonfarm employment and (2) farming elsewhere in the nation, is to be closed. The changes needed are large, if returns on labor resources especially are to be brought to levels which Americans would currently term "decent." While the economic environment will allow these adjustments in the Southeast to be more rapid in the future, capital availability stands as a major obstacle in allowing per farm increases in land and capital inputs of the magnitudes needed.

Product and Resource Prices

Farm commodity prices have been depressed in the 1950's, enough to more than offset inflation and the rise in the general price level. Prices of all inputs have increased and farm profits in agriculture have declined. In response to this price and income complex, plus the relatively favorable returns to land and transfer of labor to nonfarm uses, capital inputs have increased, with land declining slightly and labor greatly for the industry as a whole. At first glance, it would appear that market forces, the prices of commodities relative to the prices of resources particularly, would cause the industry and firm to move in the same direction. Or, with scale economies associated with new technology still not fully exploited by individual firms, contrasting trends might be expected. Yet there also are other forces which have bearing on the quantity and mix of resources used by the firm, with contrasting adjustment of the industry.

New machine technology generally has served as a substitute for labor. One relationship between new machine technology and increased capital demand by the individual farm is reflected in the farm's cost curve or structure. However, the magnitude of the machine prices relative to the prices of other resources and to farm products is an important causal factor determining the amount of this specific form of capital

which is used in agriculture. (Relative changes in the rate of substitution of machinery for other resources also are important in this respect.) Rather than discuss machinery alone within this framework, we turn our attention to capital resources in general. Resources such as fertilizer, feed additives, improved seeds and others have been used in increased quantities mainly because they have been priced favorably relative to the prices of farm products and because their marginal productivities have increased from technological discovery. Within this favorable environment, scale or cost economies have had little, if any, relationship to increased demand for such "biological" resources.

For the individual farm, capital items such as fertilizer, insecticides, fuel and seeds serve generally as complements with land. As more acres are operated, additional quantities of the capital items also are used. Similarly, with an increase in the number of animals and birds handled, the amount of feed and livestock services also increases. Technically, of course, other capital inputs can serve as substitutes for land and livestock, even for an individual farmer. He can produce a given output, for example, with more fertilizer and less land or vice versa. But in general practice and because of favorable price relatives, he either uses more fertilizer and other chemicals or inputs on a given acreage, or expands their use as he takes on a larger acreage. For the industry, however, fertilizer and similar materials serve more clearly as a substitute for land. With the large increase in fertilizer, insecticides, improved seeds and materials of other innovations, the nation's food output can now be produced with fewer acres devoted to the conventional mix of crops. Unfortunately, however, it has not been possible to withdraw or shift the excess land and surpluses still accumulate. But even if the national input of land were diminished to bring output into line with demand, individual farmers producing the particular commodity would not do so (in the absence of "across the board" control programs) but would continue to increase land and associated inputs, as long as price and marginal productivities of these resources are favorable relative to the prices of the commodities they produce.

The prices of factors used in production (Table 2.10) and the physical

TABLE 2.10

INDEX OF PRICES RECEIVED AND PRICES PAID FOR SELECTED INPUTS, 1935–59
(1935–39 = 100)

Index of	Period				
	1935–39	1940–44	1945–49	1950–54	1955–59
Prices received by farmers	100	144	231	252	221
Price of fertilizer	100	106	132	150	151
Price of machinery	100	102	130	173	191
Price of labor	100	178	333	395	455
Price of land (alone)	100	112	188	254	325
Price paid, all costs	100	122	184	220	229

Source: USDA.

TABLE 2.11

EXPECTED EFFECT OF CHANGES IN PRICE RATIOS AND MARGINAL PRODUCTIVITIES ON RESOURCE DEMAND (COMMODITY DEMAND FIXED)

Price Change	MPP Decrease	MPP Constant	MPP Increase
P_x/P increase	$X_n < X_0$	$X_n < X_0$	$X_n \; ? \; X_0$
P_x/P constant	$X_n < X_0$	$X_n = X_0$	$X_n > X_0$
P_x/P decrease	$X_n \; ? \; X_0$	$X_n > X_0$	$X_n > X_0$

magnitudes of their marginal productivities have favorably encouraged an increased demand by individual farmers for most major categories of inputs.[6] This has been true even in recent years when commodity prices have been depressed relative to factor prices generally. If marginal productivities are increased sufficiently through technical innovations, the farmer's demand for inputs can increase even under conditions of commodity prices which decline relative to factor prices.

