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SOME CONSIDERATIONS IN APPRAISING THE LONG-RUN PROSPECTS FOR AGRICULTURE

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A. INTRODUCTION

ALMOST every action taken by an individual, a firm, or a government making a commitment extending over several years—whether it be the purchase of a home or a car, the building of a factory, or the development of a huge irrigation project—involves an explicit or implicit appraisal of the future in relation to the action taken. Much legislation relating to long-run commitments made by the government provides that rather specific cost-benefit computations and repayment schedules be developed for appraising a project or for ranking one project relative to others proposed. Many departments and agencies of the government—the Interior Department, the Army Engineers, the Soil Conservation Service, the Forest Service, and lending agencies of various types—must base their proposed programs on an appraisal of the future. These programs include development of rivers and harbors, flood control, construction of power dams, improvement of waterways, conservation of resources, reforestation, construction of public buildings, river valley development, and others. Appraisals for these purposes often require projections in much

Note: This is not an official report of the Bureau of Agricultural Economics. The views are the author's own. However, the Bureau has a continuing interest in the long-run prospects for agriculture and is called upon from time to time to make such projections as a basis for appraising proposed projects relating to river valley development, flood control, reforestation, and long-term financing. One of the most controversial issues relating to such projections is that of the general price level. Many of the important factors influencing the long-run level of prices are beyond the scope of economics. This paper appraises the prospective level of prices under specific assumptions which may or may not materialize. The analysis and projections relating to prices do not represent an official position of the Bureau, nor has the report, as a whole, been reviewed by the Bureau for publication. Although the author is completely responsible for the content of the paper, he wishes to acknowledge the advice and comments of K. A. Fox, N. M. Koffsky, O. C. Stine, R. O. Been, and many others of the Bureau of Agricultural Economics. Thanks are tendered also to Professors E. J. Working and L. J. Norton of the University of Illinois for their helpful comments and suggestions. This paper is based on a report submitted for a Ph.D. thesis at the University of Illinois.

more detail than can be justified in terms of statistical error concepts. Yet such projections are made and will continue to be made.

The purpose of this investigation was to prepare a set of projections for the economy centering on 1970, in which to cast an appraisal of the long-run prospects for agriculture. Specific objectives included projections of the population, the labor force, productivity, total output, the price level, and the relative position of agriculture, i.e., the demand for farm products, farm output, imports and exports, farm income, prices received for major farm products, and prices paid for products used by farmers.

Most economists will agree that forecasting, either short-term or long-run, is a hazardous undertaking. Any appraisal of the future could set in motion the very circumstances that would make it inaccurate. Long-run forecasts are usually "conditional" within a framework of assumptions. Unfortunately, it is often difficult to specify more than the main assumptions. Projections of the population, labor force, productivity, and potential output are usually based on relatively stable patterns of growth and are generally considered to be more accurate than those involving the price level or prices of specific commodities. However, even the more basic trends may vary and may materially influence the accuracy of long-run appraisals. Probably there are no economic forecasting techniques for the long term which are highly accurate or to which a probability calculus can be applied. We cannot determine the probability that a long-term projection will fall within a given range. Informed judgments about the future also differ, as do attempts to make objective forecasts in a framework of assumptions.

Appraisals of the future are influenced to a very large extent by the sum total of social, political, and economic forces characterizing the current era, and these may distort the perspective of the economic forecaster. For example, in the spring of 1929, a report by the Committee on Recent Economic Changes of the President's Conference on Unemployment commented on the health of the nation and the "degree of progress in recent years." These observations were made on the very brink of the 1929-32 depression. It was but a few years later (1934) that Dr. Nourse and his associates in the Brookings Institution were concerned with the distribution of wealth and income in relation to economic progress, to apparent "under-consumption," to reduced outlets

for investment, and to the generally inadequate level of demand.[1] And, toward the end of the decade of the 1930's, there developed the "stagnation" or "mature economy" thesis. The mature economy, it was asserted, would lead to long periods of unemployment and continuous deficit spending by the government to maintain investment and employment. Long-run population projections of the late 1930's and early 1940's probably influenced some of the more pessimistic long-run appraisals made in this period for agriculture and the total economy.

Adam Smith, who wrote during the industrial revolution in England (1776), was optimistic about the prospects for innovation and capital accumulation. Schumpeter likewise wrote in a period of growth and development and considered innovation to be the prime mover in economic growth, without much concern for the possibility that demand might be inadequate to maintain a high rate of capital development.[2] On the other hand, Sismondi, Lauderdale, and Malthus wrote during the latter part of England's industrial and social revolution (1776-1850), when a large poverty-stricken laboring class was concentrated in cities without adequate housing, sanitation, or food. These men were concerned about the prospective lack of purchasing power of the common man and the possibility that investment and capital accumulation might result in output greater than could be absorbed in the market.

Most forecasts made in recent years recognize the potentials of the dynamic economy which has characterized the development of the United States, but the specter of war, or the possibility of long periods of semimobilization, overshadow all other considerations.[3] As man's experience is about the only basis for appraising the future, it appears logical to expect that such appraisals will continue to be influenced largely by the economic, political, and social trends of the time.

B. METHODOLOGY

The nature of growth, process, and change in the economy over

[1] E. G. Nourse and associates, *America's Capacity to Produce* (Brookings Institution, 1934), pp. 1-17.

[2] J. A. Schumpeter, *The Theory of Economic Development*, tr. from the German by Redvers Opie (Harvard University Press, 1936).

[3] See H. G. Moulton, *Controlling Factors in Economic Development* (Brookings Institution, 1949); K. E. Boulding, *The Economics of Peace* (Prentice-Hall, 1945).

time does not lend itself to the rigorous type of analysis employed for short-period or static appraisals. Moreover, in most instances, background data for long-period analyses are sketchy and conceptually inconsistent. Refined statistical techniques must be supplemented by judgment.

A long-run appraisal of the economy must be concerned with the very forces which are usually impounded in the static assumption "other things being equal," as used in most modern theory of the firm and of price determination. We are not so much concerned with the "allocation of scarce means among competing ends"[4] as with the growth in the means themselves. For long-run projections, an appraisal must be made of probable "structural changes" which result in trends in coefficients of relationship of one variable to another or to several others. It is quite probable, for example, that price and income elasticities of consumption vary over time as real income per capita grows and modes of living change. In addition, changes in "taste" and "style" and technological developments modify both the demand for and the supply of a commodity over time. The primary problem of supply response is one of growth in productive factors and innovation. Prospective changes in the "state of the arts" become of primary importance in a long-run appraisal. But, for a given industry, transfer of resources from one industry to another—changes in size—probably are as important as changes in efficiency in determining long-run supply response.

In this report, per capita use of food and other farm products was projected on the basis of apparent trends in taste and consumption habits, trends in innovations influencing consumption, the apparent long-run effect on consumption of price and income, and the judgment of commodity men, each familiar with a commodity or group of commodities. The aggregate per capita use of farm products was first appraised in the projected framework, then compared with detailed projections for the individual commodities and groups of commodities that make up the aggregate. The supply response was also appraised in relation to growth in aggregate farm output, interindustry shifts of resources, output per man, and the shift from horse to machine power. These projections were then compared with detailed commodity analyses which were related to demand, past output, acreage, capital and other inputs, and yields.

[4] G. J. Stigler, *The Theory of Price* (Macmillan, 1947), p. 12.

It will be obvious to anyone who has thought about the problem that we cannot expect to make highly accurate 20-year forecasts of production, utilization, and prices for individual commodities. We may feel reasonably certain, for example, that per capita use of food fats and oils, as an aggregate, will continue reasonably stable, as it has in past years. Yet the prospects for butter and lard as compared with margarine and shortening are much less certain. On the supply side, similar problems arise. An appraisal of the prospects for a group of related commodities is surely more reliable than one for a given commodity. The output of soybeans has grown rapidly over the last three decades. Will it continue to grow as it has in the past? An attempted answer would require assumptions regarding innovations that influence the demand and supply prospects for soybeans and the demand and supply prospects for every other commodity related to soybeans on the side of demand or resource use.

Methodology in appraisals such as those undertaken in this report must be primarily historical, insofar as past relationships and trends in economic, social, and political conditions provide the basis for appraising the future. Many trends reflect tides of change in underlying forces that influence the economy. However, projections cannot be simply an extension of trends. Judgments concerning the future and possible technological developments often provide a basis for modification of past trends. Many empirical measurements and statistical analyses were used in this investigation, with varying degrees of success. For the next two to three decades the long-run stability of growth rates and the general inertia of behavior patterns of individuals over time must provide much of the foundation for a framework of projections. No influence can be considered entirely exogenous to the whole system of cause and effect. Growth of population, the size of the labor force, government policy, and foreign demand are all influenced to some extent by underlying trends in economic, social, and political developments.

In appraising the prospects for agriculture, an equilibrium was assumed within agriculture and between agriculture and the rest of the economy. In general, the rate of growth in demand for agricultural products will marshal resources to provide the commodities desired, and the nature of the supply response will largely condition the cost price required to bring supply and demand into equilibrium. The agricultural and nonagricultural

segments of the economy are closely interdependent from the standpoint of demand and resource use. And, in a long-run economy of growth, it is assumed that labor and capital will be reasonably mobile so that productivity and income of the commercial farm population relative to the rest of the economy will approach some sort of equilibrium, given time for adjustments to take place. The projected balance within agriculture is based largely on the feed-livestock balance and other complementary relationships with respect to both quantities and prices. Prices of products that compete for the same resources were related to each other and to past and expected future trends in these relationships. In effect, an effort was made to examine the competing and complementary relationships among commodity supplies and prices.

General methodology for the over-all projections for the economy involved the basic premise that potential output of the economy over several decades will depend primarily on the growth, employment, and quality of both labor and capital, and the desires of the people as reflected in the institutional, political, and social framework in which the economy grows. The latter group of factors are often important influences on the rate of innovation, shifts in resource use, incentives, and other forces which affect the economic progress of an economy.

C. MAJOR ASSUMPTIONS

No attempt is made to specify all assumptions explicitly. It is assumed that the economy will continue to grow during the next two to three decades much as it has in the last three or four decades. The projections do not assume wartime conditions or long periods of semimobilization of sufficient magnitude to result in continued inflationary pressure. Although the economy is likely to experience ups and downs, it is assumed that the government will be at least partly effective in its countercyclical measures to maintain full employment and prevent deflations of the magnitude of the depression of the 1930's.

Population and the labor force will continue to grow. Innovation, technological development, and capital accumulation will result in greater output per man-hour, and the length of the work week is expected to decline gradually as it has in the past.

Acreage of crops probably will expand very little and the acre-

age that will be released for food production by further declines in the numbers of horses and mules will be small. However, yields per crop acre and per animal unit will continue to rise as a result of new varieties and breeds; new disease, insect, and weed controls; improved livestock nutrition; and use of fertilizer, better cultural practices, and more machinery and equipment. Agricultural policy will affect agricultural growth. But as policy is not planned in advance over long periods, it will be influenced by underlying economic conditions that affect agriculture as well as by the possibility of a politically weaker agriculture.

D. THE PROJECTED ECONOMY

Projections of the population, labor force, capital inputs, and output per man and per man-hour for the United States economy are described at length in this volume. As many of the techniques and considerations used in this study are similar, we report only the projected framework in which agriculture was appraised.

Population projections are somewhat lower than those most recently prepared by the Bureau of the Census. The labor force estimates reflect trends in labor force participation by age and sex groups. Legislation affecting employment and trends in employment by occupation was also considered, as it influences participation of the labor force by age and sex groups. Output per man-hour for the entire economy, approximated on the basis of past growth, was projected at an annual rate of around 2.4 percent per man-hour. This growth assumes, among other things, continued innovation and growth in capital per man, a continuation of interindustry shifts in employment of resources, a continuation of trends in demand influencing the composition of the gross national product, a shift toward more services and other activities formerly performed in the home, and a continued trend toward a shorter work week. Given the population, labor force, employment, hours worked, and trends in output per man-hour, we can readily compute total output of the economy.

1. *The price level*

If we are to specify a level of prices for agriculture and for individual commodities, it will be necessary to begin with a projection of the general level of prices. The association of a "price

level" or some measure of final-product prices[5] with projected employment and output is a difficult problem, both theoretically and empirically. Some of the factors that affect the level of prices, such as war, private and public controls, administrative determinations, and the influence of political pressure groups, cannot be measured. However, an attempt was made to appraise the past and likely future trends of some of the underlying factors that influence the price level, to indicate a level of prices that might be expected to prevail in the projected framework for 1970. The hazards of such projections are realized and the supporting arguments can be only briefly summarized in this paper.

The general framework of the traditional quantity-of-money theory of the price level is probably about as reasonable a basis as is available for appraising long-run movements in the price level. The quantity theory, if anything, is essentially a tool for long-run appraisals. To begin with, values were assigned to the variables of the Cambridge cash-balance version of the equation of exchange, $M = KPQ$: M refers to the total of money outside banks, demand deposits, government deposits, and time deposits; PQ represents the value of all goods and services produced by the economy—gross national product—where P is the implicit GNP deflator index and Q measures total output; and K is simply the ratio of the means of payment to total expenditures, M/PQ, representing the average turnover period or its reciprocal, the number of times per year that money filters through the economic system.

Each variable depends upon a multitude of factors, many of which cannot be measured, and the subtle system of cause and effect probably changes constantly. The rather persistent long-run growth in the supply of money M suggests that it may have a sort of impetus of its own. It seems logical to expect that the means of payment expands in response to demand for money to service a larger output, changes in cash balances, and those movements in the level of prices which are largely independent of economic and monetary considerations. Thus, although the price level will depend on monetary influences, monetary practices and policies will depend upon a complex of politico-economic forces

[5] No attempt is made to define the "price level" concept. In this connection see O. V. Wells, "Significance of the General Price Level and Related Influences to American Agriculture," *Journal of Farm Economics*, Vol. XXXI, No. 4, Part 2, November 1949.

such that the means of payment becomes more a result than an independent cause of change in the price level.[6] A rough approximation of long-run growth indicates that the money supply has tended to expand at a rate almost double that of the growth in output of goods and services.

