Volume Title: American Agriculture, 1899-1939: A Study of Output, Employment and Productivity

Volume Author/Editor: Harold Barger and Hans H. Landsberg

Volume Publisher: NBER

Volume ISBN: 0-87014-041-8

Volume URL: http://www.nber.org/books/barg42-1

Publication Date: 1942

Chapter Title: The Behavior of Agricultural Output

Chapter Author: Harold Barger, Hans H. Landsberg

Chapter URL: http://www.nber.org/chapters/c4597

Chapter pages in book: (p. 17 - 40)

Part Two

Output

Chapter 2

The Behavior of Agricultural Output

To COMPUTE measures of the physical volume of agricultural production as a whole it is necessary to weave together into a single series output data for a wide variety of commodities. These data, and the formulae used to combine them, are given in detail in Appendix A. Here it must suffice to say that as many farm products as possible have been included, and that farm prices have been used as weights throughout. In this chapter results are presented in the form of an over-all index, intended to show the movement of the entire physical output of agriculture, supplemented by fifteen partial indexes for individual groups of commodities.[1]

THE OVER-ALL INDEX

The index for the aggregate product of agriculture is shown in Table 1 and Chart 1. It will be seen that over the forty-year period net farm output increased by about one half, and that during 1937–39, it stood at a level higher than any attained previously.[2] The rise since 1899 reflects a much less

[1] The over-all index is based upon data for 88 commodities; some of the data are available for only part of the long period since 1899, some (like dairy products) are themselves composites of more than one series, others (like oranges or prunes) are regional or functional subdivisions of a single crop. The fifteen partial indexes are neither exhaustive when taken together, nor free from duplication. For the precise commodity coverage of each index, see p. 331 below. A comparison between the new index for farm output as a whole and various other published indexes of agricultural output will be found in Appendix C.

[2] The five-year average value for 1935–39 is 47.7 percent above the corresponding figure for 1897–1901. As is pointed out in Appendix A, this result depends essentially upon four Edgeworth comparisons, linked in 1909, 1919

rapid rate of growth than that of manufacturing output, which quadrupled in the same period.[3] Indeed, as may be seen from Chart 2, agricultural output grew even more slowly during these years than the population of the United States, which rose about 75 percent. The reasons for this comparatively slow development, and the question as to whether further increases in agricultural output are to be expected in the future, will be discussed in subsequent chapters.

Meanwhile we may comment briefly upon the behavior of the over-all index. The original figures are compared, in Chart 1, both with a five-year moving average derived from them and with an exponential trend fitted to the data. Over the forty-year period farm output grew on the average at a rate of about one percent a year (Table 4). In the original series, there is observable an almost uninterrupted rise between 1897 and 1914, disturbed only slightly by a minor drop in 1901, a peak and recession in 1906–07, and a minor decline in 1913. In the following period, extending roughly from 1915 to 1922, rises and falls alternate, resulting in a horizontal trend. It is not until 1923 that the 1915 high—itself largely attributable to the record cereal yields of that year—is finally surpassed in any substantial measure. Thereafter the rate at which agricultural production increases is far slower than the pace prevailing before 1915. In 1926 the upward movement levels off, to be succeeded after 1931 by the most precipitous drop recorded at any time during the period of observation. By 1934 the index has fallen almost to the level of 1916 and

---

and 1929. By contrast, a direct Edgeworth comparison between the two periods indicated suggests a slightly smaller rise, 42.1 percent. (This comparison excludes some products for which data are not available in 1897–1901; the output of these products expanded rapidly, and their exclusion is partly responsible for the difference in result.) The use of other formulae would doubtless also yield slightly differing results.

[3] Solomon Fabricant, *The Output of Manufacturing Industries, 1899–1937* (National Bureau of Economic Research, 1940), p. 6; *The Relation between Factory Employment and Output since 1899,* Occasional Paper 4 (National Bureau of Economic Research, 1941), p. 37.

1921, but that year is a turning point followed by an exceptionally rapid rise, so that in 1939 production exceeds the 1934 low by almost a third.

TABLE 1

INDEX OF AGRICULTURAL OUTPUT, 1897–1939

1899:100

Year	Basic Index	Five-year Moving Average	Year	Basic Index	Five-year Moving Average
1897	95	..	1919	125	127
1898	100	..	1920	130	128
1899	100	100	1921	118	128
1900	101	102	1922	130	131
1901	99	103	1923	132	132
1902	103	104	1924	137	138
1903	104	106	1925	138	140
1904	109	110	1926	146	143
1905	108	111	1927	141	145
1906	118	113	1928	147	146
1907	110	113	1929	144	147
1908	112	114	1930	145	147
1909	111	114	1931	150	146
1910	114	117	1932	144	141
1911	117	118	1933	140	139
1912	123	122	1934	120	136
1913	119	125	1935	133	137
1914	129	125	1936	134	140
1915	129	125	1937	153	148
1916	119	127	1938	152	..
1917	124	127	1939	159	..
1918	130	127			

The year-to-year fluctuations are relatively mild. Save for the turbulent 1930's, changes of 2 or 3 points in the index seem to be the rule, and rises or declines of 7 or 8 points the exception. Manufacturing activity, in contrast, ordinarily changes at a rate of 5 to 10 points from one year to another, and in the period preceding the first World War sometimes shifted as much as 30 points.[4]

[4] Fabricant, *The Output of Manufacturing Industries,* pp. 44-45.