Supposing that X_0 represents the original quantity of the resource, X_n is the new quantity, P is the price of the product and P_x is the price of the factor, we have the nine possible combinations of "developmental" changes represented by the cells of Table 2.11. The rows represent changes in the magnitude of the factor/product price ratio while the columns represent changes in magnitude of marginal physical productivity (MPP) of resources. Each cell indicates the expected change in factor demand by the individual farmer. For example, with the MPP and price ratio, P_x/P, both constant, no change would be expected in factor demand (the middle cell of the table). We can generally rule out the first column, except for situations such as extreme soil erosion. The middle column may apply to a few resources where technical innovation has been unimportant (for example, more so for range resources in the Inter-Mountain region than for farm resources elsewhere in the nation). However, the demand situation for most resources such as land, chemicals, machinery, livestock and feed is that characterized in the third column. The marginal productivities of the resources have increased due to technical research by the USDA, the land-grant colleges, private firms and farmer discovery and management. With the price ratio constant or decreasing, demand by individual farmers for the resources would increase. With the price ratio increasing, demand for resources would be expected to increase or decrease depending on whether the relative improvement in productivity of the resource is relatively greater or less than the increase in the price ratio. Evidently, for individual farmers in most regions of the country, the marginal physical productivities of resources have increased faster than the factor/product price ratio has increased in recent years. And in numerous occasions, the

[6] Against a 1910–14 base, indices of prices over the period 1950–59 were as follows: machinery, 349; operating expense items, 217; hired wage rate in agriculture, 642; land, 208; and building materials, 359.

specific resources (especially chemicals) have represented a situation such as the element connecting the third row and the third column.

Industry and Farm Differences Under Capital Limitations and Profit Depression

By resort to simple algebra, we illustrate how it can be profitable for an individual farmer, previously limited on resources but now able to acquire more because of capital gains in land through inflation or because of other reasons, to increase use of resources while prices and return to the industry in total decline. The demand equation is (2.1) where we substitute e for .4 and simply suppose, as in agriculture, the price elasticity is less than 1.0. The individual farm's production function is (2.2) except that we use elasticities of b and m and the industry production function, with n firms, is simply n times (2.2), in order to keep the example simple. We also suppose that b and m are each less than 1.0. While farmers are responsive to price, to be discussed later, we suppose that output in separate short-run periods is that forthcoming from a (fairly) fixed collection of resources in the period, a case to illustrate the logic but overly simplified for later analysis. (Hence, short-run supply equals the production function.) The amount of resources may be increased in a second period because farmers have the capital for acquisition and greater credit base as in the period 1940–60. Market demand and supply, in the first short-run period are equated in (2.14) and the equilibrium price thus derived is (2.15) where we set $r=e^{-1}$,

$$naX^bZ^m = cP^{-e} \tag{2.14}$$

$$P = c^r n^{-r} a^{-r} X^{-br} Z^{-mr} \tag{2.15}$$

which is a quantity greater than 1.0. The total value product, V, for the industry in this ultra-short-run equilibrium is (2.16) and will decline with any increase in magnitudes of inputs and input in a "next short-

$$V = (c^r n^{-r} a^{-r} X^{-br} Z^{-mr})(naX^bZ^m) = c^r n^{-u} a^{-u} X^{-v} Z^{-w} \tag{2.16}$$

run period" under the inelastic demand situation. Letting $1-r=-u$, $b(1-r)=-v$ and $m(1-r)=-w$, and with these quantities all being negative, this decline is obvious in the marginal value productivities of (2.17) and (2.18).

$$\frac{\partial V}{\partial X} = \frac{-vc^r}{n^u a^u X^{v+1} Z^w} \tag{2.17}$$

$$\frac{\partial V}{\partial Z} = \frac{-wc^r}{n^u a^u X^v Z^{w+1}} \tag{2.18}$$

If the industry of farmers increases inputs and outputs, net revenue will decline (marginal value productivities are negative) if the resources have prices of zero or greater. If we suppose nonzero and positive prices

of P_x and P_z for the two resources, this is still true for the industry but the outcome for the individual farm operator is different. Let us suppose that equity financing and risk aversion or credit rationing has restrained his purchase of resources such that their marginal products are greater than the two price ratios PP_x^{-1} and PP_z^{-1}. There are many experimental production function studies, linear programming and budgeting analyses and farm record summaries showing that the marginal returns on particular classes of resources have been much greater than their costs to individual farmers in postwar years. Even during the period of decline in feed grain prices, Iowa studies show that the return from fertilizer, at the rate at which farmers typically were using this resource, was over twice the cost of this resource. The same thing exists in respect to fertilizer use elsewhere over the nation, if one applies economic analysis to fertilizer response data.

