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Farm Gross Product and Gross Investment in the Nineteenth Century

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THE major objective of our paper is to provide estimates of farm output during the nineteenth century, comparable in concept and coverage to the farm gross product series of the departments of Commerce and Agriculture for 1910 to the present. Also presented is a brief analysis of the major social, political, and economic forces shaping developments in agriculture during this period.

Character of the Estimates

Both the current figures and the estimates represent the share of the gross national product originating on farms. The general approach in developing the estimates was to measure the total output of farms and to deduct the value of intermediate products consumed in the process of production. In effect, therefore, this is a value-added concept of gross product, measuring the gross value added by farm factors of production. However, depreciation and other capital consumption are not deducted from the total value of farm output.

A second objective of the paper is to estimate average annual rates of gross investment by the farm sector, by decades, 1800-1900. By gross investment is meant the total expenditure for farm capital goods, whether produced by the farm or nonfarm sector.

The estimates of farm gross product are presented in current and in constant dollars. To conform with the current series, the components of farm output included are cash receipts from sale of farm products, value of home consumption of farm products, gross rental value of farm homes, and the value of net changes in livestock inventories.

Note: The statistical phases of this study were supervised by Robert H. Masucci, who also participated generally in its planning, organization, and writing. Although the authors are employed by the Agricultural Economics Division of the Department of Agriculture, the estimates presented here are not to be considered official, nor do the views of the authors necessarily reflect those of the department.

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Estimates of two additional components not included in the Commerce series have also been developed: (1) the value of land improvements made by the farm sector, and (2) the value of home manufactures produced by farm households. Estimates of farm gross product are given both excluding and including these components, which represented a relatively more important element of gross output of people on farms in the nineteenth than in the twentieth century.

The value of intermediate products purchased from nonfarm sources is deducted from total farm output to derive gross product. These include rent paid to nonfarm landlords, repairs to structures and machinery, fertilizer, ginning, horseshoeing, and miscellaneous supplies or services purchased from the nonfarm sector. Although estimates of some of these minor items were based on inadequate source materials, they were developed to provide virtually complete concept and coverage continuity with the estimates of gross farm product for 1910 to date. They are shown in detail for the convenience of future analysts.

Estimates of gross investment include purchases of implements, machinery and harness, farm improvements, and net changes in livestock inventories.

The data underlying the estimates were of varying degrees of reliability, being generally more complete and dependable for the latter decades of the century than for the earlier decades. For 1870-1900, the estimates are based principally upon the work of Strauss and Bean both for calendar year output and average prices received by farmers.¹ Their estimates rest upon census data and on estimates of the Department of Agriculture from 1866, which made some use of voluntary crop reporting by farmers. The level of the estimates adopted for 1900 was determined by adopting the Strauss and Bean measurement of percentage change in outputs or prices for 1900-10, and accepting the 1910 level of the Agriculture estimates included in the current farm gross product series for 1910 to date. The current output estimates from 1910 forward were developed between 1938 and 1941 by commodity specialists in the Department of Agriculture as part of a comprehensive study of income parity. Although many of the series have since been revised for recent decades, the 1910 estimates to which the estimates of this paper were linked are largely unchanged. Of all of the 1800-1900 output estimates, those for 1870-1900 have the greatest continuity with and comparability to the estimates from 1910 forward, in the quantity of data underlying them as well as in the amount of effort devoted to their development by agricultural specialists at various times in the past.

The 1840-60 output estimates rely for the most part upon the accuracy and comparability over the decades of the censuses of

¹ Frederick Strauss and Louis H. Bean, *Gross Farm Income and Indices of Farm Production and Prices in the United States, 1869-1937*, Dept. of Agriculture, Tech. Bull. 703, 1940.

agriculture, and also upon the validity of our assumptions in adapting total production or inventory data to the types of output measurement. The authors are indebted, also, to Robert E. Gallman for the loan of his unpublished manuscript on income originating in agriculture between 1840 and 1880.

For 1800-30 no U.S. censuses of agriculture were taken. Fortunately, production estimates for this period were available for most of the major cash crops: sugar, cotton, and wool. For tobacco there were export data. Export data were also employed in the wheat estimates. For other commodities, however, we generally estimated output by extrapolating 1840 estimates back to 1800 by assuming per capita rates of production or consumption in these earlier years to be about the same as in the bench-mark year (usually the 1840 rate), and multiplying by either the estimated total population or the number of persons engaged in agriculture during 1800-30. From 87 to 91 per cent of the total current dollar estimates of output depend upon 1800-30 assumed per capita rates. This compares with 15 per cent or less of the total from 1840 forward.