Individuals and business apparently tend to hold larger cash balances relative to total expenditures, thus contributing to a gradual uptrend in *K*. This tendency has been observed by several writers.[7] But the reasons advanced for it are not conclusive. Probably there has been a trend toward less barter trading and toward relatively more money going through the market place for such commodities and services as gasoline, transportation, and services of various types formerly carried out in the home. The daily and the weekly payday are probably less common than formerly, and a trend toward a longer pay period would require larger cash balances. The general uptrend in prices and a decline in interest rates also may have encouraged relatively larger cash holdings. A gradual uptrend in *K* seems plausible if we assume a continuation of past trends in the economic, psychological, and institutional forces that influence the amount of money held relative to total expenditures.

One appraisal for the future assumes a continuation of past trends about as illustrated in Chart 1. Any of a number of different trends might be justified, especially for the price level. Those shown indicate a level for 1970 somewhat below current high levels. The general level of prices may tend upward also if the rise in wage rates during the next two decades is assumed to equal or exceed somewhat the gain in output per man-hour.

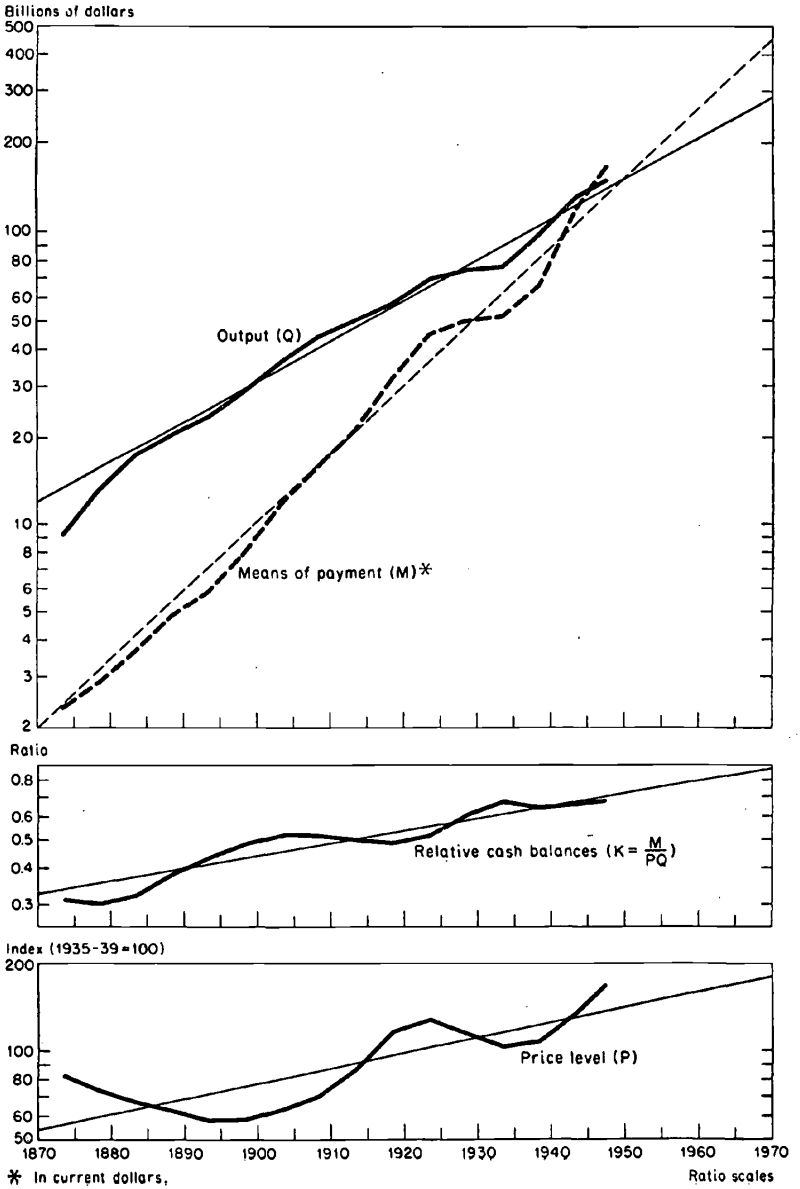
As indicated above, prices and costs of many important groups of commodities and services are independent of economic and monetary forces. For example, we have "fair trade" legislation, informal agreements, customary margins and markups, controlled utility rates, milk orders, price supports, minimum wages, and many other arrangements throughout the economy to regulate

[6] E. J. Working, "Internal Stresses as Causes of Price Level Change," chapter in *Explorations in Economics*, notes and essays contributed in honor of F. W. Taussig (McGraw-Hill, 1937), p. 275.

[7] J. M. Keynes, *The General Theory* (Harcourt, Brace, 1935), p. 306; A. H. Hansen, *Monetary Theory and Fiscal Policy* (McGraw-Hill, 1949), pp. 3ff.; E. E. Hagen, *Additional Chapters on the Theory of Price Level and Employment* (unpublished MS, 1949), p. VI-6; and Clark Warburton, "The Secular Trend in Monetary Velocity," *Quarterly Journal of Economics*, Vol. LXIII, No. 1, February 1949, p. 81.

CHART 1

Output, Means of Payment, Relative Cash Balances, and Price Level, Overlapping Decade Averages, 1869-78 to 1939-48; Projected to 1970



prices. Strong primary producer groups strive to maintain or to improve their share of total income and, more often than not, political expediency in settling disputes between large producer groups results in higher prices. In the last two decades, labor unions have become strong, well informed, and effective in their bargaining with business.

The debt structure rises in periods of high prices and becomes rather inflexible to downward adjustment. The federal debt is now deeply ingrained in our monetary system and it probably will lend greater stability to the credit base than was the case when credit expansion was based largely on private loans and securities. In addition to these considerations, many governments are more or less committed to a policy of full employment, which may prevent substantial deflations, such as took place in the 1930's. If effective, this policy may contribute to a gradual uptrend in the level of prices. Most of the arguments advanced in support of rather moderate deflations and prospects for a continued gradual rise in the United States price level are probably as applicable to foreign countries and world prices as to the United States.[8]

The projected level for 1970 approximates that of 1949, but it is below current levels. The Korean conflict and defense mobilization may postpone for years any downward adjustment in prices. Because of the upward shift of the entire debt-cost-price structure, the postadjustment level probably will be higher than it would have been.

2. *Projected framework for 1970*

Projected real output and the price level assumption provide a basis for assigning value to the gross national product. The components of the national product were approximated largely on the basis of historical relationships. No attempt is made to explain in this treatment the specific assumptions regarding tax rates, corporate profits, government revenue and expenditures, consumption, saving, and investment.

The high-employment model assumes about 5 million unemployed with a labor force of around 78 million. Employment, output per man-hour, a reduced workweek, and the projected

[8] In this connection, see *Measures for International Economic Stability* (United Nations Publications, Sales No. 1951, II. A. 2, November 1951), chap. I.

price level for 1970 resulted in a gross national product of around $510 billion, with personal disposable income at approximately $375 billion (Table 1).

TABLE 1

GROSS INCOME, PRICE LEVEL, POPULATION AND EMPLOYMENT, 1935-39 AVERAGE, 1949, AND PROJECTIONS FOR 1970

Item	Unit or Base	1935-39 Average	1949	1970	
				High Employment	Unemployment Assumption
Gross national product	$ billion	84.2	257	510	375
Consumption expenditures	do.	63.6	180	347	290
Personal disposable income	do.	66.2	186	375	310
Consumers' price index	1935–39	100	170	170	145
Wholesale prices of all commodities, index	1926	81	155	160	120
Population[a]	Million	129	150	181	181
Labor force	do.	54.4	63.6	78	77
Employment[b]	do.	45.0	60.2	73	65
Unemployment	do.	9.4	3.4	5	12

[a] Estimated as of July 1.
[b] Including armed forces.
Source: Background data from the *Survey of Current Business* (Department of Commerce).

The unemployment assumptions are not as severe as the depression of the 1930's, when nearly a fourth of the labor force was unemployed. The period of decline was assumed to be about two or three years. Associated with the lower level of employment, a reduction is assumed for money wage rates and the money supply, while the demand for cash reserves is assumed to rise as prices and incomes decline. A considerable reduction in the price level accompanies the rather severe drop in economic activity for the unemployment assumption.

E. LONG-RUN PROSPECTS FOR AGRICULTURE

The general framework within which the prospects for agriculture are appraised was projected in preceding sections of this report. Thus, many of the major factors that affect agriculture are now "given." These include population growth, the labor force, employment, income, the general price level, and an economic system and government organization in which the pricing

mechanism is the primary regulator of rates of production and utilization of individual commodities and services.

1. *The demand for farm products*

Agricultural production consists primarily of food and fibers —two major necessities of life—the total demand for which is rather inelastic with respect to both price and income. As we are primarily interested in an aggregate demand function for agricultural products, changes in taste and consumption habits for individual commodities will be to some extent offsetting and will affect very little the total per capita demand for agricultural products. It is recognized, however, that innovations may expand or reduce the total per capita use of farm products.

Total demand for agricultural products over time can be thought of as a relatively inelastic relationship between consumption and price which shifts rather continuously in response to population growth. Per capita use will depend upon: the effect of growth in per capita real income on the pattern of consumption, as indicated by the varying income elasticities of consumption; price changes and the price elasticity of demand; changes in taste or innovations which influence per capita use independent of the price and income effect; and the supply response which equilibrates price, demand, and supply. Foreign demand probably will continue to depend primarily upon government policy. Long-run changes in underlying economic conditions of different countries—industrial development, new resource development, depletion of resources, and innovations—will cause shifts in the comparative advantage of producing particular commodities and thus, over long periods, will influence the foreign trade policy of the government.

a. SOME CONCEPTS AND EMPIRICAL APPROXIMATIONS

It immediately becomes apparent that for the long-run period we will be concerned with the very forces and structural shifts which are usually impounded in such assumptions as "other things being equal" or "a given state of the arts." In order to specify and discuss some of the problems encountered, suppose per capita consumption to be as expressed in the following equation form:

$$q = k\, p^a\, o^b\, y^c\, t^d \qquad (1)$$

where q refers to quantity utilized per person, p to the price per

unit, o to prices of nonagricultural products, y to per capita real income, and t to time or trend influences. Our concern is not only with trends and the relationships among variables as indicated for a given period, but also with the possibility and the probable nature of shifts in these relationships over time, i.e., changes in the coefficients a, b, and c.

Price elasticity of demand is usually represented as the relationship between quantity and price at given levels of the other variables. In the framework of equation 1, it would be represented by a, the partial elasticity, which logically should be negative.

$$E_p = \frac{\partial \log q}{\partial \log p} = a = \frac{\partial q}{\partial p} \cdot \frac{p}{q} \qquad (2)$$

Although price elasticity of demand for farm products in the aggregate is small, demand elasticities for individual agricultural products may vary from virtually zero to unity or higher.[9] Analyses of food consumption per capita relative to retail food prices and per capita income suggest a price elasticity of demand of around –0.25. Although the empirical elasticities varied, all showed per capita use of farm products to be relatively inflexible in response to price changes.[10]

The comprehensive work of Henry Schultz on demand analyses for farm products in different periods of time indicated that price elasticity of demand may decline as real incomes rise over time.[11] For some products this tendency may be a reflection of the effect of trend factors other than price or income. The indi-

[9] Karl A. Fox, "Factors Affecting Farm Income, Farm Prices, and Food Consumption," *Agricultural Economics Research*, Vol. III, No. 3, July 1951.

[10] See, for example, M. A. Girshick and T. Haavelmo, *Statistical Analysis of the Demand for Food*, Cowles Commission Papers, New Series, No. 24, 1947, p. 109; G. Tintner, "Multiple Regression for Systems of Equations," *Econometrica*, Vol. 14, No. 1, January 1946, pp. 34-36; *Consumption of Food in the United States, 1909-1948* (Department of Agriculture, Misc. Pub. 691), p. 140; and Marguerite C. Burk, "Changes in the Demand for Food from 1941 to 1950," *Journal of Farm Economics*, Vol. XXXIII, No. 3, August 1951, pp. 281-98. Some unpublished analyses prepared in the Division of Statistical and Historical Research also indicate a retail price elasticity of demand around —0.25. See also J. Tobin, "A Statistical Demand Function for Food in the U.S.A.," *Journal of the Royal Statistical Society*, Vol. CXIII, Part II, 1950, pp. 132, 133, 142; and W. W. Cochrane, "Farm Price Gyrations—An Aggregative Hypothesis," *Journal of Farm Economics*, Vol. XXIX, No. 2, May 1947.

[11] *The Theory and Measurement of Demand* (University of Chicago Press, 1938), pp. 548-49.

cated decline in the price elasticity of demand for farm products, foods in particular, may result because purchases of food represent a declining portion of total expenditures as real incomes rise over time so that price changes tend to become less important. Also, there may be some inertia in the pattern of consumption.

Price elasticity of demand for agricultural products as a whole is very low (inelastic) and it may become somewhat less responsive to changes in price as the economy grows. In a long-run appraisal of the demand for agricultural products, the low price response suggests that growth of population and effects of income on per capita use will be the major factors influencing total utilization of agricultural products.

Income elasticity of consumption refers to the response of per capita use of farm products to changes in per capita income. In terms of equation 1, this elasticity is represented by c when prices are held constant.

$$E_y = \frac{\partial \log q}{\partial \log y} = c = \frac{\partial q}{\partial y} \cdot \frac{y}{q} \qquad (3)$$

For virtually all farm products, this relationship should be positive—consumption increases as real incomes rise. However, for some commodities—the so-called inferior goods—income elasticity is negative. Over time, the influence of income on per capita use is probably inextricably bound up with changes in "taste," which are independent of income. However, the effects on consumption of year-to-year changes in income can be measured much more accurately.

As foods generally represent 80 percent or more of the total utilization of farm products, substantial increases or decreases in the physical volume of per capita use should not be expected, even though prices and incomes vary widely. About 175 years ago (1776), Adam Smith made the frequently quoted observation that ". . . the desire for food is limited in every man by the narrow capacity of the human stomach." He might have enlarged on this statement by observing also that waste may represent a substantial disappearance of food and clothing and, possibly even more important, that the resources required to keep the human stomach full of the commodities desired may vary widely with the pattern of consumption and with techniques of production.