Chart 1

INDEX OF AGRICULTURAL OUTPUT
(1899 : 100)

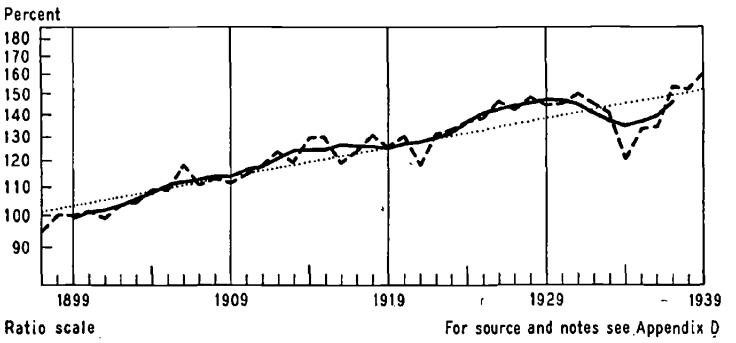
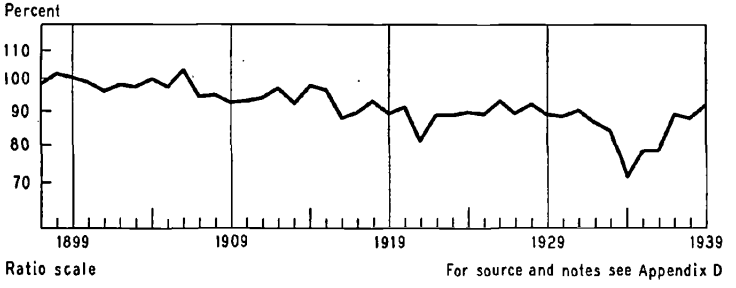
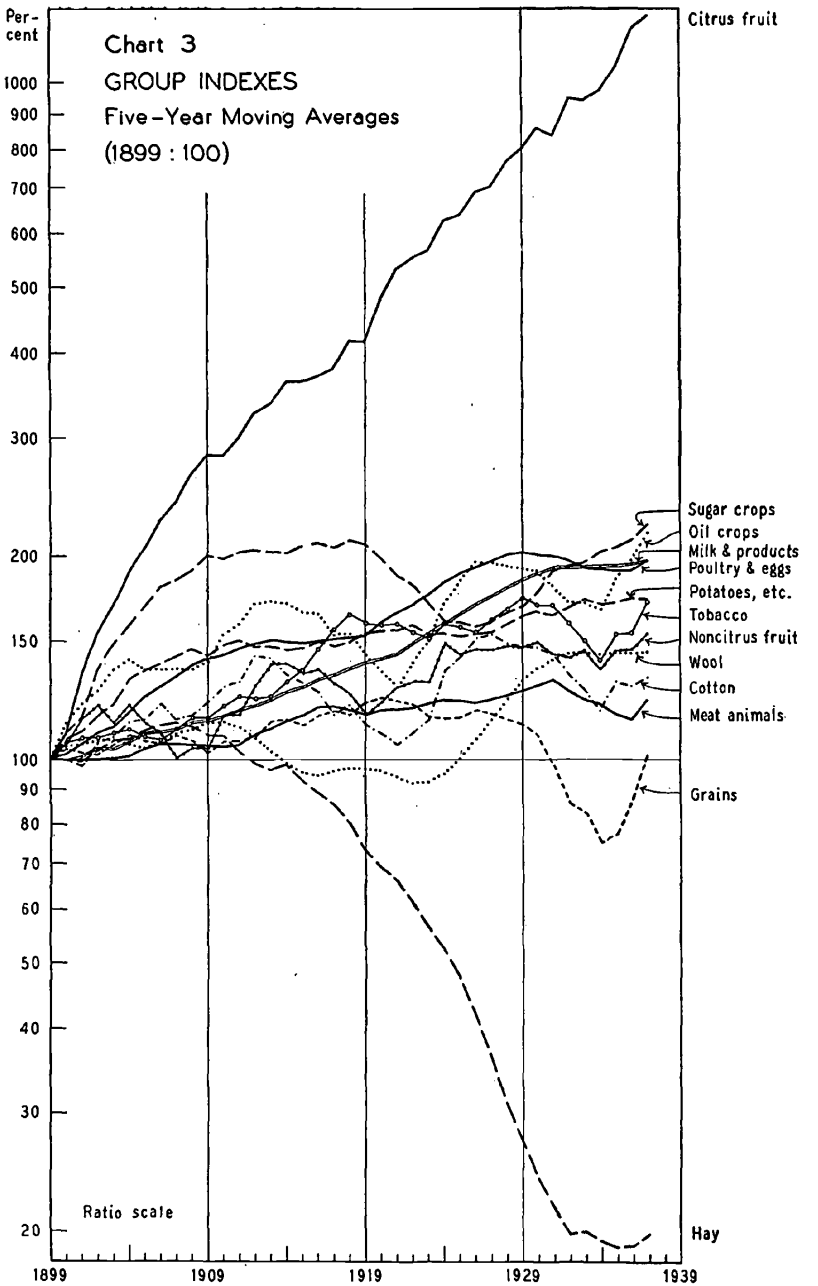