Because of atomistic competition, demand for the product of individual farm is infinite at a constant product price of P. Total value product for the individual farmer is that in (2.19) while the marginal value products of resources are (2.20) and (2.21) where Q_p is as defined as n^{-1} proportion of the left-hand member of (2.14).

$$V = PaX^bZ^m \tag{2.19}$$

$$\frac{\partial V}{\partial X} = bQ_pPX^{-1} \tag{2.20}$$

$$\frac{\partial V}{\partial Z} = mQ_qPZ^{-1} \tag{2.21}$$

Total value product and marginal value productivities for an individual are not negative from the outset, as for the industry. Given a sufficient degree of capital limitations prior to a period such as 1940–60, marginal value quantities can be much larger than the factor prices for the individual farmer. If he has excess of income over expenditures and capital appreciation due to inflation or saving, providing him with added funds or credit base for purchasing resources beyond the original restraint levels, he can add to net income by using more resources, even though the industry cannot. He can profitably add resources (with the industry doing likewise but with price and aggregate net income declining) as long as the quantities in (2.20) and (2.21) for him are greater than factor prices.

For an important portion of the period following 1940, farmers used a big part of their increased incomes to pay off debts. But even so, individual farmers had added savings for purchase of more resources. Also, a smaller percentage debt on greater total assets still allowed a greater dollar or absolute amount of borrowing. While total inputs of the agricultural industry increased only modestly over the period 1940–59 under these conditions, there was a sharp rise in per farm use of

resources. This differential change was possible because farmers remaining in the industry were in an advantageous resource purchasing position, able to acquire some resources otherwise used by migrating persons less well situated economically.

We have attempted to examine only one force: namely, the use of more resources by individual farmers in a depressed industry and illustrating that in an industry where greater inputs and output cause aggregate income to decline, individual farmers, previously limited in resource quantity by capital limitations, can still purchase more inputs and increase income relative to the group. But to do so they must increase their output by a larger percentage than the decline in price and/or attain certain other conditions in respect to costs. Farmers who cannot do so find themselves with depressed incomes, with the alternative of also increasing resources used or of leaving agriculture. Many followed the latter course over the past decade, with the conditions explained above allowing for individual farmers to remain in the industry. Industry net farm income declined in recent years, even while industry capital inputs were increasing. Because of fewer farms, income per farm has not fallen proportionately, although there is great difference among farms. Individuals increasing use of inputs by largest proportions and changing to profitable new technologies have partly offset the decline in prices by greater volume and lower unit costs. Some have increased their income by doing so, even while average income per farm declined. Other strata of farmers have experienced a sharp decline in income because capital and other forces have restrained their use of more resources and new technology.

Scale Returns and Cost Economies

Generally, however, the opportunity for individual farmers to increase their use of resources, extend output and increase profits (or keep profits from declining when returns to the industry are depressed from greater output) rests on (1) increasing scale returns or cost economies associated with the prevailing or potential technology and/or (2) the relation of input prices to product prices.

On-the-farm scale returns or cost economies arise mainly from mechanical innovations such as those relating to power, machinery, equipment and buildings. They are only slightly, or not at all, related to such biological innovations as new seed varieties, fertilizer, insecticides and chemicals. Power units, field machines and harvesters of greater capacity and larger crop handling equipment have particularly increased the size or acreage range over which declining per unit costs prevail in cotton, corn, wheat and other field crop areas. Too, increased capacity and productivity of these machines has increased greatly the number of acres, animals and birds which can be handled by one man or the farm family. Since the fixed costs of these high capacity machines are greater than those of machines in prewar days, the curve of per unit costs declines more sharply over larger outputs. A greater gain in net returns per unit

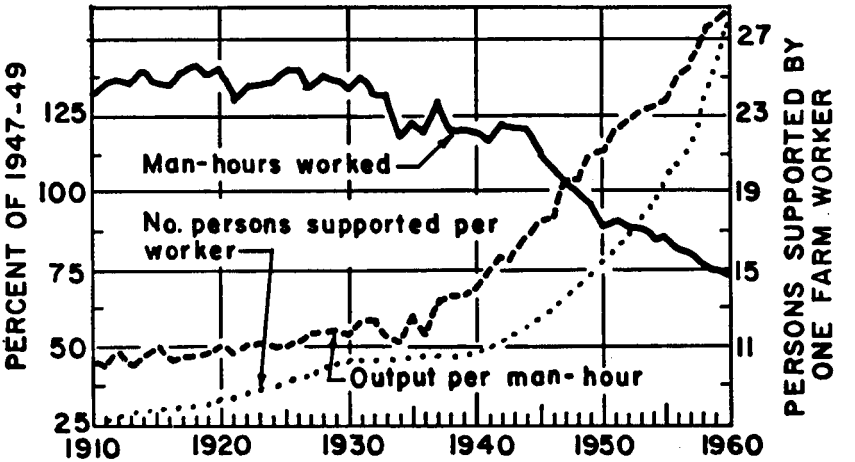

Fig. 2.7. Man-Hours worked, Man-Hour Productivity and Persons Supported Per Farm Worker.