A brief review of statistical analyses that attempt empirical measurements of income elasticity makes one hesitant to generalize a coefficient for farm products. Most studies have dealt with foods at the retail or approximately retail level. The list of studies referred to in footnote 10 shows income elasticities varying from approximately 0.2 to around 0.9. They also demonstrate how elasticity may vary depending upon the types of data used. An income elasticity around 0.25 appears reasonable on the basis of the Bureau of Agricultural Economics index of per capita food consumption.[12] Analyses using deflated retail expenditures for food as a measure of consumption are inadequate for the present purpose. Such measures, indicating elasticities from 0.5 to 0.9, reflect marketing and processing services and, possibly, some influence of price.

Budget studies based on a cross section of incomes and expenditures at a given time show the nature and extent of differences in the consumption pattern at different income levels. An examination of 1947 data[13] for various commodities indicates that unit prices rise with income for some commodities, especially for such foods as meats, vegetables, and the highly processed grains, fats and oils, and sugar products. The quantity of livestock products, fruits, and vegetables also increased with income, but consumption of such foods as grains, fats and oils, sugar, dry beans, and potatoes declined as incomes rose. The indicated shifts in the pattern of consumption appear reasonable.

One appraisal of these data indicated an income elasticity for food consumed (quantity) of only 0.14.[14] Elasticities of expenditures for food relative to income for recent years appear to be around 0.3.[15] Although budget and time series data are conceptually different, elasticities based on budget data effectively illustrate that the income elasticity of demand for food tends to

[12] This is an index of per capita disappearance of major foods on an approximate retail weight basis which was weighted by unit retail prices as of 1935-39 and expressed on that base as 100. The index does not reflect variations in the services rendered by restaurants and retailers and, in some instances, it does not reflect processing costs. See *Consumption of Food in the United States*, as cited above.

[13] *Food Consumption of Urban Families in the U.S., Spring 1948* (Bureau of Human Nutrition and Home Economics, Department of Agriculture, Prel. Report No. 5, 1949).

[14] Fox, *op.cit.*, p. 81.

[15] See Marguerite C. Burk, "A Study of Recent Relationships between Income and Food Expenditures," *Agricultural Economics Research*, Vol. III, No. 3, July 1951, p. 89.

decline as real incomes rise. An index of per capita food consumption (BAE) computed on the basis of estimated food use per person by income level suggests larger income elasticities at low than at higher income levels.[16] An elasticity of about 0.25 was computed for the range of incomes from $750 to $4,000. But for average incomes from $750 to $1,250, the income elasticity of consumption was around 0.3; from $1,250 to $1,750, around 0.23; from $1,750 to $2,500, around 0.22; and from $2,500 to $4,000, the elasticity was approximately 0.15.

Available information from time series and budget data, as well as reason, suggests that the income elasticity of consumption (physical volume) of farm products would tend to decline as real incomes rise over time. A very low income elasticity of consumption is implied for the long run on the basis of historical data for the last seven or eight decades. Rough measures of per capita use of agricultural products indicate that, during the 40-year period before 1900, average use of agricultural products per person based on overlapping decade averages ranged between 90 and 100 percent of 1935-39, in 1925-29 just over 100 percent, and during 1940-45, 115 percent. In comparison, per capita real incomes during the last seven decades have increased nearly five times above the average for 1869-78. Prices received for farm products have varied widely during the period, but the trend has been upward.

Several different equation forms were tried to approximate empirically the influence of gradually rising real income on changes in the income elasticity of per capita use of farm products over time. Fairly reasonable results were obtained from a logarithmic relationship between per capita use of farm products and income where it was assumed that the income coefficient, and thus income elasticity, declines gradually as real incomes rise over time. This form was

$$\log q = a + (c - dt) \log y + \ldots . \qquad (4)$$

where income elasticity of per capita use is represented by the partial elasticity $(c - dt)$. This form of equation assumes that, as real incomes rise over time, the slope of the relationship between consumption and income becomes flatter—consumption becomes less responsive to changes in income. The analysis was based on some rough approximations of per capita use and total real in-

[16] *Consumption of Food in the United States*, as cited, p. 142.

come per person, using multiple correlation techniques. The results, by no means conclusive, are not unreasonable compared with some other techniques of analysis. Trend factors are, of course, very important. Empirical approximations based on the period 1919 to 1949 are shown in equation 5:

$$\log q = 0.605 + (0.486 - 0.00575t) \log y - 0.000693p + 0.016t \quad (5)$$

where q represents per capita use, y represents per capita real income, p represents the ratio of farm prices to the general price level, and t represents time (1, 2, . . . n). For period 1 in this equation, income elasticity was 0.48 and declined to around 0.18 for the 1970 projection. Similar results were obtained in several analyses using slightly different variables. In the long-run analysis employed above, price and income coefficients were "statistically significant" by the usual measures.

To digress for a moment: An examination of the *income elasticity of expenditures* for food will give more insight into relationships of elasticities to each other and, in addition, provide information that can be used as a further check on the projected framework. Price variations, as might be expected, are highly correlated with changes in expenditure and income. Variations in quantity contribute relatively less to changes in expenditure for food. Income elasticity of expenditures logically should range somewhere between the coefficient of price flexibility relative to income and the elasticity of quantity with respect to income. In this connection, a study referred to earlier shows an income elasticity of expenditures for food of about 0.8 compared with price flexibility relative to income of 1.0 and income elasticity of demand around 0.24.[17] Variations in expenditure because of price would be expected to approximate the higher elasticity and those because of quantity, the lower elasticity.

The persistent long-run downtrend in the ratio of total expenditures for farm products to gross national income indicates an income elasticity of expenditures of less than unity, though it may be rising gradually over time. Extending the long-run decline observed in the above ratio on the basis of the projected increase in income and the income elasticity of expenditures indicated for recent years provides another basis for appraising total expenditures for farm products in the projected framework. These computations are discussed later in the report.

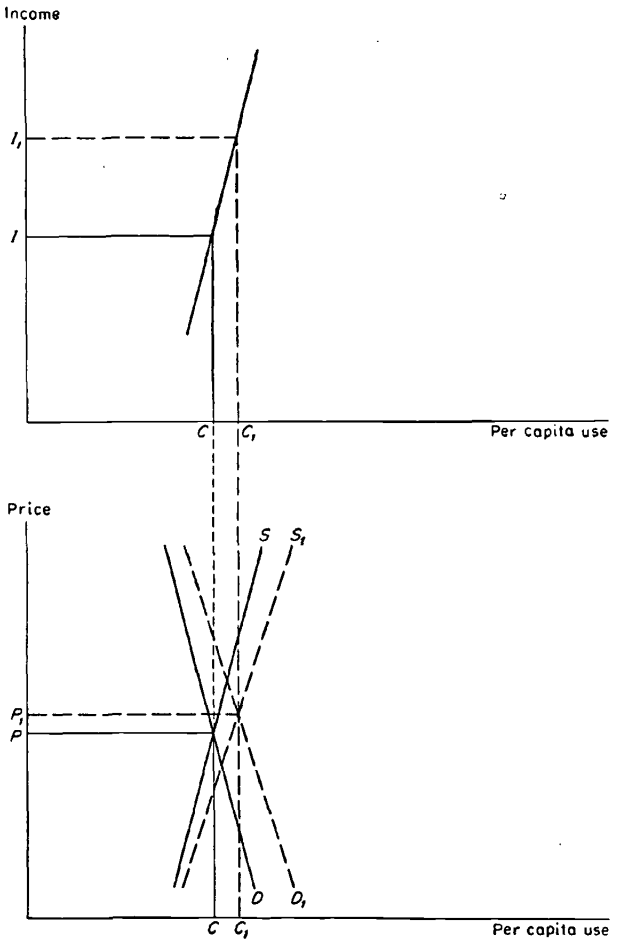
[17] Burk, "Changes in the Demand for Food from 1941 to 1950," as cited above, p. 297.

b. CONSUMPTION OF FARM PRODUCTS

The major relationships among the variables consumption, income, and price, discussed above, may be illustrated approximately as shown in Chart 2. Changes in per capita use of agri-

CHART 2

Hypothetical Illustration of Relationship of Income, Price, and Consumption of Agricultural Products



cultural products are very small in relation to changes in income. Likewise, consumption is rather inflexible in relation to price changes. The illustration indicates an increase in per capita real

income of approximately 50 percent, which results in a rise in per capita demand of nearly 10 percent at the same relative price for agricultural products. The increase is indicated by the shift in the demand curve from D to D_1. Price, in this context, depends primarily upon the growth in output of agricultural products per person in response to the shifts in per capita demand. The illustration shows a slight increase in relative prices for farm products. The shift in supply response depends primarily upon innovations, with resulting greater output per unit of resources used, and upon the possible diversion of resources away from or to agricultural production.

In the framework of empirical measurements discussed in the preceding section, per capita demand for farm products may be approximated from projected income, a price assumption, and the price and income elasticities approximated from analyses of historical data or from such analyses supplemented by judgment. This relationship is of the general form

$$q = k\, p^a\, y^c \qquad (6)$$

in which a and c are approximations of the price and income elasticities of consumption, respectively. In this case, the per capita income y is given. As a first approximation of per capita consumption, prices for farm products were assumed which appeared reasonably consistent with the general price level assumption. These computations are not shown. They were first approximations until an appraisal of the supply of farm products, exports, and imports determined the per capita domestic supply in this general framework. The final approximations show a slightly higher price for farm products and a little lower per capita consumption than were used in the first approximation. Per capita demand for all farm products under the high-employment assumption, at 115 percent of 1935-39, turned out to be about equal to per capita supply for domestic consumption at an index of prices received by farmers of around 260-265 (1910-14 = 100) and a general price level about 180 percent of 1935-39 (consumers' price index around 170 percent of 1935-39). Per capita use under the unemployment assumption was estimated at 110 percent of 1935-39.

The results of empirical analyses were far from conclusive. Probably there will never be any very conclusive bases for projecting the structural changes that are important in long-run

appraisals. Consequently, it was considered desirable, as a basis for projecting consumption, to consider in some detail the trends taking place in the pattern of consumption and to enlist the cooperation of commodity specialists in order to get informed appraisals by persons intimately familiar with each commodity. Commodity specialists were given the broad framework of assumptions for income, growth of population, employment and unemployment, and the general price level. They were requested to estimate, in this framework, the per capita use of their commodity. These estimates were examined for over-all consistency, converted into an index of per capita food consumption (BAE), and combined with projected use of nonfoods to arrive at an estimate of total per capita use of agricultural products.

Per capita consumption of food, projected to 117 percent of 1935-39, in general reflects increased use of meats and livestock products and increased consumption of fresh vegetables and citrus fruits. Lower per capita consumption was projected for potatoes, cereal crops, butter, and sugar. These projections generally reflect trends. But they are not inconsistent with most empirical measurements of income elasticities, which indicate positive coefficients for fresh citrus fruits, other fresh fruits, beef and veal, and livestock products in general. Negative income elasticities were indicated for potatoes and grains, for example (Table 2).

During the last seven to eight decades, per capita consumption of food in total apparently has not fluctuated widely from year to year. But averages for selected five-year periods indicate a gradual uptrend. The shifts mentioned above from low-unit-cost to high-unit-cost foods would cause a price-weighted index to rise without any necessary increase in physical volume of consumption or in calories. However, the price-weighted index is probably a better measure of demands on resources. Use of nonfood agricultural products was projected to around 107 percent of the 1935-39 average, which is about the same as in 1949. Projected higher per capita use of tobacco approximately offsets assumed declines in per capita use of cotton. Competition of synthetic fibers is expected to be important in the demand for cotton. Technological developments in synthetic detergents used for soaps, in synthetic resins, and in chemical developments in the paint industry may moderate trends in per capita demand for industrial fats and oils. As is to be expected, use of nonfood

TABLE 2

PER CAPITA USE OF FOOD AND NONFOOD AGRICULTURAL PRODUCTS, 1935-39 AVERAGE, 1949, AND PROJECTIONS FOR 1970

Item	*Unit*	*1935-39 Average*	*1949*	*1970*	
				High Employment	*Unemployment*
Per capita food consumption	Index	100	111	117	113
Meats (carcass weight)[a]	Pounds	126.2	143.9	156.5	151.0
Beef	do.	55.2	63.5	67.0	65.0
Pork, excluding lard	do.	56.1	67.6	75.0	72.0
Poultry					
Chickens and turkeys	do.	20.5	29.7	34.0	32.5
Eggs	Number	298	381	375	370
Dairy products (fat-solid basis)	Pounds	801	761	780	770
Fluid milk and cream (milk equivalent)	do.	340	384	410	405
Butter (actual weight)	do.	16.7	10.5	9.0	9.0
Fats and oils, including butter (fat-content basis)	do.	44.7	42.3	44.2	43.1
Fruits, fresh and processed on fresh-equivalent basis	do.	218	234	273	257
Vegetables					
Fresh	do.	235	249	275	260
Processed (processed weight)	do.	30.6	44.5	53	50
Potatoes, white and sweet	do.	152.4	122.3	99	103
Dry edible beans and peas	do.	9.4	7.4	8.8	8.8
Sugar (refined)	do.	97.0	94.9	93.0	92.0
Grains					
Wheat	do.	226	193	185	185
Other	do.	68.6	66.4	66.4	63.4
Nonfood commodities					
Cotton	do.	25.3	25.6	21.0	20.0
Wool, apparel	do.	2.2	2.3	2.7	2.2
Tobacco	do.	7.1	9.4	11.5	10.5

[a] Includes veal, lamb, and mutton.

Sources: Background data from *Consumption of Food in the United States, 1909-1948* (Department of Agriculture, Misc. Pub. 691); *The National Food Situation* (Bureau of Agricultural Economics); commodity situation reports of the BAE; and estimations by the author.

products fluctuates much more than the food consumption index and thus causes slightly more variation in the indicator of per capita use of all agricultural products.