Chart 2

AGRICULTURAL OUTPUT PER HEAD OF
U. S. POPULATION
(1899 : 100)



The comparative stability of agricultural output in the short run is not difficult to explain. Yields are largely a function of the weather, and as the weather is rarely either uniformly good or bad throughout the country, low and high yields in different localities tend to offset one another, except



For source and notes see Appendix D

of course in years of general drought like 1934.[5] Moreover, the farmer is subject to considerable inertia; for example, he must develop breeding and crop rotation programs, which cannot be quickly changed. Unless induced by government to do otherwise, he usually plants a fairly constant acreage year by year; once an area is planted he will tend to harvest and sell or use the entire product, unless it appears that prospective returns will not even repay the cost of harvesting. As for the demand for agricultural output, it is probably as inelastic, in the short run, as the supply. Consequently, the burden of adjustment falls upon prices rather than upon production; the course of farm prices has always been marked by much more violent fluctuations than has that of farm output.

Breakdowns of the kind shown in Chart 4 and Table 2 suggest that about 81 percent of net farm output in 1897–1901, and about 84 percent in 1935–39, was destined for consumption as human food. But the size of the human stomach is limited. Clearly, unless a nation's foreign customers absorb the surplus, the boundaries of agricultural expansion, as compared with the growth of manufacturing, are reached rather quickly. This must not be taken to imply that the nation's consuming capacity, estimated upon a physiological rather than a pecuniary basis, has ever been reached. On the contrary, experts are agreed upon the presence of large "nutritional deficits." It is estimated that if all the nation's families were to enjoy what may be defined as "good" diets, consumption would have to increase by the following amounts: milk, 20 percent; butter, 15 percent; eggs, 35 percent; tomatoes and citrus fruit, 70 percent; leafy, green and yellow vegetables, 100 percent.[6] However, not even the practical realization of

[5] Even in 1934 as much as one quarter of the entire country remained unaffected. (U. S. Department of Agriculture, *Yearbook of Agriculture, 1935,* p. 15.)

[6] J. P. Cavin, H. K. Stiebeling and Marius Farioletti, "Agricultural Surpluses and Nutritional Deficits," *Yearbook of Agriculture, 1940,* p. 333. Inasmuch as allowance may be necessary for offsetting reductions in other foods, these figures give an exaggerated picture of the potential increase in farm output.

such a program would result in an expansion in agricultural production of the proportions observed in manufacturing, when comparisons are made today with the situation at the beginning of the century.

The physiological barrier to increased food consumption is reflected in a tendency on the part of the population at large to apply increased purchasing power to items other than food, or at least to diversify rather than to amplify the diet. Because of the nature of our index, diversification shows up only in the form of a shift toward higher-priced products. In the long run, however, these more expensive products gradually become cheaper (citrus fruit is a good example) as sales volume, output and marketing facilities expand, and thus the qualitative improvement in the aggregate food intake affects the index in steadily diminishing degree. If we had available a ready measure that would indicate the changing nutritive value of agricultural output, it might well show a more pronounced rise between 1899 and 1937 than that recorded by the present index, which takes account of qualitative changes only indirectly so far as they influence constant dollar values. In this respect, indexes of agricultural production suffer from the same deficiency as do those for manufacturing. However, in manufacturing there is much wider scope for expansion in the progressive diversification of output, a factor whose comparative absence in agriculture accounts in part for its slower growth, both actual and observed.

When we compare agricultural production with population increase, the lagging growth of the former becomes still more apparent. An index of agricultural output per capita, shown in Chart 2, has fluctuated in recent years around a level from 10 to 20 percent below that prevailing at the beginning of the present century. The combined index, as might be expected, conceals wide variations in the movement of individual products. This dispersion, which is depicted in Chart 3, is discussed in the next section.

CHANGES IN THE COMPOSITION OF FARM OUTPUT

Changes in the composition of agricultural output are at least as noteworthy as changes in its total, whose behavior we have just reviewed. The contribution of different products to total output can be computed, of course, only in value terms, but changes in the physical composition of the aggregate between different dates may be measured with the help of a comparison in constant prices. For this purpose we have chosen the initial and final five-year periods, 1897–1901 and 1935–39, multiplying the average output of each commodity in each period by its average farm price for all ten of the years specified. To insure comparability only those items were included for which data were available for both periods.[7] The resulting weighted quantities for each product and group were then transformed into percentages of the aggregate for either period. These percentages are what we have in mind when in the discussion to follow we speak of "contributions" or "shares" of individual products or groups. The results are shown in Table 2 and Chart 4.

Grains, meat animals, and dairy products underwent the most striking changes. Grains as a group declined in relative importance from 17.7 percent of the total in the initial period to only 12.6 percent in the second.