as size increases is thus realized. For the same reason, the economic disadvantage extends more sharply to farms of small acreage. And, as pointed out in Chapter 14, they realize less relative gain from supply-restricting policies.

These recent and developing machine technologies increase the per farm demand for, or use of, several types of capital. First, of course, if they are going to be used, the investment in machinery and equipment itself is increased. But since the main cost advantages of these newer machines are realized only if their higher fixed costs are spread over more acres or animals, the latter categories of capital must be increased and the investment is augmented accordingly. Also, as implicit in (2.19) and (2.20), greater input of one factor increases the marginal value productivity and demand for others. In numerous types of production, investment in the added land or livestock, inputs necessary to allow attainment of the lower per unit costs from newer but more costly machines, is greater than the increase in machine investment.

PRODUCTIVITY AND OUTPUT OF LABOR

Adoption of new technology and the general structural change discussed above have greatly increased the physical productivity of U.S. farm labor. Value productivity per man has also increased, but by a much smaller proportion because price elasticity of demand is less than 1.0. Figure 2.7 indicates the magnitude of increase in physical productivity. Productivity per man hour increased by about 200 percent between 1940 and 1960 while productivity per person increased by 130 percent. The average number of persons supported per farm worker increased from 10.8 in 1940 to nearly 30 in 1960, compared to 7.1 in 1910

and 4.1 in 1820. In a developmental sense, these figures contrast with around 75 percent of the labor force used in agriculture in India and around 40 percent in Russia.

Resource Substitution Rates

Numerous factors have led to this remarkable increase in labor productivity. First, migration of persons from low productivity farms would increase the average of the industry, even if remaining farms did not increase labor productivity. However, other commercial farms have done so through use of mechanization and substitution of machines for labor and through the adoption of biological techniques generally. Innovations which increase yield per animal and acre do not increase labor requirements proportionately, and sometimes scarcely at all. Accordingly, productivity of labor is increased, just as it is when greater capacity in power and machinery is used to increase the number of animals and acres handled per man. Then, too, productivity of a particular resource is always increased, along a product isoquant, as input of one factor is decreased and another is increased.

Any development leading to an increase in labor productivity also tends to increase the rate at which capital substitutes for labor. Hence, fertilizer and improved seed, which increase yield per acre, and feed additives, which increase output per animal or feed unit, serve as substitutes, just as mechanization which replaces labor directly. With a fairly constant output desired by consumers at a particular time, and with prices favoring adoption of a technique, the greater productivity of land decreases the amount of both land and labor required to produce the nation's food. This point can be illustrated with either discrete type of innovations or continuous functions representing changes in technology. For example, suppose that fertilizer can be used on an acre of land to give a production function of typical form in (2.22) where Y is yield per acre and F is fertilizer per acre. (The same results prevail generally for any type of production function.) For a given soil type, supposing it is possible to obtain the same results for each acre, the aggregate

$$Y = f(F) = a + bF - cF^2 \tag{2.22}$$

$$Y^* = aA + bF - cF^2A^{-1} \tag{2.23}$$

production function in (2.23) exists where A, number of acres, is multiplied by the per acre production function in (2.22) and F in (2.22) is divided by A for (2.23). The "gross" marginal rate of substitution of fertilizer for land thus is defined in (2.24), derived from (2.22) and (2.23).[7]

[7] If we wish to express marginal rates of substitution for a particular output level, we can first define the isoquant in (a):

$$A = \frac{Y - bF \pm \sqrt{4acX^2 + (Y - bX)^2}\,K}{2a} \tag{a}$$

It is the negative of marginal productivity of fertilizer divided by

$$\frac{\partial A}{\partial F} = \frac{2cFA^{-1} - b}{a + cF^2A^{-2}} \tag{2.24}$$

marginal productivity of land. If labor requirements per acre are constant regardless of yield, and land and labor are pure technical complements, we can substitute the appropriate term for A in (2.23). For example, if L is labor and r units of labor are required per acre, $L = rA$ and $A = r^{-1}L$, the same total function expressed in terms of labor is (2.25). The "gross" marginal rate of substitution of fertilizer for labor is

$$Y^* = ar^{-1}L + bF - crL^{-1}F^2 \tag{2.25}$$

$$\frac{\partial L}{\partial F} = \frac{2crL^{-1}F - b}{ar^{-1} + crL^{-2}F^2} \tag{2.26}$$