With a relatively short period of falling employment assumed for the lower projection, farm output probably would be maintained at a high level. Slightly reduced output with substantially

lower prices would tend to result in a per capita use of farm products only moderately below the projection for high employment. Exports probably would decline and some net accumulation of stocks would be expected with the reduction in employment and income.

C. EXPORTS AND IMPORTS

Exports and imports of supplementary agricultural products (the similar competing products) were first assumed approximately equal with a relatively high level of trading. Later estimates of imports and exports by commodity and group of commodities were prepared in connection with detailed projections. The projected volume of agricultural exports under the high-employment assumption is nearly 80 percent (1924-29 = 100), compared with 108 for 1949 and 60 in 1935-39 (Table 3). Although reductions from the high levels for 1949 are projected for wheat, flour, and other grains, exports of food grains are expected to be relatively large. Value of exports in this framework is estimated at $2.5 to $3.0 billion under the high- and about $2 billion under the low-employment assumptions. Agricultural exports were valued at $3.6 billion in 1949.

Imports of supplementary agricultural products, projected in some detail by commodity, are 122 percent (1924-29 = 100)

TABLE 3

INDEXES OF VOLUME OF AGRICULTURAL EXPORTS AND IMPORTS, SELECTED PERIODS AND PROJECTIONS FOR 1970
(INDEXES, 1924-29 = 100)

Item	1925-29 Average	1935-39 Average	1940-42 Average	1949	1970	
					High Employment	Unemployment
Agricultural exports	98	60	43	108	79	66
Total imports	104	101	103	100	137	122
Complementary[a]	105	108	97	110	148	134
Supplementary[b]	102	92	110	87	122	106

[a] Complementary agricultural imports include those not considered as supplementary—about 95 percent of which consist of rubber, coffee, raw silk, cocoa beans, carpet wool, bananas, tea, and spices.

[b] Supplementary agricultural imports consist of all imports similar to agricultural commodities produced commercially in the United States, together with all other agricultural imports interchangeable to any significant extent with domestic production.

Source: Background data from *Foreign Agricultural Trade* (Office of Foreign Agricultural Relations, Department of Agriculture).

for high employment. This compares with 87 in 1949 and 110 for the 1940-42 average. Complementary imports, representing primarily rubber, coffee, bananas, carpet wool, cocoa beans, tea, and spices, are projected to 148 for high employment compared with 110 in 1949. Total agricultural imports are projected to 137 percent of 1924-29 compared with 100 in 1949. The values of supplementary and complementary imports of agricultural products are each estimated at around $2 billion under the high-employment assumption and $1.4 billion for the unemployment assumption. The projected high-employment value of $4 billion compares with about $2.9 billion for 1949.

d. TOTAL UTILIZATION

The product of projected per capita use of agricultural products and population should approximate total domestic use of farm products. This computation, on the basis of index numbers, is shown in Table 4. Detailed projections indicated that exports above competing supplementary imports may average 1 to 2 percent of total output. Data presented for the 1970 projections represent final approximations after all the pieces of the picture were fitted together—after exports, imports, and output, as well as consumption and prices, were fitted into what appeared to be a reasonably consistent picture for agriculture in the framework of assumptions for the entire economy.

The absolute difference between the estimated index of total utilization and the index of agricultural production for sale and home consumption was expressed as a percentage of total farm output. This difference represents primarily net exports of agricultural products and net stock changes. Since the approximation of total consumption is rather rough, the difference probably is subject to some error. As a basis of comparison, net value of agricultural exports above the competing supplementary imports was expressed as a percentage of "value of farm sales plus farm home consumption." The comparison indicated that, in most periods, the difference between domestic utilization and total production was accounted for by net exports of agricultural products. With a projected increase in imports and some decline in agricultural exports from recent high levels, projected net exports are small. The relatively large residual for the unemployment assumption represents mostly assumed net stock accumulation.

TABLE 4

PER CAPITA USE OF AGRICULTURAL PRODUCTS, POPULATION, TOTAL CONSUMPTION, AND TOTAL OUTPUT, SELECTED PERIODS AND PROJECTIONS FOR 1970

Item	1915-19 Average	1925-29 Average	1930-34 Average	1940-44 Average	1945-49 Average	1970 High Employment	1970 Unemployment
			Indexes, 1935-39 = 100				
Food consumption per capita[a]	92.6	101.2	99.2	109.0	114.0	117	113
Nonfood use per capita[b]	113.6	102.0	85.4	134.3	124.9	107	98
Total utilization per capita[b]	100.0	101.4	96.5	113.6	116.0	115	110
Population	80.0	92.2	96.7	104.6	111.6	141	141
Total utilization[c]	80.0	93.5	93.4	118.8	129.5	162	155
Production for sale and home consumption[d]	87.2	99.2	97.0	122.6	137.0	165	163
			Percent				
Difference as a percentage of total production[e]	8.5	5.7	3.7	3.1	5.5	2.0	5.0
Value of net exports as a percentage of farm income[f]	11.0	7.0	4.9	2.5	6.5	1.3	1.0

[a] *Consumption of Food in the United States, 1909-1948* (Department of Agriculture, Misc. Pub. 691); and *National Food Situation* (Bureau of Agricultural Economics).

[b] Computed for this purpose by the author.

[c] Total utilization is a product of population and per capita use.

[d] From *1950 Yearbook of Agricultural Statistics* and *Farm Income Situation* (BAE).

[e] Percentage points difference between total utilization and total production expressed as a percentage of total production index.

[f] Value of agricultural exports above imports of supplementary agricultural products from *Foreign Agricultural Trade* (Office of Foreign Agricultural Relations, Department of Agriculture) expressed as a percentage of value of farm sales plus home consumption from the *Farm Income Situation* (BAE).

2. *Supply of agricultural products*

The data presented in Table 4 put us ahead of our story, as output is yet to be considered in our framework of assumptions and in relation to projected demand and relative prices for farm products. Having considered major demand factors for agricultural products and attempted some empirical generalizations for the long run, let us examine supply prospects in the light of projected demand, agricultural productive facilities, possible innovations, and the level of prices received for farm products. Successive approximations among demand, supply, and price

projections for agricultural products were used as a basis for projecting relative prices considered reasonable in relation to demand and supply considerations in the projected framework.

a. GENERAL NATURE OF THE SUPPLY RESPONSE

For several reasons, the long-run supply response for agriculture is difficult to appraise. The inherently involved problems of supply probably account for so few attempts at statistical measurement of agricultural production functions.[18] And, even with approximate empirical measurements, innovations may result, in the long run, in substantial shifts in the use and contribution of each agent. Thus, they may constantly modify the production function. The problem is to appraise probable use of resources in agriculture and possible innovations that affect the output per unit of input. Simply stated, the output of agricultural products depends upon resources used—land, labor, and capital—the quality of these resources, and innovations.

In some respects, the competitive long-run theory of the firm is unrealistic for agriculture, because of the relative immobility of labor and capital within agriculture and, particularly, between agriculture and the rest of the economy. Yet, during long-run periods, resources do move into and out of agriculture. Employment in agriculture has declined moderately during the last four decades. Indexes of volume of farm power, machinery, and equipment indicate that this type of capital has more than doubled since 1890, both in total and per worker, and these indexes probably do not reflect improved quality of capital.[19] Inputs of fertilizer and materials for control of diseases and insects appear to be very responsive to prospective changes in agricultural prices and income. Cropland harvested has varied moderately in the past, primarily because of crop failure for one reason or another and because of variations in general economic conditions. Land in the fringe uses may become profitable under "high" prices, but in periods of low farm prices it will revert to a natural state (dry-farm grain land, for example), and the cropping of pasture land or more intensive types of rotation may

[18] See Cochrane, *op.cit.*, and D. G. Johnson, "The Supply Function for Agricultural Products," *American Economic Review*, Vol. XL, No. 4, September 1950, p. 559, n. 32.

[19] M. R. Cooper, G. T. Barton, and A. P. Brodell, *Progress of Farm Mechanization* (Department of Agriculture, Misc. Pub. 630, 1947), p. 7.

vary the acreage of cropland harvested, depending on economic conditions.

As a basis for long-run appraisals, it seems reasonable to assume that resources used in agriculture will vary in response to changes in both demand and innovations. Acreage of land may vary moderately, depending upon river valley developments, reclamation work, economic conditions, and possible withdrawals of cropland in the interest of conservation, reforestation, recreation, flood control, and urban development. In the long run, it is reasonable to assume some rough equality of returns to "commercial agriculture," compared with the rest of the economy, in order to induce or retard shifts in resource use. Admittedly many institutional and social factors will influence these shifts—government financing of farm capital, financing of education in rural areas, better communication, unemployment services, shifts in industry to rural areas, social prejudices, and many other factors. But continued availability of nonfarm jobs will be of major importance in the shift of labor out of agriculture. Use of capital per man and per acre probably will continue to increase as demand expands and workers continue to shift out of agriculture.

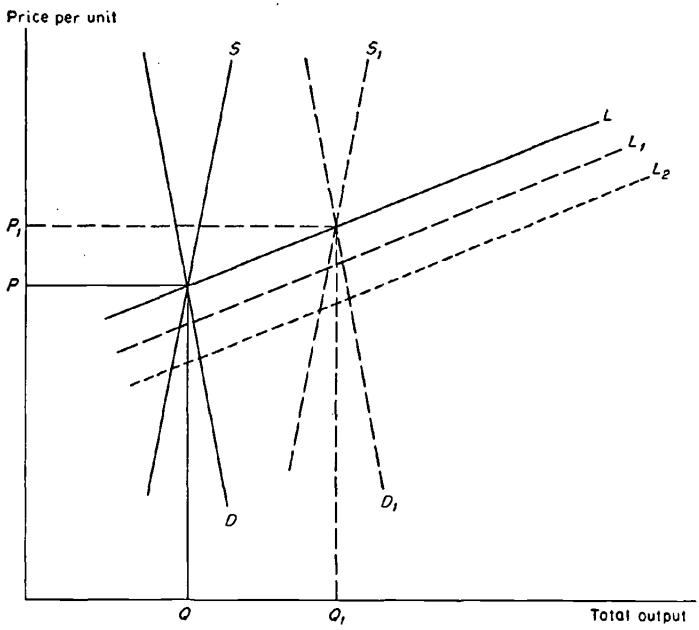
For short-period adjustments, it is reasonable to expect that the agricultural-supply function will be very inelastic to changes in price and especially to downward adjustments in prices. Most agricultural land has practically no alternative uses aside from agriculture, and farm capital equipment has few alternative uses. Mobility of labor is low, for both relatively declining and relatively rising prices of farm products. The bulk of farm labor is classed as "unpaid family labor," so that the supply of labor may actually rise during generally depressed economic conditions.

Over time, we may conceive of an inelastic short-run supply response of the type described above, which shifts as resources move into or out of agriculture and because of innovations. These shifts are usually made in response to a rather continuous growth in total demand for farm products. Under a given "state of the arts," the long-run supply response for agriculture may be expected to rise as more resources are bid away from alternative employment for use in agriculture. The long-run supply curve L is traced out by successive inelastic short-run responses S (Chart 3). Innovations result in similar shifts in the short-run supply curve, but they also tend to shift the entire long-run supply response downward as indicated by L_1 and L_2. Innovations reduce

resources required for a given output and thus lower the entire price-output relationship for the long run. Substantial innovations that cause a shift in the supply response, such as that indicated by L_2, may result in relative prices for farm products, at a given level of demand, so low that returns to productive agents will be reduced below what they could command in alternative employment. Under such circumstances, we might expect a withdrawal of resources—labor, capital, and possibly land—from use in agriculture. This would result in some backward shift in the supply response and higher relative prices for farm products.

CHART 3

Long-Run Supply Response of Agriculture to Resource Shifts and Innovations



Innovations often result in greater total expenditure and greater output, as well as lower expenditures per unit. For example, fertilizers, weed control, insecticides, and better seed tend to increase total production expenditures. New processes, better transportation, and new machinery in production and marketing may actually reduce total costs by displacing other, less efficient resources. Innovations, also, may involve the introduction of new

goods and new methods of production and marketing. They may open new markets, provide new sources of raw material, and make new uses for old goods.

The rate of innovation in agriculture and its effect on output are not easy to anticipate. Increased output per man reflects increased capital used per man, which is not an innovation in itself. However, increased use of machinery frequently results indirectly from innovations. Increased output per man may also reflect shifts in employment from less to more productive lines of work, more land per unit of labor, better management, and many other factors, as well as innovations. Growth in output per man in agriculture has been very rapid, if measured from the middle 1930's. A more generalized trend for the last three to four decades would indicate a rate of growth approaching 1.5 percent per year. This has been accomplished with approximately the same crop acreage; a moderately increasing amount of farm power, machinery, and equipment per man (also, a change in the type and quality of this capital); a declining number of workers; higher expenditures for such variable capital inputs as fertilizer, seed, insect control, disease control, and weed eradication; and the many and varied innovations that have affected the growing, harvesting, and marketing of agricultural products during the last half century.[20]

b. AGRICULTURAL OUTPUT: TRENDS AND PROJECTIONS

Long-run growth in output of agricultural products is examined, first, as a basis for projection. Obviously, several different "answers" might be forthcoming from an examination of trends. Apparently a simple arithmetic trend line fits the long-run rise in farm output reasonably well, but runs above the output level of the 1930's and below that for 1943-49 (Chart 4). This trend, projected out to 1970, indicates an index of physical volume of production for sale and home consumption of around 155 percent (1935-39 = 100). The same slope projected from the 1943-49 level indicates an output of around 165 for 1970. A semilogarith-

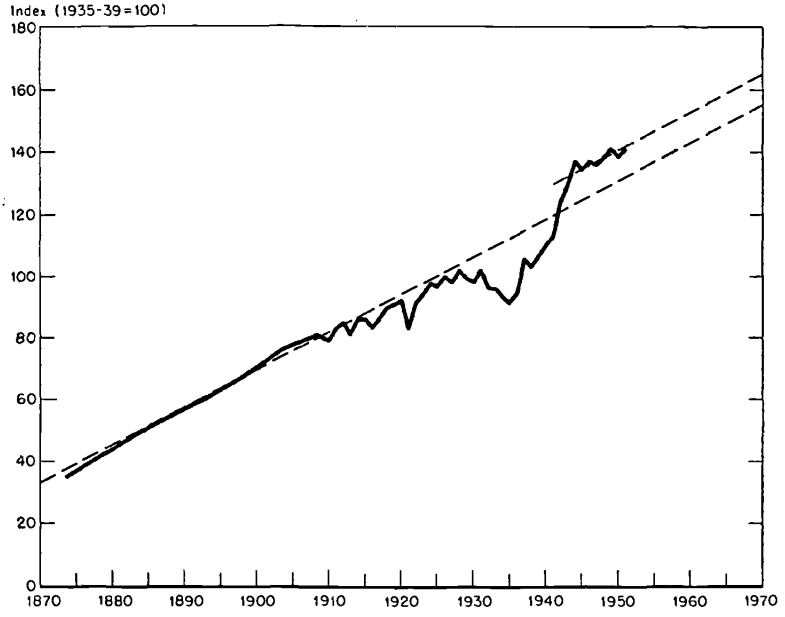
[20] An indication of the nature and influence of these innovations is presented by S. E. Johnson, *Changes in American Farming* (Department of Agriculture, Misc. Pub. No. 707, 1949); *Technology on the Farm* (Department of Agriculture, August 1940). See also Dorothy C. Goodwin, "A Brief Chronology of American Agricultural History," *Farmers in a Changing World, Yearbook of Agriculture*, 1940, pp. 1184ff.

mic-growth line, approximating a rate of increase of about 1 percent per year, indicates a level of output around 170.