Meat animals showed less of a decline, decreasing as a share of the total from 32.5 to 27.2 percent. The loss is fully accounted for by the diminishing importance of cattle and hogs. The declining output of meat animals contrasts with the increased contribution of the poultry group, which advanced in relative importance by about one third between the two periods. By far the greatest absolute expansion took place in dairying, which accounted for 22.1 percent of the total in

[7] This qualification eliminates nuts and truck crops and tends to overstate the relative importance of all items in the second period, since data for the crops that have shown the greatest rise—certain fruit and vegetables—are omitted. See note d to Table 2.

TABLE 2

PERCENTAGE COMPOSITION OF OUTPUT, 1897–1901 and 1935–39[a]

	1897–1901	1935–39		1897–1901	1935–39
Grains	*17.7*	*12.6*	*Fruit, noncitrus*	*3.2*	*3.1*
Wheat	10.1	6.6	Apples	2.8	1.9
Corn	5.0	3.9	Apricots	.1	.1
Rye	.2	.2	Grapes	.3	.8
Oats	1.7	.8	Dried prunes	.1	.2
Barley	.5	.6	*Oil crops*	*1.8*	*2.2*
Buckwheat	.1	[e]	Cottonseed[b]	1.1	1.4
Rice	.1	.6	Flaxseed[c]	.5	.2
Cotton (lint only)	*9.8*	*8.8*	Peanuts	.2	.6
Tobacco	*2.5*	*3.0*	*Hops*	*.1*	*.1*
Sugar crops	*.4*	*1.1*	*Milk and milk products*	*15.9*	*22.1*
Sugarcane	.3	.3	*Poultry and eggs*	*9.2*	*12.4*
Sugar beets	.1	.7	Chickens	3.5	4.6
Potatoes, etc.	*3.3*	*4.1*	Eggs	5.7	7.8
Potatoes	2.6	2.8	*Meat animals*	*32.5*	*27.2*
Sweetpotatoes	.6	.7	Cattle	14.2	10.7
Dry edible beans	.2	.6	Calves	1.0	1.8
Hay	*2.1*	*.3*	Hogs	15.8	13.1
Fruit, citrus	*.2*	*1.9*	Sheep and lambs	1.5	1.7
California	.2	1.0	*Wool*	*1.2*	*1.1*
Florida	[e]	1.0	TOTAL[d]	100.0	100.0

[a] Based on average quantities produced (excluding seed and feed) in either period, weighted by average farm prices for the ten years 1897–1901 and 1935–39.

[b] In computing the group output indexes of this chapter and Chapter 3, cottonseed has been included both in the index for cotton and cottonseed and in the index for oil crops.

[c] In computing the group output indexes of this chapter and Chapter 3, flaxseed has been included both in the index for the grains and in the index for oil crops.

[d] The total includes only the products shown, for which data are available in both 1897–1901 and 1935–39. Products excluded from the comparison, for which no data are available in 1897–1901, comprise the following: sugarcane sirup, sorgo sirup, maple sugar and sirup, soybeans, broomcorn, pears, peaches, plums, other prunes, strawberries, cranberries, olives, figs, citrus fruit outside California and Florida, walnuts, almonds, pecans, truck crops (artichokes, asparagus, snap beans, beets, cabbage, cantaloups, carrots, cauliflower, celery, sweet corn, cucumbers, eggplant, lettuce, onions, green peas, green peppers, spinach, tomatoes, watermelons), mohair, turkeys and peppermint. These items had a value in 1937 of $570 million, and the value of all items shown in the table in the same year was $8,540 million, making a total value of agricultural products of $9,110 million. The value of products omitted from the comparison was therefore about 6 percent of the value of the net output of all agricultural products in 1937.

[e] Less than 0.05.

1935–39 as compared with 15.9 percent in 1897–1901. This sharp gain in importance made dairy products the second largest group in 1935–39, with almost twice the weight of grains, whereas in the early period the contribution of grains had exceeded that of dairy products by about one eighth.

Among other outstanding changes are the almost tenfold increase in the contribution of citrus fruit (from 0.2 to 1.9 percent), the virtual elimination of the net output of hay (from 2.1 to 0.3 percent), the sevenfold increase in sugar beets (from 0.1 to 0.7 percent), and the decline in the importance of apples (from 2.8 to 1.9 percent). The increase in oil crops is slightly understated, since soybeans are excluded from the computation. If we included them by assuming their production in 1897–1901 to have been nil, and by inserting their average value for 1935–39, the percentage contribution of oil crops in the latter period would be 2.4 percent instead of 2.2.