(2.26), a continuous function of the amount of fertilizer applied per acre and the number of acres fertilized.[8] However, the same general procedures specify the rate of substitution of other discrete practices or materials for labor, if we simply consider increments and replace ∂ with Δ. Roughly, as an average rate of substitution, it appears that each 20,000 bushel increase in corn production ($\Delta y^* = 20{,}000$) from new technology has allowed release of one worker for agriculture; each 10,000 bushel increase in wheat ($\Delta y^* = 10{,}000$) from new technology has released about one man. Recent estimates suggest that, for the 1960 level of food requirements, new technology has substituted for the equivalent of 60–80 million acres of cropland. Land is extremely immobile and various strata of farm labor highly so. Consequently, in the short run, land and labor have not been released physically and immediately from production. Instead they have tended to remain, producing an output which has not been constant in the product isoquant sense. Output has been increased, with consequent pressure on prices and income and movement of commodity into government storage.

With lagged or delayed action, labor has responded to this change by eventual transfer to business and industry. The migration has resulted both from the push of low incomes in agriculture and the pull of higher returns in other industries. However, because of its low reservation price, often for a particular commodity as wheat and cotton as compared to grass and trees, the quantity of cropland committed to agriculture has remained almost constant, covering 470 million acres in 1920–29 and in 1959. While land remained constant and labor decreased by around 40 percent in this period, total output has doubled. This is

[8] If labor requirements were considered to be a constant fixed amount, K per acre plus m quantity per unit of product (mY^* for total) and k per unit of fertilizer applied (kF for total), the equation can be modified accordingly. In (2.25), we have labor and land as technical complements so that r^{-1} acres of land are used with each value of L in the equation. Also, for each value of L in (2.26), r^{-1} acre of land also is replaced.

the type of change which less developed countries greatly desire; either to substitute other resources for land and be able to feed a growing population or to substitute resources for labor, freeing the latter for industrial expansion. In the United States, the rate at which farm commodity supply has increased and the tardiness with which labor and land have been withdrawn or shifted has not allowed realization of the developmental gains which other economies drive for, or which are probably preferred in the long run by U.S. society.

GENERAL RESOURCE TRANSFERS

National economies take long-run directions which conform largely to consumer preferences and national needs. In general, consumers with higher incomes place greater relative or marginal values on tertiary industries, representing services especially, than on secondary or fabricating and primary or extractive industries. In a broad sense, too, greater marginal value is placed on secondary than on primary industries. With technological improvement and economic growth, resources appear to respond well in the long run to these consumer preferences and, over time, are reallocated accordingly among industries. It is not apparent that there has been sufficient degree of monopoly in the U.S. economy, or that the extent of monopoly and nonprice competition which exists in the short run absolutely prevents this broad pattern in the long run.

Shifts specified by economic growth have not been unique to the agricultural industry but have applied equally to other primary and some secondary industries. (As Chapter 16 shows, productivity increases have been greater in nonfarm sectors than in agriculture.) Historically, changes in technology and demand have revolutionized the structure of some industries and diminished the relative magnitude of others. Capital has been substituted for labor, or workers have shifted from industries with low income elasticities of demand to those where they are higher. Table 2.12 indicates the general types of long-run adaptations which have taken place over an extended period in the United States. Relatively, shift of labor from agriculture has been large but no greater than for other primary industries.

The farm industry has faced all of the types of adjustments mentioned above. New technology in the form of mechanical and biological innovations have substituted for both farm labor and land. Low price and income elasticities of demand have not allowed output to expand as rapidly as for many other industries. The demand for farm labor has shrunk accordingly and migration has been necessary if (1) persons with limited opportunities in farming, because of lack of capital and managerial ability, are to take advantage of alternatives elsewhere in the economy where they can earn higher incomes and (2) those who remain in farming are able to operate with enough capital and land and on a scale which will provide their families with satisfactory incomes.

American society has had great gain from advance of agriculture.