A generalization of the trend in output per crop acre over the last three decades approximates a growth rate of a little less than 1 percent per year. This trend reflects among other things, higher yields because of new and better seed; more fertilizer and lime;

CHART 4

Agricultural Production for Sale and Home Consumption, 1875-1951; Projected to 1970



and better control of insects, diseases, and weeds. Per unit output of breeding animals also increased moderately but some of this growth may have been due to expanded feed output, so the two rates are not additive.

The long-run supply of agricultural products may also be considered in relation to past trends in some of the primary agents of production and trends in output per man as a basis for projecting future output. Total land available for crops, as indicated above, probably will not change greatly during the next two decades.[21] An important factor that has influenced land available

[21] See, for example, approximate land use conversions needed on privately owned land as reported in *Probable Impacts of Missouri Basin Pro-*

for production of food and fiber during the last three decades has been the decline in the numbers of horses and mules and the release of that acreage and production for other purposes. It is assumed that the numbers of horses and mules will continue to decline and this may release another 10 to 12 million acres of cropland for other purposes.[22]

Farm employment, as a percentage of the total labor force, declined rather steadily (both series vary little from year to year) until 1940, when the exodus of farm labor reduced the agricultural portion sharply. In view of past trends in employment, productivity, and use of capital, farm employment is projected to around 75 percent (1935-39 = 100) by 1970.

A trend line fitting the long sweep of years reasonably well suggests an increase in output per worker to around 220 to 225 percent (1935-39 = 100) by 1970. Such a projection implicitly assumes, among other things, continued expansion in farm power, machinery, and equipment per man; increased use of fertilizer, lime, and other variable inputs; and continued development of innovations in agriculture. Farm employment around 75 percent and output per man around 220 percent of 1935-39 appear reasonable in relation to past growth. These projections would result in farm output around 165 percent of prewar by 1970.

The long-run supply response for agriculture was also built up from detailed appraisals for each commodity or group of commodities. Each commodity was considered in relation to a first approximation of projected utilization for that commodity. Crop yields and acreage were projected in each case, livestock was related to feed supplies, acreage was considered in relation to all crops and to past performance, and many competitive and complementary relationships were considered both on the supply or resource side and on the demand side in working out the demand-supply-price balance for each commodity. In this connection, considerations for each commodity were discussed with commodity men familiar with each group of farm products. The detailed projections that allow for feed, seed, waste, industrial use, exports, stocks, and consumption came out very close to the 165 projected above.

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gram on United States Agricultural Economy, a statement by O. V. Wells (Department of Agriculture, Release No. 1845-50, August 1-2, 1950).

[22] See *Progress of Farm Mechanization* (Department of Agriculture, Misc. Pub. 630), p. 76.

The livestock projections assume a cattle population of around 100 million head on a sustained basis, with virtually all of the gain in production of beef cattle. Hog slaughter was projected to around 100 million head, assuming a continued trend toward lighter, lean hogs. A sheep enterprise of about 40 million head of stock sheep and feeders was assumed. Some of the data on supply and disposition and on the livestock-feed concentrate balance built up from detailed appraisals are shown in the appendix tables.

Production of meat under the high projection is about 30 percent above 1949, and production of poultry is up 35 percent. Output of dairy products based on detailed demand and supply prospects is projected to about 15 to 20 percent above 1949, and eggs to about 15 percent above 1949. Utilization of grains (corn, oats, and barley) for feed was increased by nearly a fourth from the 1948-49 feeding year. The outputs of fruits and vegetables are projected for 1970 to about 45 and 35 percent, respectively, above 1949 outputs. Detailed projections of supply and demand prospects indicated smaller production for such crops as food grains, potatoes, dry beans and peas, and cotton.

3. *Prices received for farm products*

Prices and incomes still have considerable influence as regulators of rates of consumption and production. Agriculture will not continue indefinitely to produce and accumulate goods in excess of "effective demand," even though it may do so over a period of several years. Labor and capital can and do flow between agriculture and the nonagricultural segment of the economy. Over the long run, demand for agricultural products will influence the use of resources, the rate of adopting innovations, and probably the rate of innovation itself, and thus direct the use of resources to provide goods in demand. The relative ease or difficulty of meeting this demand—the supply response—will complete the pricing mechanism and determine long-run relative prices for agricultural products. Prices in the long run must cover the supply price of a given output, which represents a payment to all services used in production approximately equal to what they could command in alternative employment. Obviously, many largely noneconomic influences affect the relative prices for farm products. Many controls, by private groups and by the government, affect output and prices for many commodities, both

farm and nonfarm. Yet, it is believed that these controls are responsive to changes in underlying economic forces.

The prices of agricultural products, both the absolute and the relative price, contain an element of the general level of all prices. However, prices of farm products may be relatively higher or lower depending upon long-run forces of demand (population growth, growth in real income, innovations that affect the demand for farm products, and exports) in relation to the long-run supply response for agricultural products. It is unlikely that prices for a substantial group of staples, such as food and fibers, will vary widely from past relationships to the general level of prices so long as projections assume a continuation of relative rates of innovation and approximately equal returns to services used in commercial agriculture and the rest of the economy. Assuming considerable mobility of resources, the supply response and relative prices for farm products will depend upon possible limiting resources, such as land and the rate of innovation. Another major factor that is likely to influence relative prices for farm products is the political strength and the price policy of the farm bloc.

a. TERMS OF TRADE: SOME EMPIRICAL APPROXIMATIONS

Suppose the farm output projection to 165 percent of the 1935-39 average is considered reasonable relative to past growth and in relation to projected demand, trends in consumption, and favorable general economic conditions. After accounting for imports and exports, that level of output and projected population provide a per capita supply of all farm products around 115 percent of 1935-39. This supply and projected demand, together with the empirical elasticities approximated from historical data, indicate a price for agricultural products of around 260-265 percent (1910-14 = 100) for the high-employment projection. An index of 190 is indicated under the unemployment framework, if it is assumed that per capita supply (not consumption) may be about the same as that for the high projection. Per capita income and the general level of prices would be lower under the unemployment assumption. As pointed out earlier, empirical approximations may yield a rather wide range of results, especially in a long-run appraisal of this type.[23] However, the level of farm

[23] As an illustration of the type of result we might get under these gen-

product prices indicated does not seem unreasonable in this general framework of assumptions for 1970.

The agricultural share. Over the last seven or eight decades, agricultural output apparently increased nearly 1 percent per year. Total output of the economy, except for depression periods, has tended to increase around 3.5 percent a year. These relative trends have meant that agricultural output necessarily has become a progressively smaller part of the total. It was observed, also, that the ratio of prices received for agricultural products to the general level of prices was inversely related to the ratio of farm output to total output of the economy. This relationship tended to shift to the left (downward) over time. That is, at a given time (or in this case, a given relative level of farm and nonfarm output) when agricultural output represented a relatively larger share of total output, agricultural prices were relatively low; and vice versa. In the depression years, even though farm prices were low, farm output was maintained and represented a relatively large share of total output. In this rather simple framework, the ratio X of prices of farm products to the general price level (GNP deflator index) was expressed as a function of two variables: the ratio P of farm output to total output, and the trend ($t = 1, 2, \ldots n$), which reflected the tendency for the relationship to shift downward gradually as farm output became a smaller share of total output.

$$X = 2.27 - 8.566P - 0.0084t \qquad (7)$$

R, the multiple correlation coefficient, is 0.92.

If the relative growth in farm output, indicated by the trend line (Chart 5), continues to decline in the projected economy of growth to around 6 percent of the total by 1970, a prices-received index of 260 to 265 is indicated for the high-employment economy. For the unemployment framework in this approach, it may be assumed that farm output will recede little, if any,

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eral assumptions, suppose prices are estimated on the basis of the following equation, which is sometimes used for shorter-period approximations:

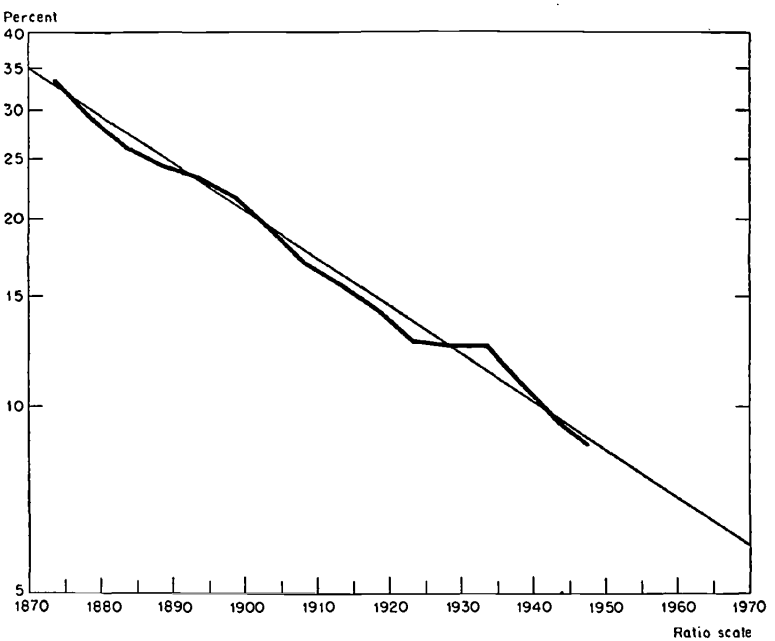
Log (prices-received index) = 2.812 + 1.241 log (disposable income)
+ 0.142 log (value of agricultural exports)
− 1.658 log (volume of farm marketings index)

These relationships indicate an index of prices received under the high assumptions of around 415 percent of 1910-14. The equation was taken from *Some Statistical Relationships Used in Price Analysis and Outlook Work*, working data made available at the 1949 Department of Agriculture Outlook Conference.

from the figure for the high-employment assumption. But a substantially reduced gross national product would tend to increase the ratio of farm to total output, possibly to around 6.5 percent. Such a rise in farm output relative to the total and the lower general price level for the unemployment assumption suggest a

CHART 5

Ratio of Farm Sales plus Farm Home Consumption to Gross National Product (Both in 1935-39 Dollars), Overlapping Decade Averages, 1869-78 to 1939-48; Projected to 1970



price for farm products of about 200 percent (1910-14 = 100).

The indicated value of farm sales plus home consumption is around $40 billion for high employment and about $30 billion under the unemployment assumption.[24] A long-run relationship,

[24] It may be of interest to compare this approach with results obtained from a forecasting equation which has given reasonably good results for year-to-year estimates of cash receipts from farm marketings.

$$\text{Cash receipts} = -1.05 + 0.113\ (\text{disposable personal income}) + 1.722\ (\text{value of agricultural exports})$$

This equation, with projected disposable income and agricultural exports, indicates cash receipts about $10 billion larger than equivalent cash receipts estimated above. Cash receipts of $46 billion and volume of farm marketings

expressing the value of farm sales plus home consumption as a function of gross national income and time, indicates an elasticity of value of farm products with respect to national income of around 0.6 to 0.7 at the means. The estimated value of farm sales plus farm home consumption, based on projected gross national income and an elasticity of 0.6 to 0.7, comes very near the $40 billion estimated for the high-employment assumption.

A composite of commodity prices. Detailed price appraisals were also prepared for each commodity in an effort to project prices which seemed reasonably consistent with the projected demand and supply prospects for each commodity as well as consistent with the assumed general price level. Each commodity specialist was asked to estimate demand, supply, and prices for his commodity in the general framework of assumptions for 1970. These prices were compared to others through competitive relationships on the demand side and relationships among commodities competing for the same resources on the supply side. Estimates were appraised in relation to each other and to projections prepared independently by the author on the basis of statistical analyses, trends in price relationships, product-feed price ratios, and other techniques. Detailed price projections resulted in an index of prices received of 265 (1910-14 = 100) for the high-employment assumption and 190 under the unemployment assumption (Table 5).

b. THE PROJECTED PICTURE SUMMARIZED

Projections of per capita demand for agricultural products, population, exports, imports, total output, and an over-all price index for farm products are now available for the two employment assumptions. We also have estimates of the value of farm sales plus home consumption. These projections should be tied together. The total value of agricultural production should be approximately equal to the following:

$$R = \Big[(qP) + e\Big]p$$

where R is cash receipts including value of home consumption, q is per capita use, P is population, e is net exports and net stock

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projected to around 178 (1935-39 = 100) indicate an index of prices received for farm products of around 340 percent of 1910-14. This compares with 415 percent, computed in the preceding footnote.