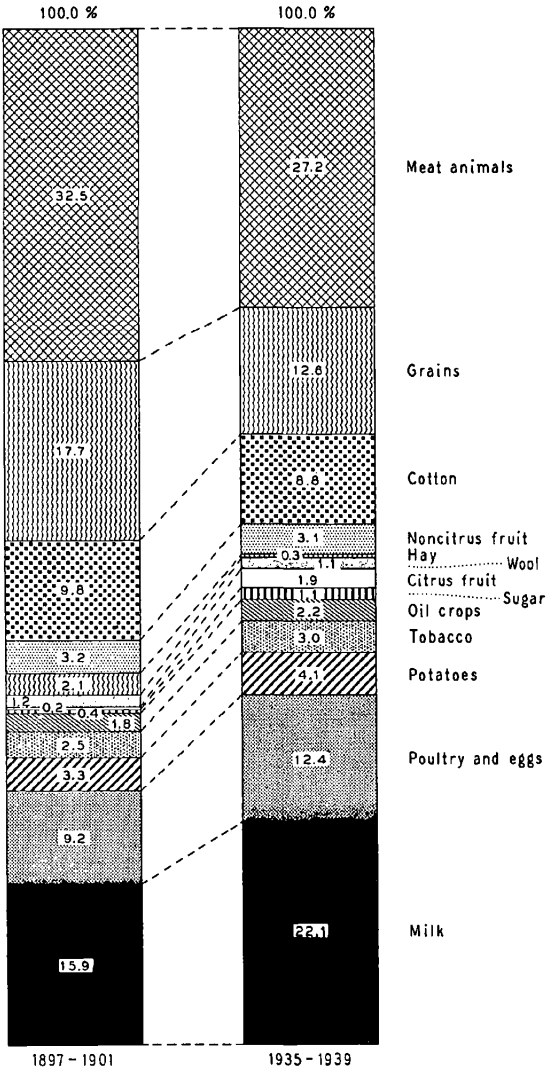
INDEXES FOR GROUPS AND COMMODITIES

The changes in the composition of farm output over the period as a whole reflect the markedly dissimilar behavior of different products. In examining the relative growth of these products we could of course make use directly of the data for individual commodities assembled in Appendix A. However, because of the obvious affinities among various products, already suggested in Table 2, it was found preferable to compute separate partial indexes for the entire period on the same plan, with the aid of the formula used in the construction of the over-all index presented above.

We may first compare the fortunes of crop raising and livestock production, for agricultural output can be divided between vegetable products of every kind (all of which can be termed "crops" for the present purpose) on the one hand, and meat, poultry products, wool and dairy products on the other. Indexes in the form of five-year moving averages are

Chart 4

COMPOSITION OF AGRICULTURAL OUTPUT



For source and notes see Appendix D

shown in Table 3 for these two categories. The remarkable growth, during most of the period, of dairying at the expense of the raising of cash crops is clearly apparent. On an 1899 base, to be sure, livestock products did not outstrip crops until about the year 1915, but thereafter the disparity increased rather steadily. If the growth of dairying has not been confined to any particular area, it has of course resulted in an increased demand for feed. We may say, if we like, that corn which forty years ago would have been sold as such is now marketed as milk or eggs. The increase in crops produced for feed is not of course reflected in the index of crop production shown in Table 3; but the augmented feed requirements have been no more than a partial offset to the decline in the per capita demand for cereals for human food (see pp. 163-66 below). The enlarged fraction of agricultural resources devoted to dairying has probably reduced the need for regional specialization and lessened dependence upon the weather. It has tended also to regularize the farmer's work year, for cattle require a much less fluctuating amount of labor from one season to another than do crops. The shift of labor from cropping to caring for animals has been all the more substantial because of the fact that labor requirements per unit of output have diminished in cropping, but in dairying have remained almost unchanged.[8]

As the next step in the analysis, in order to explore the behavior of different types of output, fifteen partial indexes were computed for groups of products. The indexes for thirteen of these groups are shown, in the form of five-year moving averages, in Chart 3.[9] Divergence in behavior is extremely marked. The most extreme movements are revealed, not by any of the staples, but by hay and citrus fruit respectively.

[8] See Chapter 7 below.

[9] The fifteen indexes are given in numerical form in Tables 5 and 6 in the next chapter. Only thirteen of them are reproduced in Chart 3 because two of the fifteen (truck crops and tree nuts) are not available for the early years of the period.

The virtual disappearance of the city horse reduced sales of hay off the farm by four fifths. Growing popularity and ease of distribution raised the output of citrus fruit tenfold. For

TABLE 3
CROPS AND LIVESTOCK
Net Output, Five-Year Moving Averages[a]
1899 (1897–1901): 100

Year	Combined Index	All Crops[b]	All Livestock Products	Year	Combined Index	All Crops[b]	All Livestock Products
1899	100	100	100	1919	127	124	129
1900	102	103	100	1920	128	124	131
1901	103	103	102	1921	128	123	133
1902	104	107	103	1922	131	125	136
1903	106	109	104	1923	132	125	139
1904	110	114	106	1924	138	133	142
1905	111	113	109	1925	140	135	145
1906	113	115	111	1926	143	139	147
1907	113	115	112	1927	145	140	150
1908	114	116	113	1928	146	139	153
1909	114	114	114	1929	147	138	155
1910	117	119	115	1930	147	137	157
1911	118	120	116	1931	146	132	159
1912	122	125	119	1932	141	124	156
1913	125	129	121	1933	139	122	154
1914	125	127	124	1934	136	115	153
1915	125	125	126	1935	137	123	151
1916	127	127	128	1936	140	128	150
1917	127	124	129	1937	148	139	156
1918	127	125	129				

[a] Based on Table A-3, Appendix A.