TABLE 2.12

SHIFTS IN DISTRIBUTION OF U.S. LABOR FORCE AMONG INDUSTRIAL SECTORS, 1890 TO 1920 AND 1920 TO 1950

Industry	1890		1920		1950		Percent Change 1890–1920	Percent Change 1920–1950
	No.	%	*No.*	%	*No.*	%		
	(000)		(000)		(000)			
Farming	9,990	42	11,120	27	7,015	12	+ 11	− 37
Forestry and fishing	180	1	280	1	127	0	+ 56	− 55
Total primary	10,170	43	11,400	28	7,142	12	+ 12	− 37
Mining	480	2	1,230	3	1,035	2	+156	− 16
Manufacturing	4,750	20	10,880	27	15,930	27	+129	+ 46
Construction	1,440	6	2,170	7	3,940	7	+ 51	+ 82
Transportation and utilities	1,530	7	4,190	10	4,750	8	+174	+ 13
Total secondary	8,200	35	18,470	45	25,758	44	+125	+ 40
Trade and finance	1,990	8	4,860	12	12,650	22	+144	+160
Personal services	640	3	1,630	4	3,600	6	+155	+121
Other services	2,570	11	4,810	11	9,310	16	+ 87	+ 94
Total tertiary	5,200	22	11,300	27	25,560	44	+117	+126
All industries	23,570	100	41,170	100	58,460	100	+ 75	+ 42

Source: Solomon Fabricant, "The Changing Industrial Distribution of Gainful Workers," *Conference on Income and Wealth*, Vol. XI, National Bureau of Economic Research, Inc., New York. 1949; and George Stigler, *Trends in Employment in the Service Industries*, National Bureau of Economic Research, Inc., New York, 1956. Comparable data for primary, secondary and tertiary classification estimated from data in the U.S. Census of Population, 1950. Vol. II, Part I.

Between 1940 and 1960 alone, output increased by more than 50 percent while total inputs increased by only 6 percent as indicated in Table 2.13. (See also figures 16.1 and 16.2.) Consequently, the amount of resources or inputs (real costs) required per unit of output declined by almost a third in the 20 years. This degree of progress, an increase in ends from given means or reduction in means to attain a given end, has nearly kept pace with that in the economy generally in recent years. Agriculture has not, however, digested this change as rapidly as most other industries. Resources potentially released from food production by this process have remained in agriculture, and while many have been underemployed, they have not been unemployed. Greater productivity has been unleashed as much through greater output as through reduced inputs. With low price elasticity of demand, consumers simply will not take enough product so added to reward farm resources, in amounts retained by the industry, at the level of other economic sectors. But to understand why this condition prevails in a continuous series of short runs, each representing depressed incomes and resource returns, we must later examine the nature of product supply in agriculture; or more importantly, the structure of factor supply for the industry explaining why resources remain in the short run under returns which compare unfavorably with those of other groups.

MAGNITUDES AND EFFECTS OF COMPENSATION POLICIES

Technological improvement, in farming and nonfarm sectors, is the important source of economic progress and rising per capita incomes. Without improvements in technology, limits to the size of national income would soon be encountered. Or while national income might in-

crease gradually with population and size of the labor force, per capita income would decline as population grew. Fortunately in the United States, particularly as a result of technological advance, capital accumulation and improved skill of people, national income has grown more rapidly than population, with a consequent rise in income per capita. Labor productivity has increased throughout the economy, as well as in farming. The nonfarm worker can obtain his family's food requirements with fewer hours of work than at any previous time in history. But also, because of technological progress in farming and other industries, farm people also can acquire nonfarm goods and services with a smaller outlay of labor than in previous decades—even though resource returns have been deeply depressed for a decade. (See Figure 3.5.)

This general type of progress, with more goods and services available with less human effort, is valued highly by United States and other societies. It is desired no less in farming than in other industries. Farming has contributed importantly to this process. Labor has been freed for use in other industries, capital requirements per unit of food production have been kept relatively low, and the real price of food has declined markedly.

But farming has also borne a burden or social cost of important magnitude as a result of its contribution to progress. It has contributed greatly to general progress but its rate of adaptation has been so slow

TABLE 2.13

INDICES OF FARM PRODUCTION AND RESOURCES USED, U.S., 1940–60
(1940=100)

Year	Total Farm Production	Total Farm Resource Inputs Used*	Resource Productivity	Resources Per Unit of Production
1940	100	100	100	100
1941	104	100	104	96
1942	117	104	112	90
1943	115	104	109	90
1944	118	104	113	89
1945	116	102	113	89
1946	120	102	117	85
1947	116	102	113	89
1948	127	103	122	81
1949	123	104	118	84
1950	123	104	118	84
1951	130	107	118	81
1952	132	107	122	81
1953	133	106	125	80
1954	133	106	126	80
1955	138	105	131	76
1956	140	105	132	75
1957	140	105	134	75
1958	152	103	145	68
1959	154	106	144	68
1960	158	106	149	67

* Taxes are included as inputs or costs in the "resource." Hence, the middle column differs slightly from the figures presented in Chapter 16.