TABLE 5

INDEXES OF PRICES RECEIVED FOR FARM PRODUCTS, SELECTED PERIODS, 1935-49, AND PROJECTIONS FOR 1970 (INDEXES, 1910-14 = 100)

Item	1935-39 Average	1937-41 Average	1948	1949	1970	
					High Employment	*Unemployment*
All farm products	107	107	285	249	265	190
Livestock and livestock products	115	117	314	272	300	218
Meat animals	117	121	361	311	345	252
Dairy products	119	123	300	251	286	207
Poultry products	107	105	235	219	222	159
Wool	134	153	263	273	245	190
All crops	99	96	252	223	224	159
Feed grains and hay	95	87	250	170	216	144
Food grains	94	90	250	219	207	144
Oil-bearing crops	113	112	351	242	309	207
Cotton	87	87	270	245	218	151
Tobacco	172	163	380	398	409	296
Fruit	95	92	174	199	200	144
Truck crops	95	106	214	201	210	173
Other vegetables	99	96	252	222	161	112

Sources: Background data from *Agricultural Prices* (Bureau of Agricultural Economics).

accumulation (may be negative), and p is prices received for farm products. This relationship assumes that net stock accumulation, net exports, and home consumption are valued at the average of prices received. For convenience, these variables were expressed in terms of index numbers. Measuring the change in the computed value of R from both 1949 and 1942 to 1970 and raising the dollar value of farm sales plus farm home consumption for 1949 and 1942 on the basis of the projected percentage change in R suggest a total of around $39 billion under the high projection. If the relative change in the computed value of R from the high-employment to the unemployment assumption is applied to the $39 billion projected for high employment, a value of farm sales plus home consumption of around $28 to $29 billion is indicated for the unemployment assumption. Cash receipts for these projections would total around $36 billion for high employment and $25 billion for the low-employment projection. These receipts and projected farm marketings reflect prices received by farmers of around 265 percent of 1910-14 for the high- and about 190 for the low-employment assumption.

4. *Prices paid by farmers*

The problem of projecting prices for cost items used in farm production is basically the same as that of projecting prices for farm products or any other product. However, no detailed consideration is attempted. The "parity index," which is used to compute parity prices for most farm products, includes nearly 180 cost items for family living, 159 price series for production items, interest payable per acre, taxes payable per acre, and farm wage rates for hired labor. As so many items are involved, a very simple procedure was adopted. The gross national product deflator index—the price component of GNP—and the parity index had closely correlated movements during the last three decades. Both indexes represent a wide range of commodities at retail and wholesale levels. On the basis of this relationship, the parity index was first approximated from the projected general level of prices for the high-employment and unemployment assumptions.

TABLE 6

INDEXES OF PRICES PAID BY FARMERS, INCLUDING INTEREST, TAXES, AND WAGES, SELECTED PERIODS, 1935-49, AND PROJECTIONS FOR 1970
(INDEXES, 1910-14 = 100)

Prices Paid for Items in:	*1935-39 Average*	*1937-41 Average*	*1948*	*1949*	*1970*	
					High Employment	*Unemployment*
Family living	124	124	251	243	245	202
Farm production	124	126	250	238	237	195
Family living and production	124	125	250	240	241	201
Interest payable per acre	117	104	72	76	70	70
Taxes payable per acre	182	184	254	275	300	250
Wage rates for hired labor	121	133	442	428	470	350
Prices paid, interest, taxes, and wages	125	127	259	250	256	210
Parity ratio[a]	86	84	110	100	103	90

[a] Ratio of the index of prices received to the index of prices paid, interest, taxes, and wage rates.

Source: Background data from *Agricultural Prices* (Bureau of Agricultural Economics).

As interest, taxes, and wages represent only 15 percent of the total index weight, it is reasonable to expect a very high association between the parity index and the index of prices paid for items used in family living and farm production. Consequently,

this relationship was used as a basis for projecting the index of prices paid for living and production items. A similar procedure was followed in projecting major components of the living- and production-cost indexes.

The index of wage rates was projected on the basis of past growth in real wages (the wage rate deflated by the index of prices paid for items used in family living). The projection was then converted to a current-dollar basis, using the projected index of prices paid for items used in family living. This approximation of the wage rate index appeared reasonable in relation to past trends and to other cost items in the parity index. Farm and nonfarm wage rates were not compared, but per capita incomes are shown below. Interest payments per acre were assumed to be at levels around those of 1949. Interest has a very small weight in the index. Taxes payable per acre, also a small part of the total cost index, were assumed to be at levels somewhat higher than the 1949 level (Table 6).

5. *Farm income*

Many techniques of appraisal used above assumed that wide differences in returns to productive services would not persist during long periods. Although some comparisons are made between farm and nonfarm income, no attempt is made to determine whether equality exists. Almost any type of data will show considerably lower money incomes to farmers than to the nonfarm segment of the economy.

The usual census concept of a farm includes many units which are not primarily in the business of farming. There are some rural residences, estates, institutions, and part-time units of various types. This latter group of farms can be approximated and separated from commercial farms on the basis of the 1945 Census of Agriculture.[25] Economic classes I through IV are primarily "commercial" farms. Data as to number of farms, population, value of farm products sold, and value of products used in the home were tabulated for the commercial and noncommercial groups. About 57 percent of the farms and around 62 percent of the population fall in the "commercial" group. However, commercial farms sold more than 95 percent of all farm products and accounted for 92.5 percent of the total value of products for

[25] See the special report *Sample Census of Agriculture, 1945* (Bureau of the Census).

sale and use in the home. If farm population, production, and income are allocated to commercial farms on the basis of these proportions, per capita incomes of persons on commercial farms are well above the average for all farms.

TABLE 7

INCOME PER PERSON FOR ALL FARMS, COMMERCIAL FARMS, AND THE TOTAL POPULATION, SELECTED PERIODS, 1935-45, AND PROJECTIONS FOR 1970
(IN DOLLARS)

Item	1935-39 Average	1949	1970	
			High Employment	Unemployment
Net income per person on farms from agriculture[a]				
All farms	177	592	927	645
Commercial farms	—	905	1,595	1,105
Agricultural gross product per person on farms				
All farms	226	792	1,190	847
Commercial farms	—	1,190	2,040	1,450
Gross national product per person	653	1,713	2,818	2,070

[a] Includes government payments.
Source: Background data partly from the *Farm Income Situation* (BAE) and partly estimated.

Data in Table 7 are approximations, but they indicate the extent of differences between farm and nonfarm incomes and between all farms and commercial farms. Persons on farms also received an estimated $181 per person in 1949 from nonfarm sources, and nonfarm people averaged around $18 per capita from agriculture. Other differences, such as valuing the estimated rental of farm homes and products used on the farm at "retail" rather than at farm prices, might be approximated. Such an adjustment may account for several hundred dollars of the difference between per capita farm and nonfarm incomes. In addition, the purchasing power of the dollar may be generally higher in the country.[26] There are many nonmonetary considerations, too, that may make individual families prefer the farm (or the urban area), even with a lower real income. Finally, and equally as important, these figures are rough approximations and may be

[26] See N. M. Koffsky, "Comparison of Purchasing Power—Farm and Urban," *Studies in Income and Wealth, Volume Eight* (NBER, 1946).

subject to a considerable range of error. Probably no explanation of absolute differences can ever be conclusive.

6. *Some projections under different assumptions*

a. AGRICULTURAL OUTPUT AND PRICES

The computations made in this short section are largely mechanical first approximations prepared to indicate variations in farm prices and incomes under rather restricted sets of conditions. The results have not been examined for internal consistency.

Suppose the over-all assumptions as to population, income, prices, and the projected demand for farm products remain unchanged for each of three alternative levels of farm output—160, 165, and 175 percent of 1935-39 (Table 8). In this general framework, the index of per capita supply rises as output increases, resulting in lower prices and lower incomes for high than for low farm output. It is recognized, however, that total real incomes per person would vary somewhat with different levels of farm output, and, also, that output and total utilization would depend upon prices and incomes in agriculture. Thus, for an assumed output of 175, per capita real incomes would probably be a little higher than for a smaller farm output. And, although the influence of price on aggregate per capita use of farm products is small, lower prices would encourage a higher per capita use, particularly if a relatively large part of the greater output consisted of livestock and livestock products. If these successive approximations were made, prices and incomes would tend to be

TABLE 8

PRICES AND INCOMES RECEIVED FOR FARM PRODUCTS UNDER GIVEN LEVELS OF TOTAL DEMAND WITH VARYING LEVELS OF FARM OUTPUT AND PER CAPITA SUPPLY

ITEM	LEVELS OF FARM OUTPUT (1935-39 = 100)		
	160	*165*	*175*
Net exports of farm products (in index points)	3	3	3
Domestic supply of farm products	157	162	172
Per capita supply of farm products	111	115	122
High-employment assumption			
Prices received for farm products (1910-14 = 100)	305	264	193
Cash receipts from marketings (in billions of dollars)	40	36	28
Unemployment assumption			
Prices received for farm products (1910-14 = 100)	225	191	133
Cash receipts from marketings (in billions of dollars)	30	26	19

somewhat different from those indicated under the alternative assumptions specified for the computations.

b. THE PRICE LEVEL AND AGRICULTURAL PRICES

For purposes of illustration, suppose all real magnitudes remain as projected and only the "price level" is varied so that we can observe its influence on prices received by farmers, on cash receipts from farm marketings, and on the gross national product (Table 9).

TABLE 9

APPROXIMATE INFLUENCE OF DIFFERENT PRICE LEVEL ASSUMPTIONS ON THE GROSS NATIONAL PRODUCT, INDEX OF PRICES RECEIVED BY FARMERS, AND CASH RECEIPTS FROM FARM MARKETINGS[a]

ITEM	UNIT OR BASE	ALTERNATIVE PRICE LEVEL ASSUMPTIONS[b]			
		I	*II*	*III*	*IV*
High-employment assumption					
Consumers' price index	1935-39	170	160	145	180
Prices received by farmers, index	1910-14	264	246	220	280
Cash receipts from marketings[c]	$ billion	36	33	30	38
Gross national product	do.	510	477	426	542
Unemployment assumption[d]					
Consumers' price index	1935-39	145	136	124	154
Prices received by farmers, index	1910-14	190	178	160	206
Cash receipts from marketings[e]	$ billion	25	24	21	27
Gross national product	do.	375	350	320	405

[a] Only the price level is varied in these calculations. Real income per person, farm output, exports and imports, and employment are the same for each price level assumption.

[b] Assumption I is the price level projection assumed for most calculations for this report; II is simply an alternative; III is the same price level assumed for the "Hope Report" long-range projections; and IV approximates the January 1951 level of prices. The alternative levels are based on the consumers' price index indicated for each.

[c] Assumes farm production for sale and home consumption at 165 and volume of farm marketings at 178, both based on the 1935-39 average.

[d] The unemployment price level alternatives assume the same percentage decline as projected under price assumption I.

[e] Assumes volume of farm marketings around 175, based on the 1935-39 average.

Price level alternative III, as represented by the consumers' price index, is about the same as that used in the Hope Report—*A Study of Selected Trends and Factors Relating to the Long-Range Prospect for American Agriculture*—made for the House Committee on Agriculture and dated March 10, 1948. Alternative I was used for most projections in this report and alternative IV

approximates the level of prices as of January 1951. The importance of the price level assumption as a factor influencing the level of prices and dollar incomes received by farmers is immediately obvious.

C. POPULATION, AGRICULTURAL OUTPUT, AND PRICES

Population growth is the major factor that influences growth in total requirements for farm products. Moreover, growth of population may be a key factor in over-all vigor and expansion in the economy. The rate of population growth will very likely slow down during the next several decades. But prospects for agriculture during the next two to three decades will depend largely on growth of population compared with expansion of agricultural output.

As a basis for examining the importance of population growth on prospects for agriculture, let us assume the same projected level of per capita use of farm products and compute required output under three levels of population. The total product of the economy would vary with growth of population, as would farm output for a specified level of per capita demand. For example, a population of 210 million by 1970—the high census projection —with the same assumptions for rates of labor force participation, unemployment, productivity, and price level used for the high-employment projections in this report, would result in a gross national product of around $600 billion. Assuming no change in relative prices for farm products and no change in per capita demand, a population of 210 million would require a farm output of around 188 percent of 1935-39, even though no net exports of farm products are assumed (Table 10).

As indicated above, with lower prices for farm products, we would expect some increase in per capita use for a specified level of demand. Likewise for a given level of output, as price changes with each population assumption, per capita use would also change and moderate the rise or decline indicated for the specified assumptions.

F. SUMMARY AND CONCLUDING OBSERVATIONS

Long-run projections should be appraised in relation to a framework of assumptions. As anticipations of the future must be based largely on past experience, the framework of assumptions and,

TABLE 10

INDICATED PRICES RECEIVED FOR FARM PRODUCTS UNDER THREE POPULATION AND FARM OUTPUT ASSUMPTIONS

ITEM	FARM OUTPUT ASSUMPTION (1935-39 = 100)		
	165	*175*	*180*
Index of per capita supply under each population assumption (1935-39 = 100)			
165 million people[a]	121	129	133
181 million people[a]	115[b]	122	125
210 million people[a]	101	107	110
Indicated index of prices received for each per capita supply assumption (1910-14 = 100)			
165 million people	202	125	88
181 million people	264[b]	193	163
210 million people	420	351	317

[a] For 165 million people, net exports are assumed as 10 points of the output index; for 181 million, net exports are assumed as 3 points; and for 210 million, zero net exports are assumed. Per capita real income is assumed to be the same for each combination.

[b] Projections based on assumptions used for the body of this report.

consequently, the projections are, to some extent, products of the times and probably tend to be conservative. War, or an extended period of defense mobilization, accompanied by a high level of economic activity, would tend to raise prices and might stimulate growth in output and incomes sufficiently to make specific quantitative projections obsolete in a matter of several years. In such a period, innovations and the rate at which they are adopted by farmers could result in farm output well in excess of that which might be expected on the basis of past growth.