[b] Some readers may prefer to compare the output of livestock products with the gross rather than with the net output of crops. A rough check shows that an index for crops which measured gross output (including seed and feed requirements) would report practically the same change over the period as does the index given here for net output (which of course excludes these items). This result is due to the combined effects of two opposing tendencies which neutralize each other. Thus, on the one hand, increased use of the grains and hay for feeding livestock has raised the gross output of these products relatively to their net output (see pp. 47, 139, below). On the other hand, (1) even their gross output has risen less rapidly than the output of crops in general; moreover, (2) the substitution of their gross for their net output gives them a heavier weight in the index for crops as a whole. The second consideration appears to be slightly more important than the first, so that an index for the gross output of all crops would stand at the end of the period about one percentage point below the net output index shown in the table.

other products the rises or declines were much more moderate. Sugar, oil crops, poultry and dairy products each roughly doubled in output, while grains hardly rose at all. The remaining groups gained somewhat, although several of these, if the series were converted to a per capita basis, would show declines.

These contrasts in the behavior of different types of product have been responsible for considerable variation in the fortunes of different farming areas. By 1900 wheat growing in California was already declining, but since then the phenomenal development of the citrus industry has led to an expansion of agricultural activity in that state; the same influence has been at work in Florida. Wheat growing has continued to decline in the East, and the raising of this crop is being confined more and more closely to the North Central states. Between 1917 and 1930 wheat farming spread into the western counties of the Dakotas, Nebraska and Kansas, and into the Oklahoma panhandle, but a succession of years with low rainfall discouraged this enterprise during the following decade. Drought also pushed the margin of corn cultivation eastward, and led to the substitution of wheat, which requires less moisture than corn, in the eastern parts of Kansas and Nebraska.[10] Other crops also have undergone regional changes. The center of the nation's cotton acreage, for example, has shifted westward toward Texas,[11] but the decline in cotton farming in the deep South has been counterbalanced to some extent by an increase in livestock production.[12] Among other noteworthy developments are the introduction

[10] U. S. Department of Agriculture release, "Regional Adjustments to Meet War Impacts" (Washington, 1940).

[11] See pp. 76-77 below.

[12] The number of cattle on farms in the Delta Cotton area (Arkansas, Louisiana and Mississippi) increased by 35 percent between 1907–11 and 1937–41 (averages for January 1); the corresponding increase for the United States was roughly 12 percent. See U. S. Department of Agriculture, *Livestock on Farms, January 1, 1867–1935* (Washington, 1938); U. S. Department of Agriculture, *Agricultural Statistics, 1941*, Tables 458 and 460.

of the sugar beet into California, the advent of the soybean and the growth in the importance of truck farming, especially in the neighborhood of the larger cities.