Source: USDA.

that it has been penalized in income. Evidently as a compensation for this cost, and through the interest and pressure of farmers and related groups, society has generated numerous compensation policies for agriculture, such as those mentioned in the previous chapter. These policies have not, however, solved the basic problem of agriculture. In their effects, because of the particular variables which were manipulated, they have sometimes had the same outcome as developmental policies, favoring the use of more resources and the extension of output.

In general, policies of the 1950's have not solved the direct problems of supply and price, or the more fundamental problems of factor inputs and their returns. Policies have not arrested the rate of growth in output or the decline in relative income, even though these have been the immediate goals of recent policy. Public costs of programs have increased rapidly, with a greater proportion of price supported crop going under government loan and greater investment in carry-over of increasing stocks. Efforts in expanding demand through foreign and domestic disposal programs have not withdrawn large enough amounts for the domestic market to offset the increment in supply from technical improvement, immobile resources and policies which have had as much effect on the developmental as on the compensation side. In a nation where food supply is scant relative to demand and nutrition, an increase in P of equation (2.4) would be expected to increase the magnitude of Q_s, output. It would also increase cultivators' incomes. This would be accomplished if there were no restraint on X in (2.3). The equivalent of this increase in P and Q_s generally has been accomplished in U.S. farm policy since 1930 when the hope was to eliminate the surplus problem. Support prices have boosted P and modest and ineffective control on magnitude of land use have not restrained capital or X. (In the late 1950's, support prices were used and no input controls were exercised for corn.) As under economic development, income of farmers was supported, if not maintained, and output expanded, just as would be expected had the goal been one of developmental policy to expand output. In the backward nation, where agricultural supply is tardy, we also could pep it up by reducing the magnitude of P_x in (2.4) and increasing the magnitude of π and the elasticity in (2.3). This also has been accomplished in the United States by policies hoping to solve the farm problem; reduction in P_x being the same as (1) ACP payments to subsidize cost of resources and (2) reduced prices for credit resources; and enlargement of π or the elasticity coming about through technical improvement. Programs which have not had developmental effects, in the sense of encouraging even greater outputs, were those dealing with such coefficients as c and the elasticity in (2.1), including school lunch, foreign disposal and others. Government storage and eventual purchase of commodities, without requirement of input control to realize support price, is the equivalent of increasing the exponent of P in (2.1) to 1.0.

The effects of these several programs on commodity stocks and supply for three major categories of agricultural commodities during the

1950's is indicated in Table 2.14. By 1960, the total supply of wheat, including carry-over and production, had reached a level approaching five times the annual domestic food use of this commodity and more than twice the total domestic and export uses of a billion bushels (par of the latter being shipped under government subsidy with economic aid programs). Government stocks were equal to annual production. Total carry-over of feed grains were approaching half of annual uses. Even with price supports and government storage causing large increments in production to be held off the market, however, income from farming declined as indicated earlier. Prices of hogs and poultry products declined quite steadily during the 1950's. Cattle, hogs and poultry followed their normal cyclical price pattern; with the cycle for hogs being somewhat amplified by the rather fixed level of feed prices generated by government support.

Policies aimed at compensation of agriculture supplemented farm incomes but did not arrest the (1) sag in resources returns and (2) further increase in output and supply. This was true even though an important portion of labor resources had migrated from agriculture, farms were fewer and larger with much more capital per unit, and total input of resources and their services remained nearly constant over the decade. By 1960 the more general problem of inelastic factor and product supply functions, large output and depressed resource returns was not the pressing issue. A more immediate problem was disposal of mammoth government stocks requiring a large public outlay for their storage. An even more pressing problem was how to stop the buildup of stocks.