Total demand for farm products during the next two to three decades will depend primarily upon the growth of population and per capita income. It would be possible to have a large growth of population and a decline in per capita demand for farm products. However, these projections assume substantial increases in per capita real income during the next two decades. Because of the relatively low price and income elasticities of demand for all farm products combined, increases in total utilization per person probably will be small even with much higher incomes or somewhat lower prices. As a result, most of the projected rise in total utilization is due to growth of population. The pattern of consumption, however, will continue to change, and to some extent these shifts will be independent of changes in income and prices. Empirical elasticity measurements as well as a priori

reasoning lend economic significance to many changes in per capita use, such as the shift away from grain products and potatoes, and toward more fruits, vegetables, and livestock products in general. It must be recognized, too, that changes in taste, fashion, working conditions, education, advertising, technological developments, and many other factors probably are inseparably bound up with price and income effects on shifts in the pattern of utilization of farm products over a long period of years.

Projected utilization of farm products for 1970, on which most calculations in this study are based, provides for an increase of around one-fourth in total domestic utilization of farm products above the 1945-49 average. This appraisal assumed a population of 181 million by 1970. Per capita utilization of all farm products is about the same as the relatively high 1945-49 average, with a small increase in per capita food consumption and a decline in nonfood use per person. A high level of foreign trade was assumed. But, with some decline in exports and an increase in imports, the estimate of net exports of farm products for 1970 is well below the 1945-49 average. If population expanded to around 210 million—the high projection—the same level of per capita consumption would result in domestic utilization of around 45 percent above the 1945-49 average. The nature of the supply response to an expansion in total demand will largely determine relative prices for farm products and it may also modify the pattern of consumption. That is, heavy pressure of population on available resources could cause a shift back toward more cereals and less livestock products.

The supply response for agriculture is difficult to appraise for several reasons. Even if approximate empirical measurements were available, innovations during the long run might result in substantial shifts in the use and contribution of each agent of production. Given projected demand and approximate relative prices for farm products, the problem becomes one of appraising probable use of resources in agriculture, together with possible innovations, and their effect on unit costs and output per unit of the resources used. There is ample evidence to demonstrate that resources do move into and out of agriculture over the long run in response to changes in demand, shifts in use of resources, and innovations, although probably not rapidly enough to maintain equality of returns for agriculture. Employment on farms has declined during the last four decades, and the use of

farm power and machinery has increased rapidly. Tractors on farms rose from around 1,000 in 1910 to more than 4 million in 1951. Much of this gain represents merely a substitution of machine power for horse power, but the shift has released around 65 million acres of cropland for production of foods and fibers. Total crop acres harvested changed little during the last four decades, but land used for food rose by about 100 million acres, or approximately 50 percent.

Yields per crop acre have continued to increase by nearly 1 percent per year reflecting greater inputs per acre and innovations relating to improved seed, insect and disease control, weed control, cropping practices, plant feeding, and other developments contributing to greater output per acre. Use of fertilizer in 1951 was more than 300 percent of the 1935-39 average, and inputs of material for disease, insect, and weed control have also risen substantially. The rate of innovation in agriculture apparently has been relatively rapid, but its effect on output is by no means clear-cut. Production per man or per man-hour is largely a reflection of increased capital inputs as well as innovations, which may result in increased inputs, but also in greater output per unit of resources used.

Total acreage of cropland probably cannot be increased much during the next several decades. In fact, conservation, flood control, and urban development may withdraw more acreage than is made available through reclamation. Acreage that will be released for food production by further declines in numbers of horses and mules will be small. Thus, increased production of food and fiber must come largely from more intensive use of land, which means greater capital inputs and continued innovation. It is conceivable, too, that tillable pasture land may be used for more intensive cropping.

Domestic consumption for 1970, around a fourth larger than the 1945-49 average, probably would not place a heavy strain upon agriculture. Exports were relatively large in the 1945-49 period, and stocks of many farm products had become burdensome by the latter part of that period. Moreover, an examination of trends in yields suggests that an increase of 20 percent in total farm output during the next two decades could be attained with only moderate increases in yields. Such an increase probably will not be difficult under favorable economic conditions and probably would provide for projected utilization at relative prices

for farm products around the parity level as now defined. If past growth in farm output is indicative of what can be expected in the future, projected demand for farm products suggests relatively favorable terms of trade for agriculture over the long run.

Preliminary results of a survey by the Land Grant College–Department of Agriculture joint committee on the productive capacity of agriculture are very optimistic and may be instrumental in influencing projections of farm output well above what might have been expected on the basis of long-run growth and well above most projections published in recent years. The assumptions for the capacity study were very favorable, and, for some commodities, productive capacity was well above prospective demand. Under forced draft, agriculture probably could expand rather rapidly during a period of several years. However, such growth would depend upon the expansion of domestic and export demand for farm products and upon the composition of that demand. Substantial increases may be easy for food grains, potatoes, or cotton, for example, but they are not likely to occur if consumers want more livestock and livestock products. It should be pointed out, in this connection, that with prospects for little change in acreage, just a continuation of past growth assumes a rate of innovation and a rate of adoption of innovation somewhat more rapid than those of the last several decades.

A projection well in excess of that indicated on the basis of past growth would reflect a larger expansion in total demand, a very rapid rate of innovation, or probably a combination of both. A very rapid rate of innovation for a given expansion in total demand would contribute to relatively lower prices and incomes for agriculture. A large or short supply of farm products relative to demand probably would also change the pattern of consumption and thus would tend to modify the pressure on resources in agriculture. Farm output will not be expanded rapidly enough relative to growth in demand to result in incomes to resources in agriculture substantially lower than they could earn in alternative employment. A comparison of farm and nonfarm incomes indicated in the projected framework is probably one of the most reasonable checks that can be made on the internal consistency of a set of projections.

The rather optimistic projections for population growth and expansion of the economy during the next 25 years compared

with long-run growth in farm output suggest relatively favorable terms of trade for agriculture in the long run. However, if domestic economic activity recedes somewhat and export demand weakens in the next few years, the rapid expansion in farm output in recent years may contribute to surpluses of some farm products following the defense build-up.

STATISTICAL APPENDIX

TABLE A-1

GROSS NATIONAL PRODUCT, MONEY SUPPLY, AND RATIO OF MONEY SUPPLY TO GROSS NATIONAL PRODUCT, UNITED STATES
(OVERLAPPING DECADE AVERAGES, 1869-78 TO 1939-48, AND AVERAGE, 1944-51)

Period	*GNP in Billions of Current Dollars*[a]	*Money Supply in Billions of Current Dollars*[b]	*Ratio of Money Supply to GNP*
1869-78	7.5	2.33	0.311
1874-83	9.5	2.85	0.300
1879-88	11.4	3.67	0.322
1884-93	12.7	4.83	0.380
1889-98	13.6	5.87	0.432
1894-1903	16.7	8.03	0.481
1899-1908	23.0	11.84	0.515
1904-13	30.7	15.79	0.514
1909-18	42.8	21.33	0.498
1914-23	66.0	31.95	0.484
1919-28	86.8	44.53	0.512
1924-33	85.1	49.98	0.603
1929-38	77.9	51.43	0.672
1934-43	107.0	65.89	0.636
1939-48	180.8	119.77	0.655
1944-51	249.9	165.78	0.673

[a] See Table A-2.

[b] Money supply includes adjusted demand deposits, time deposits, government deposits, and currency outside banks. Data from *Banking and Monetary Statistics* (Federal Reserve Board), p. 34; *Federal Reserve Bulletin* for recent years; and for years before 1892 from A. G. Hart, *Money, Debt and Economic Activity* (Prentice-Hall, 1948), p. 538.

TABLE A-2

OUTPUT, EMPLOYMENT, TOTAL HOURS WORKED, AND PRODUCTIVITY PER MAN AND PER MAN-HOUR, UNITED STATES (OVERLAPPING DECADE AVERAGES, 1869-78 TO 1939-48, AND AVERAGE, 1944-51)

Period	*GNP in Current Dollars*[a] *(billions)*	*Price Deflator Index*[b] *(1935-39=100)*	*GNP in 1935-39 Dollars (billions)*	*Employment*[c] *(thousands)*	*Total Hours Worked*[d] *(millions)*	*Output per Man 1935-39 (dollars)*	*Output per Man-Hour 1935-39 (dollars)*	*Hours per Man-Year*	*Hours per Week*
1869-78	7.5	82.5	9.1	13,430	41,902	678	0.217	3,120	60.0
1874-83	9.5	72.8	13.0	15,400	48,048	844	0.271	3,120	60.0
1879-88	11.4	66.5	17.1	18,750	58,500	912	0.292	3,120	60.0
1884-93	12.7	62.1	20.4	22,050	66,547	925	0.307	3,018	58.0
1889-98	13.6	57.6	23.6	23,530	68,519	1,003	0.344	2,912	56.0
1894-1903	16.7	57.8	28.9	26,330	75,304	1,098	0.384	2,860	55.0
1899-1908	23.0	63.5	36.2	30,200	84,802	1,199	0.427	2,808	54.0
1904-13	30.7	69.9	43.9	34,520	91,547	1,272	0.480	2,652	51.0
1909-18	42.8	86.0	49.8	37,760	94,249	1,319	0.524	2,496	48.0
1914-23	66.0	116.1	56.8	40,040	95,776	1,420	0.594	2,392	46.0
1919-28	86.8	126.8	68.7	42,622	99,656	1,607	0.688	2,338	45.0
1924-33	85.1	114.2	74.0	43,762	99,117	1,686	0.746	2,262	43.5
1929-38	77.9	102.3	75.7	43,406	94,051	1,737	0.803	2,164	41.6
1934-43	107.0	106.5	97.9	48,633	105,845	1,986	0.915	2,167	41.7
1939-48	180.8	134.9	131.1	57,478	128,010	2,268	1.021	2,221	42.7
1944-51	249.9	167.6	149.0	61,769	136,296	2,410	1.094	2,205	42.4

[a] Department of Commerce official estimates for 1929-51. Data for 1869-78 to 1928 based on S. Kuznets' *National Product since 1869* (NBER, 1946), adjusted to Commerce series by linking in 1929.

[b] The Kuznets data were presented in current and 1929 dollars. The implicit index was computed from these two series and put on a 1935-39 base. Kuznets' deflated series in 1929 dollars was obtained by deflating components of GNP. The data for 1929-51 are an implicit series based on the deflated Commerce series of GNP related to GNP in current dollars (*Survey of Current Business* [Department of Commerce], January 1951, p. 9). This deflation process was also done by components. The deflator series tends to be more flexible than the consumers' price index and less flexible than wholesale prices.

[c] Employment for 1869-78 to 1914-23 based on Kuznets' data on gainfully occupied (*National Product since 1869*, p. 120), with employment estimated on basis of E. R. Frickey's series on production (industry and commerce) found in his *Economic Fluctuations in the United States* (Harvard University Press, 1942), and also shown in A. G. Hart's *Money, Debt, and Economic Activity* (Prentice-Hall, 1948), p. 272. The peaks were connected and the deviations from the line connecting these peaks were arbitrarily used as a basis for estimating the average percentage employed by decade. The data for 1919-28 are based on employment data in Senate Committee Print No. 4, *Basic Facts on Employment and Production*, 1945. These data were adjusted upward to the current series on the basis of 1930-39 (divided by 0.9739). Current data for 1929-51 are official estimates of the Bureau of the Census.

[d] Hours worked per week for 1869-78 to 1914-23 estimated from Colin Clark's estimates of "hours actually worked" for all industry in *Conditions of Economic Progress* (London: Macmillan, 1951), p. 79. Hours worked per week for 1919-28 are composed of estimates for agricultural and nonagricultural employment. The nonagricultural series is based on hours per week for manufacturing industries adjusted to 1929 relationship of total nonagricultural hours per week to manufacturing hours (the hours per week for manufacturing were raised by 1.0153 back of 1929). Missing years in these data were interpolated on the basis of change in other estimates available for those years—Colin Clark's, Paul Douglas's, and others. Hours worked in agriculture are an estimate of total man-hours of work in agriculture from *Gains in Productivity of Farm Labor* by R. W. Hecht and Glen T. Barton (Department of Agriculture Tech. Bul. No. 1020). Hours worked for 1929-49 are a composite of an unpublished estimate for hours worked in the private nonagricultural segment of the economy (this series is a confidential one from the Commerce Department and is not shown separately in the report), total man-hours worked in agriculture (Department of Agriculture Tech. Bul. No. 1020), and an estimate of hours worked in government (40 hours per week during 1929-41 and 1946-49). These series were weighted by employment in each segment to get total hours worked and the average work week for 1929-49.

TABLE A-3

ESTIMATED EMPLOYMENT, GROSS PRODUCTION IN 1935-39 DOLLARS, AND HOURS WORKED IN AGRICULTURE, THE NONFARM SEGMENT, AND THE TOTAL ECONOMY
(DECADE AVERAGES, 1869-78 TO 1939-48)

PERIOD	THE LABOR FORCE[a] (*thous.*)	EMPLOYMENT			GROSS PRODUCT			HOURS WORKED		
		Total[a] (*thous.*)	*Nonfarm*[b] (*thous.*)	*Farm*[c] (*thous.*)	*Total*[a] (*$ bil.*)	*Nonfarm*[d] (*$ bil.*)	*Farm*[e] (*$ bil.*)	*Total*[a] (*millions*)	*Nonfarm*[b] (*millions*)	*Farm*[f] (*millions*)
1869-78	14,440	13,430	5,590	7,840	9.1	6.2	2.9	41,902	17,441	24,461
1874-83	16,740	15,400	6,690	8,710	13.0	9.4	3.6	48,048	20,873	27,175
1879-88	19,528	18,750	9,260	9,490	17.1	13.0	4.1	58,500	28,891	29,609
1884-93	22,729	22,050	11,880	10,170	20.4	15.7	4.7	66,547	34,817	31,730
1889-98	25,580	23,530	12,780	10,750	23.6	18.4	5.2	68,519	36,656	31,863
1894-1903	28,311	26,330	15,110	11,220	28.9	23.3	5.6	75,304	43,798	31,506
1899-1908	31,792	30,200	18,720	11,480	36.2	30.3	5.9	84,802	54,954	29,848
1904-13	35,954	34,520	23,160	11,360	43.9	37.9	6.0	91,547	64,374	27,173
1909-18	39,329	37,760	26,690	11,070	49.8	43.4	6.4	94,249	69,496	24,753
1914-23	41,927	40,040	29,320	10,720	56.8	50.4	6.4	95,776	72,921	22,855
1919-28	45,003	42,622	32,101	10,521	68.7	62.2	6.5	99,656	76,553	23,103
1924-33	48,759	43,762	33,356	10,406	74.0	67.1	6.8	99,117	75,051	23,066
1929-38	52,193	43,406	33,320	10,086	75.6	68.9	6.8	94,051	72,276	21,776
1934-43	56,229	48,633	39,023	9,610	97.9	90.4	7.5	105,845	85,160	20,684
1939-48	60,986	57,478	48,611	8,867	131.1	122.4	8.7	128,010	107,737	20,274

[a] See footnotes to Table A-2.