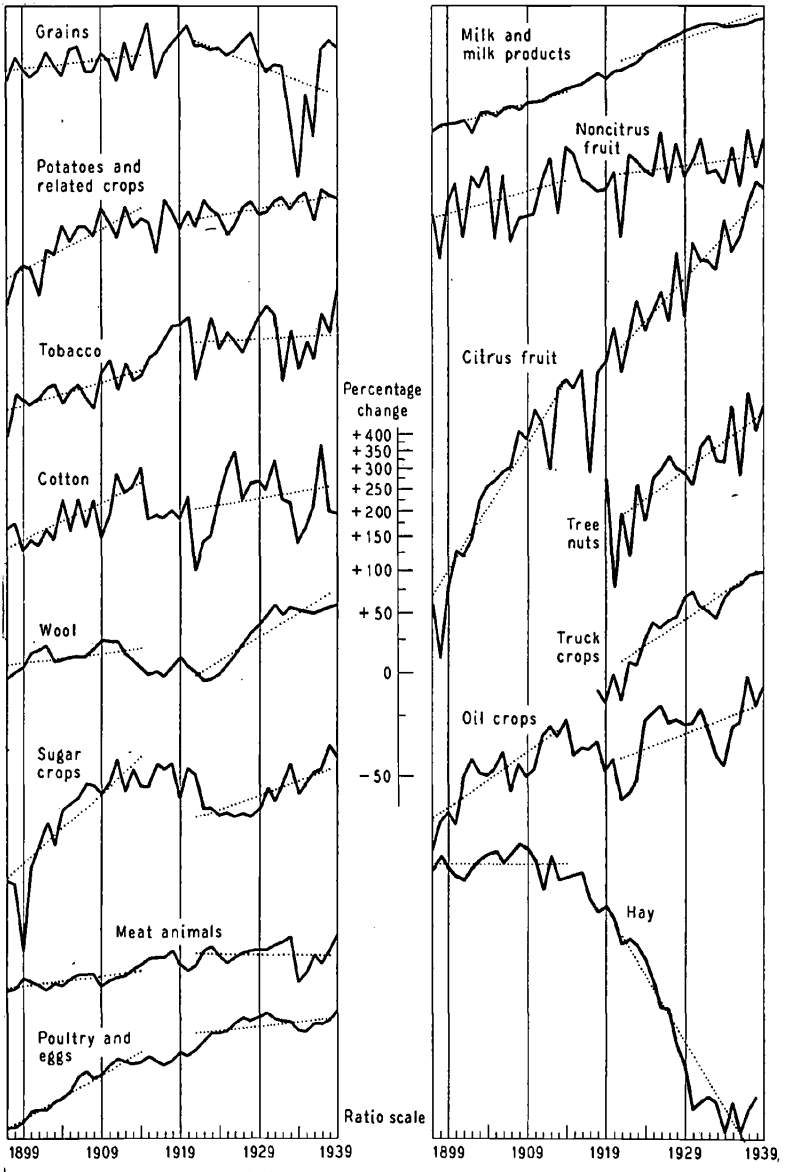
THE MEASUREMENT OF TRENDS

The volume of agricultural production is subject only in part to control by the producer. To a great extent it is determined by weather conditions, or by the activity of insect pests and plant diseases, which are unpredictable and in large measure uncontrollable. Consequently year-to-year changes in the output of individual products will tend to be erratic, and to conceal, perhaps for several years at a time, any underlying tendency for production to expand or contract as a result of economic conditions. Such a tendency, operating as it must through changes in acreage and in agricultural technique, can be expected to emerge only over a period of years of indeterminate length. It may readily be seen from Charts 1 and 5 that while the fluctuations in agricultural output as a whole are comparatively mild, the output of several of our groups of products fluctuates from year to year with considerable violence. Because of this situation, only a vague impression concerning trend movements can be derived from a casual inspection of the series. In order to summarize the movements of these series, we have therefore fitted trend lines to the total and to the fifteen partial indexes. For this purpose the simplest appropriate computed trend appears to be one which allows for a constant percentage change from one year to the next: in other words, an exponential growth curve fitted to the original output data. The computation, when carried out by Glover's method, is not laborious.[13] In the accompanying chart the various trend lines obtained in this

[13] Commonly called an exponential growth curve, it may conveniently be fitted by the method of moments. The constants are readily obtained from tables.

Chart 5

GROUP INDEXES AND TRENDS



For source and notes see Appendix D

fashion have been superimposed upon the crude movements of the indexes. Since the chart is drawn on a logarithmic scale the growth curves appear as straight lines.

Besides describing the trend during the period as a whole, the same technique may be used to determine whether there has been retardation of growth. Thus the period studied—1897 to date—falls naturally into two parts, more or less equal in length, divided by the first World War. That conflict left the output of some crops comparatively unaffected, but markedly increased the output of others. Retardation of growth, as a secular phenomenon, can therefore best be studied if we omit the war years, and institute a comparison between annual growth rates in the pre- and post-war periods respectively. For this purpose we have arbitrarily chosen the eighteen-year subperiods 1897–1914 and 1921–38. The influence of the war did not affect any of our groups until 1915 [14] at the earliest, and by the year 1921 wartime demand had disappeared.[15] The legacy of war of course remained: changes in migration, foreign trade, indebtedness and price levels persisted, and there was a further impetus to technical change. It is this legacy, in large part, that distinguishes the post-war from the pre-war period.

The average annual percentage rates of growth are assembled for comparison in Table 4. They merely afford a convenient summary of the dominant tendency of the series under observation. It is unwise, however, to regard the trend lines to which they correspond, shown as dotted lines in Chart 5, simply as substitutes for the original series. Not only does the average rate of growth hide deviations from the central tendency as computed; but the choice of terminal dates in comput-

[14] It is well to remember in this connection that the crop harvested in the fall of 1914 had been sown prior to the outbreak of the war and was thus largely unaffected by it.

[15] See also A. B. Genung, "Agriculture in the World War Period," *Yearbook of Agriculture, 1940,* p. 278.

TABLE 4

GROUP INDEXES OF OUTPUT

Average Annual Percentage Change, by Groups[a]

Group	*1897–1914*	*1921–38*	*1899–1937*
Grains	+ .6	−2.0	− .2
Potatoes and related crops	+2.8	+ .9	+1.0
Tobacco	+1.5	+ .3	+1.3
Cotton	+2.6	+ .9	+ .6
Wool	+ .6	+3.3	+ .9
Sugar crops	+5.0	+2.0	+ .7
Meat animals	+ .7	− .1	+ .6
Poultry and eggs	+3.1	+ .6	+1.7
Milk and milk products	+1.5	+1.8	+2.1
Noncitrus fruit	+1.5	+ .7	+ .9
Citrus fruit	+8.9	+5.9	+5.8
Oil crops	+3.8	+2.1	+1.2
Tree nuts	[b]	+3.9	[b]
Truck crops	[b]	+3.6	[b]
Hay	nil	−8.6	−4.2
TOTAL AGRICULTURAL OUTPUT	1.5	.5	1.0

[a] The groups for which percentage changes are shown in the table are neither exhaustive nor entirely free from duplication. For a list of products contained in each group, see Appendix A. The order in which the groups are presented is of no significance. The results are derived from the material in Table 5.

[b] Data not available.

ing the trend affects to some extent the results obtained.[16] If agricultural production moved in more or less regular cycles, we might choose our terminal points, in computing the annual rate of growth, in such a way as to represent approximately similar phases of these cycles.[17] Unfortunately the

[16] The behavior of noncitrus fruit may be cited as an extreme example of this waywardness. Because 1921 was a year of abnormally low yield, the average annual percentage increase for 1921–38 is as high as .7; whereas for 1922–38 (17 years instead of 18) the increase amounts to only .1 percent per annum. Similarly in the case of cotton and cottonseed the growth rate for 1921–38 is .9 percent, but for 1921–37 (omitting the final year) 1.3 percent per annum.