The U.S. public had made large investments in agriculture, just as

TABLE 2.14

STOCKS, PRODUCTION, FOOD SUPPLY OF SELECTED COMMODITIES, 1949–60

Year	Feed Grain (million tons)				Wheat (100 million bushels)			Cotton (million bales)		
	Govt. stocks	Other carry-over	Production	Total supply*	Govt. stocks	Production	Total supply*	Govt. stocks	Production	Total supply*
1949	15.3	15.1	120.1	175.5	3.6	11.0	14.1	3.8	15.9	21.5
1950	20.9	9.6	121.8	178.8	2.1	10.2	14.6	3.5	9.9	16.9
1951	14.8	13.8	113.1	169.2	1.6	9.9	14.2	.8	15.1	17.4
1952	9.0	11.1	119.7	167.7	4.9	13.1	15.8	.3	15.2	18.1
1953	16.6	10.4	117.5	172.2	8.5	11.7	17.8	2.0	16.4	22.1
1954	22.6	9.1	123.9	181.8	9.9	9.8	19.2	7.0	13.6	23.5
1955	29.7	9.4	130.9	196.9	9.8	9.4	19.8	8.1	14.7	26.0
1956	34.7	8.6	130.2	200.4	8.4	10.6	10.0	10.0	13.0	27.6
1957	40.8	8.1	142.9	219.5	8.5	9.5	18.7	5.2	10.9	22.4
1958	49.2	9.9	157.7	246.1	12.1	14.6	23.5	2.9	11.4	20.3
1959	57.0	10.0	167.1	264.2	12.6	11.3	24.3	7.0	14.6	23.6
1960	66.5	12.1	159.4	268.3	13.0	13.7	26.9	5.0	14.3	22.0

* Total does not equal columns on left due to: private carryover in wheat and cotton, by-products for feed grains and variation in definition of period. (Wheat and feed grain stocks also include CCC holdings acquired from private trade and farmer quantities held under nonrecourse loans.)

agriculture had made large contributions to national economic growth, but it had not solved the basic problems of the industry. If anything, the problems were more severe, even though policy mechanisms might have been employed to use the same or fewer funds to compensate agriculture equally (or more) while solving some of the more basic supply and resource problems. These policies were not initiated, probably because agriculture and the general public lacked sufficient understanding of the role of agriculture in a wealthy, rapidly growing economy. Or, perhaps more important was lack of agreement on the policy means to be used; these means taking the short-run character of ends or goals, with conflicts in values or economic interests among particular groups. As indicated in Chapter 14, the nation spent nearly 18 billion dollars on price and income supports over the period 1932–59, or 27 billion dollars if we add ACP direct payments and the cost of school lunch and other domestic food disposal programs. By 1959, these three programs were running to 2.8 billion dollars annually; an amount equal to 23 percent of the year's net farm income. The annual investment was large enough to make great inroads on the basic problems of developmental and poverty origin.

Low Income in Agriculture

Most major policies since 1940 have been aimed at commercial agriculture. The problems of this sector are of quite different degree, but of the same general nature (in terms of labor underemployment and low resource returns), as those of the chronically low income or poverty sectors of American agriculture. The latter had low incomes even in the more profitable era of commercial agriculture. In general, incomes in this sector of agriculture stem from initial conditions which placed little capital and education in the hands of the particular group of farm people. Farmers in this strata sell so little product and possess so few resources that policies of the 1950's could provide them with little income gain. Even had their incomes been supported or increased by as great a proportion as for all U.S. farmers, the increment would have been too small to take them near income levels Americans generally look upon as consistent with the nation's current state of economic development and wealth. While they are important in particular commodities, these farmers contribute little to the national farm output and are not part of the general supply problem. Over 44 percent of all farms had less than $2,500 in gross sales in 1959. This group is unimportant in total supply, producing only 7 percent of total output in 1954. Commercial agriculture has problems of human resource and family supplies which are large relative to the size of the market and the rewards consumers will provide them through a pure competition market. Low income agriculture has this same problem, but deeper in degree and for somewhat different historic and attached economic reasons.

Any industry has persons with low incomes resulting from age, illness and human hardship of various kinds. Agriculture has these, but they

are not the basis of the widespread low income problem. The truly low income sector of agriculture is regionally concentrated in such areas as the South, the Appalachian Mountains and a few other scattered regions. In the South, 33 percent of farms had gross sales of less than $2,500 in 1954. They produced only 15 percent of the product in the region. Of the 1.2 million farms with sales of less than $2,500, nearly two-thirds were in the South. To explain the causes for this low income, we would need to delve deep into institutional, industrial and historic variables. Even if these problems were solved, the major problems of commercial agriculture would remain. Or, conversely, if the commercial farm problem were solved, the low income problem would remain. The task for the latter is, while allowing some to become commercial farmers, to give low income farm families, and particularly their children, the educational and occupational opportunities which are consistent with their abilities, human rights and growth opportunities in a wealthy and growing society. In this sense, many of them have been by-passed in economic and social legislation of recent decades.