[b] Nonfarm employment and nonfarm hours worked were computed by taking the differences between estimates of the total and the farm segment.

[c] Employment in agriculture for 1910-28 is based on the old BAE series (*Farm Labor* [BAE], January 14, 1948) for the period linked to the census series in 1929-30 (0.9255 percent of the BAE series). This adjustment was made in order to use census data on farm employment which is considered consistent with the labor force concept. Estimates before 1910 are rough approximations from census data on persons engaged in agricultural pursuits for selected years, as reported in *Progress of Farm Mechanization* (Department of Agriculture, Misc. Pub. No. 630, 1947), p. 5.

[d] Nonfarm gross product is the difference between estimated total and estimated farm gross product.

[e] Gross product for agriculture was approximated by adding to net income from agriculture, 1910-49 (*Farm Income Situation* [BAE], August 1950, p. 25), the estimated value of maintenance and depreciation (*Net Farm Income and Parity Report* [BAE, 1943], p. 23, for 1910 to 1939; and *Farm Income Situation*, August 1950, p. 30). The decade data were approximated from the long-run relationship of value of farm sales plus home consumption to the gross product of agriculture as estimated above. These estimates follow very closely those published in the *Survey of Current Business* (Department of Commerce), September 1951. There were wider year-to-year variations in the deflated series. Estimates of the gross product for agriculture were then deflated by the index of prices received by farmers (1935-39 = 100). The price series for 1869-1909 is the arithmetic index of prices received by farmers reported in *Gross Farm Income and Indices of Farm Production and Prices in the United States, 1869-1937*, by F. Strauss and L. H. Bean (Department of Agriculture, Tech. Bul. No. 703, December 1940), p. 24; recent data are from *Agricultural Prices* (BAE).

[f] Hours worked in agriculture are based on estimates prepared by R. W. Hecht and G. T. Barton for *Gains in Productivity of Farm Labor, 1910 to 1948* (Department of Agriculture, Tech. Bul. No. 1020). Decade data are rough approximations based on assumed hours per week for all labor and are designed to tie into the data for 1910-48.

TABLE A-4

ESTIMATES OF PER CAPITA USE OF FARM PRODUCTS, 1910-49
(INDEXES, 1935-39 = 100)

Year	*Per Capita Food Consumption*[a]	*Per Capita Use of Nonfoods*[b]	*Per Capita Use of All Farm Products*[c]
1910	96	95	96
1911	97	97	97
1912	98	102	99
1913	96	101	97
1914	97	100	98
1915	96	110	99
1916	95	120	100
1917	95	120	101
1918	97	113	100
1919	98	105	99
1920	97	100	98
1921	95	97	95
1922	99	99	99
1923	101	102	101
1924	102	93	100
1925	100	99	100
1926	102	100	102
1927	101	106	102
1928	101	100	101
1929	102	104	102
1930	101	86	98
1931	100	88	97
1932	98	79	94
1933	98	90	97
1934	99	83	96
1935	96	95	96
1936	99	104	100
1937	100	104	101
1938	101	91	99
1939	104	106	104
1940	106	110	107
1941	109	141	115
1942	109	146	116
1943	109	140	114
1944	112	135	116
1945	114	130	117
1946	119	132	121
1947	115	131	118
1948	111	125	114
1949	111	107	110

[a] *Food Consumption in the United States* (Department of Agriculture, Misc. Pub. No. 691) and *National Food Situation* (BAE).

[b] The approximation of per capita nonfood use of agricultural products is based on tobacco, cotton, wool, and industrial oils. The index is price-weighted and based on the period 1935-39. It is a simple combination of available information on per capita use. No attempt was made to investigate and handle some of the conceptual problems involved, particularly for industrial oils. Data are from statistical publications of the Bureau of Agricultural Economics.

[c] Per capita use of all farm products is a combination of the food and nonfood indexes. They were combined by weighting each by the respective food and nonfood aggregates for each year computed for the BAE index of agricultural production for sale and home consumption.

TABLE A-5

SUPPLY AND UTILIZATIONS: ESTIMATED FOR MAJOR COMMODITY GROUPS, UNITED STATES, 1935-39 AVERAGE, 1949, AND PROJECTIONS FOR 1970 UNDER HIGH-EMPLOYMENT AND UNEMPLOYMENT CONDITIONS

COMMODITY AND YEAR	UNIT	PRODUCTION	IMPORTS	EXPORTS AND SHIPMENTS	CONSUMPTION OR USE			OTHER UTILIZATION[u]
					Food	*Feed and Seed*	*Other*[a]	
Meats (carcass weight)[b]								
1935-39 average	Million lbs.	16,182	262	198	16,382	—	—	—136
1949	do.	21,710	242	133	21,853	—	—	—36
1970: High employment	do.	28,193	245	111	28,327	—	—	—
Unemployment	do.	27,332	205	205	27,332	—	—	—
Dairy products (fat-solid basis)								
1935-39	Million lbs.	106,450	741	351	103,992	2,794	—	54
1949	do.	121,962	308	2,581	114,360	3,219	—	2,110
1970: High employment[c]	do.	142,600	1,950	370	141,180	3,000	—	—
Unemployment	do.	140,790	1,950	370	139,370	3,000	—	—
Poultry (dressed weight)								
1935-39	Million lbs.	2,677	2	2	2,670	—	—	7
1949	do.	4,556	18	13	4,456	—	—	130
1970: High employment	do.	6,151	18	15	6,154	—	—	—
Unemployment	do.	5,844	13	15	5,842	—	—	—
Eggs								
1935-39	Million doz.	3,335	18	2	3,225	—	126	—
1949	do.	5,186	2	20	4,755	—	210	185
1970: High employment	do.	5,916	15	15	5,656	—	260	—
Unemployment	do.	5,836	10	15	5,581	—	250	—
Fats and oils (incl. butter on actual-weight basis)								
1937-41	Million lbs.	8,239	1,974	479	6,486	—	3,163	85
1949	do.	11,961	1,093	2,328	6,718	—	3,548	460
1970: High employment	do.	12,424	1,460	1,208	8,026	—	4,650	—
Unemployment	do.	12,155	1,260	1,060	7,830	—	4,353	172

TABLE A-5 (continued)

COMMODITY AND YEAR	UNIT	PRODUCTION	IMPORTS	EXPORTS AND SHIPMENTS	CONSUMPTION OR USE			OTHER UTILIZATION[b]
					Food	*Feed and Seed*	*Other*[a]	
Fruits (fresh and processed on fresh-equivalent basis)								
1935-39[d]	Million lbs.	25,154	4,840	3,132	26,862	—	—	—
1949[d]	do.	31,752	4,659	2,447	33,964	—	—	—
1970: High employment	do.	45,268	6,220	2,075	49,413	—	—	—
Unemployment	do.	43,810	4,645	1,990	46,465	—	—	—
Vegetables (fresh and processed on fresh-equivalent basis)								
1935-39	Million lbs.	37,577	354	221	37,293	—	133	284
1949	do.	48,725	482	541	48,340	—	165	161
1970: High employment	do.	65,189	629	386	65,232	—	200	—
Unemployment	do.	61,672	521	386	61,607	—	200	—
Potatoes and sweet potatoes								
1935-39	Million bu.	423	1	3	334	92	3	—8
1949	do.	456	10	5	314	111	26	10
1970: High employment	do.	383	5	5	304	69	10	—
Unemployment	do.	400	5	5	313	75	10	—
Dry edible beans and peas								
1935-39	Million lbs.	1,590	46	73	1,216	273	—	74
1949	do.	2,303	46	145	1,287	282	—	635
1970: High employment	do.	1,880	50	65	1,595	275	—	—
Unemployment	do.	1,890	40	65	1,595	275	—	—
Sugar (raw)								
1935-39	Thous. tons	1,948	4,868	108	6,733	—	—	—25
1949	do.	2,112	5,703	60	7,544	—	—	211
1970: High employment	do.	2,500	6,560	100	8,960	—	—	—
Unemployment	do.	2,500	6,470	100	8,870	—	—	—
Wheat, rye, and rice (crop year)								
1935-39	Thous. tons	24,708	464	1,995	14,838	7,140	232	967
1948-49	do.	41,381	250	16,048[e]	14,868	6,844	188	3,594
1970: High employment	do.	34,534	142	8,350	17,384	8,728	224	—
Unemployment	do.	34,224	159	7,550	17,384	7,888	224	1,320

TABLE A-5 (concluded)

COMMODITY AND YEAR	UNIT	PRODUCTION	IMPORTS	EXPORTS AND SHIPMENTS	CONSUMPTION OR USE			OTHER UTILIZATION[b]
					Food	*Feed and Seed*	*Other*[a]	
Corn, oats, and barley (crop year)								
1935-39	Thous. tons	87,304	1,000	1,520	4,312	75,712	2,920	3,840
1948-49	do.	134,568	620	4,068	5,572	98,820	4,148	22,580
1970: High employment	do.	132,512	680	980	5,424	120,932	5,856	—
Unemployment	do.	131,640	480	980	5,176	116,812	4,808	4,344
Cotton lint								
1935-39	Thous. bales	13,149	171	5,300	—	—	6,938	9,419
1949	do.	16,128	244	5,906	—	—	8,870	1,218
1970: High employment	do.	12,030	250	4,500	—	—	7,780	—
Unemployment	do.	12,000	250	3,000	—	—	7,410	1,790
Wool (scoured basis)								
1935-39	Million lbs.	187	56	—	—	—	281	—38
1949	do.	111	155	7	—	—	339	—80
1970: High employment	do.	150	350	—	—	—	500	—
Unemployment	do.	150	260	—	—	—	410	—
Tobacco (crop year; farm sales weight)								
1935-39	Million lbs.	1,460	88	478	—	—	969	101
1949	do.	1,980	100	581	—	—	1,340	159
1970: High employment	do.	2,580	110	610	—	—	2,080	—
Unemployment	do.	2,500	110	500	—	—	1,900	210

[a] Includes hatching eggs, fats and oil used in soaps, paints and other industrial uses, shrinkage and waste of vegetables, cotton, wool, tobacco, and nonfood industrial uses for grains.

[b] These are balancing items, including primarily net stock change in most years, and, in 1949, Department of Agriculture net purchases.

[c] Exports of nonfat solids which make up a large part of total milk exports are not reflected on a fat-solid basis.

[d] Projections on basis of total apple crop, while background data are for commercial apple crop only. If an estimate for all apples is included, average production for 1935-39 may be around 26.5 billion pounds and for 1949 would be around 32.8 billion pounds.

[e] Includes military purchases of wheat and rice.

TABLE A-6

FEED CONCENTRATE BALANCE: LIVESTOCK PRODUCTION UNITS AND FEED PER UNIT, UNITED STATES, 1935-39 AVERAGE, 1948-49, 1949-50, AND PROJECTIONS FOR 1970
(IN MILLIONS OF TONS)

ITEM	YEAR BEGINNING OCTOBER			1970 PROJECTIONS	
	1935-39 Average	*1948-49*	*1949-50*	*High Employment*	*Unemployment*
Supply					
Stocks at beginning of year	10.7	7.9	30.8	[a]	[a]
Production of feed grains					
Corn	64.9	103.1	94.6	99.68	99.12
Oats	16.7	23.9	21.3	24.48	24.48
Barley	5.7	7.6	5.7	8.35	8.04
Sorghum grains	1.6	3.7	4.3	5.04	5.04
Total	99.5	138.3	125.9	137.55	136.68
Other grains fed[b]	5.1	4.5	5.5	6.86	5.91
By-product feeds fed	14.4	20.0	20.6	23.18	22.29
Total supply	119.0	170.7	182.8	167.59	164.88
Utilizations, October-September					
Concentrates fed					
Corn		73.3	83.2	91.09	88.35
Oats	75.3	20.8	19.3	22.13	21.44
Barley and grain sorghum		5.7	5.5	9.36	8.80
Wheat and rye	4.2	3.9	4.8	6.17	5.42
Oilseed cake and meal	3.3	7.3	7.8	9.73	9.15
Animal protein feeds	2.8	2.4	2.5	2.25	2.29
Other by-product feed	8.3	10.3	10.3	11.20	10.86
Total concentrates fed	93.9	123.7	133.4	151.93	146.31

TABLE A-6 (concluded)

ITEM	YEAR BEGINNING OCTOBER			1970 PROJECTIONS	
	1935-39 Average	*1948-49*	*1949-50*	*High Employment*	*Unemployment*
Feed grains for seed, human food, industry, and export	11.2	17.7	17.2	15.66	14.23
Total utilization	105.1	141.4	150.6	167.59	160.54
Utilization adjusted to crop year basis	104.5	139.9	152.6	—	—
Stocks at end of crop year	14.5	30.8	31.2	[a]	4.34[c]
Total supply	119.0	170.7	182.8[b]	167.59	164.88
Livestock production in terms of production units (in millions)	140.2	171.4	176.5	207.0	201.0
Concentrates fed per production unit	0.67	0.72	0.76	0.733	0.728

[a] Stocks are assumed at normal levels with no net accumulation of inventory.
[b] Imported grains and domestic wheat and rye.
[c] Net stock accumulation.
Source: Background data from *Feed Statistics* (Department of Agriculture, Stat. Bul. Nos. 85 and 95).