[17] This was the procedure adopted by Arthur F. Burns to measure trends in industrial production; *Production Trends in the United States Since 1870* (National Bureau of Economic Research, 1934).

behavior of agricultural output is too irregular to lend much value to such a procedure. The same standard pairs of terminal dates have therefore been used in computing trends for all the agricultural output series.

For the reason indicated particular significance should not be attached to small variations among the growth rates computed in Table 4. However, even when due allowance has been made for the type of bias mentioned, changes in growth rates between the two periods stand out clearly enough. For every group except wool and dairy products the rate of increase in the post-war period is the smaller of the two, and in three cases an average annual increase in the earlier period turned into a decline in the later period. To be sure, we have no data for truck crops or tree nuts in the earlier period—groups which (with the exception of citrus fruit) grew most rapidly during 1921–38. Nevertheless the available evidence points toward retardation in the growth of agricultural output as a whole.

FACTORS INFLUENCING AGRICULTURAL OUTPUT

Before proceeding to an interpretation of changes in the output of individual groups and products, we may briefly recapitulate the outstanding findings of the preceding pages.

First, we have seen that the movement of agricultural output as a whole is marked by an absence of either regular or violent fluctuations.

Second, the increase in agricultural output for the period under observation has failed to keep pace with population growth. Even for a year of record output like 1939, per capita production fell short of the level prevailing at the turn of the century by as much as 10 percent.

Third, significant changes in the composition of total output have taken place during the four decades. Grains, hay and meats have lost ground, while poultry, eggs and milk

have accounted for a growing share of total output. Citrus fruit and sugar production too have increased their shares of the total, but still account only for a small proportion of aggregate output.

Fourth, changes in the composition of total output are confirmed by the establishment of trends for the major groups. Grains, hay and meat animals, again, show the least rapid rates of growth, while citrus fruit, dairy products, and poultry and eggs rank highest. Furthermore, rates of growth for the post-war period, in all instances but two, are lower than for the pre-war period. The two exceptions are dairy products and wool.

These changes in the amount and character of agricultural production are to be interpreted mainly in terms of two types of influence: foreign trade on the one hand, domestic demand on the other. The fraction of the wheat crop exported has fallen perhaps from a third to an eighth, of cotton from two thirds to less than half, of beef and pork products from nearly one fifth to practically nothing. Tobacco alone among agricultural products has come near to holding its own in the export market. Every agricultural export has to compete with products from countries other than the United States. To the extent that the United States has lost out in foreign markets, the products of other countries have been available to foreigners more cheaply, or have been preferred by them for political or sentimental reasons. Moreover agricultural protection has closed the markets of many European countries to imports of cereals and livestock products from any outside source. Of no product is the United States sole producer, but it comes close to monopoly, perhaps, in the case of certain types of tobacco. This fact may explain why exports of tobacco have been somewhat less severely hit than have exports of most other products.

From the viewpoint of the domestic market the output of agriculture consists primarily of food materials. Ordinarily,

as we have seen, more than four fifths of all farm produce is destined for consumption as human food. The remainder consists of raw materials supplied to a great variety of industries other than those manufacturing food products. The chief industries in this second group are those processing tobacco, cotton, wool and leather; industries making or using starches and oils; and industries making wine, beer and distilled spirits. The industrial demand for materials of this kind produced by domestic agriculture depends partly upon the availability of similar materials from abroad, and partly upon the competition of substances not of agricultural origin. The principal domestic products subject to competition from imports are sugar, vegetable oils, wool and hides, and in the case of at least two of these—sugar and wool—domestic output has been powerfully influenced by the availability of imported supplies.[18] The competition of nonagricultural products is felt mainly in respect of fibers: there can be little doubt that rayon has cut into the demand for cotton and possibly for wool also.

As we have seen, food accounts for the largest part of the domestic consumption of agricultural output, either directly or through the intermediary of the processing industries. For physiological reasons per capita demand for food as a whole, whether measured by weight or by calorific value, is rather stable. Yet there is some evidence of a shift from low- to high-priced foods; and the behavior of individual foodstuffs is even more variable. For instance, we have seen that the output of citrus fruit increased much more rapidly than did population; cereal production, on the other hand, hardly rose at all, and, if measured on a per capita basis, actually declined. Clearly changes of this kind have been influenced by the export of foodstuffs; but they are also a function of changing dietary habits among our own citizens. Thus in the case of wheat, had per capita domestic consumption not declined,

[18] See Chapter 3 below.

population increase would have more than compensated for the loss of exports.[19] On the other hand, the sensational advance in the production of citrus fruit was due in the main to a rise in per capita consumption within the United States.

These summary reflections represent as much as it is possible to say within the compass of the present chapter. The output history of individual products, and the detailed evidence surrounding each, are reviewed in Chapter 3. The material is organized by groups of products and by individual commodities. Not all products are treated in equal detail: some commodities are more important than others, or present points of special interest, and the reader will find that these are discussed at greater length.

[19] Per capita wheat consumption per annum fell between 1909 and 1939 about 1.3 bushels; on the basis of the population in the latter year this amounts to about 170 million bushels. Exports of wheat averaged 150 million bushels during 1900–09 and 70 million bushels during 1930–39.