The assumption of constant per capita rates of output or consumption implies more or less static (or at least cumulating or consolidating) agricultural technology and productivity during this period. Although this contrasts sharply with the dynamic developments after 1850, it does not necessarily imply a lack of consistency. Research, experiment, and education precede the benefits of technological innovation. Evidence suggests that an increase in the application of technology to agriculture began in the early part of the nineteenth century but that it did not cause a significant increase in productivity until the middle of the century. Bidwell and Falconer, for example, stated:² "The first four decades of the nineteenth century were characterized by important beginnings in agricultural progress, rather than by striking or revolutionary accomplishments. It was a period of preparation both in the technical and in the business sides of farming—preparation for subsequent progress and expansion." The present authors recognize that the employment of constant per capita rates subjects the estimates for this period to a possible wide margin of error—wider than those for the latter part of the century. For this reason, small variations in the estimates of gross farm product per worker from decade to decade during 1800-40 should not be considered significant.

With respect to output for the century as a whole, the quality of the data is such that only broad trends and general magnitudes should be inferred from them for total gross product. Individual commodity series should be used with greater caution since, unlike the gross

² P. W. Bidwell and J. I. Falconer, *History of Agriculture in the Northern United States, 1620-1860*, Carnegie Institution of Washington, 1925.

product totals, they do not benefit from the possibility of compensating errors of overstatement and understatement.

The principal task in this study was the assembling and adaptation of available data into a gross product frame of reference. In recognition of the need for further refinement, these are presented in detail under "commodity detail."

Agriculture in the Nineteenth Century

The estimates of gross farm product for the decade years of the nineteenth century provide an aggregative measure of the magnitude and direction of change in the level of agricultural economic activity. Historians have provided accounts and interpretations of the many social, political, and economic forces which shaped our destiny. But heretofore, only general impressions of the movement of agricultural economic activity in the period have been presented. We hope that the combining of available data into the aggregates of farm gross product will sharpen the picture.

GRADUAL GROWTH

Agriculture during the first five decades of the nineteenth century appears to have increased its total output at a rate sufficient to supply the more or less constant per capita requirements of a growing population and the pressing demands of foreign countries for cotton and tobacco. This was accomplished for the most part with an increase in both human and land resources allocated to agricultural production.

Although this brought into production much fertile acreage west of the Allegheny Mountains, the full potential of the westward movement was not realized until after 1840, since the lack of cheap transportation kept many settlers on little more than a subsistence basis. At the same time, farm land along the Atlantic Coast had lost much of its fertility, and yields of tobacco, wheat, and other crops were low. Maine and Massachusetts offered bounties on wheat production in the 1830's. Claimants under the Massachusetts law averaged about fifteen bushels per acre in 1839. The South was in no better situation. Gray stated:³ "In the upland areas from Virginia to Georgia the expansion of cotton and tobacco left behind an ever-widening circle of lands suffering from soil exhaustion. Year after year the old lands were depleted until it was no longer profitable to farm them. By 1850 a large proportion of Virginia and Maryland east of the Blue Ridge was a waste of old fields and abandoned lands covered with underbrush and young cedars."

³ Lewis C. Gray, *History of Agriculture in the Southern United States to 1860*, Carnegie Institution of Washington, 1933.

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If we accept the estimates in this paper, it appears that real farm gross product increased more than fourfold from \$333 million in 1800 to \$1,442 million in 1850 (in constant 1910-14 dollars). This compares with a rise of similar magnitude in total population, which increased from 5.3 million persons in 1800 to 23.2 million in 1850. Output per worker (in 1910-14 dollars) was about the same in 1850 as in 1800.

Rates of increase for individual commodities varied, with cotton showing outstanding gains. Several major forces were at work in increasing cotton output. First was the invention of the cotton gin in 1793. The westward movement of the population in the South also contributed significantly by providing new lands for cultivation and production. And finally, a growing foreign demand for cotton provided a ready outlet.

Meat animal production was stimulated by the increasing demand of city markets, and by the lower cost of raising cattle on western lands. Cincinnati became the first important pork packing center in the United States. Packers there developed slaughtering and processing techniques which permitted the economic handling of large numbers of hogs, thus broadening the market for pork products.

Although output of grains during this period probably grew no faster than the population, revolutionary changes were taking place in production and marketing. Improved means of transportation, especially canals, were broadening markets. The opening of the Erie Canal in 1825, for example, permitted wheat growers in Ohio to compete with those in the East. Developments were taking place which presaged a new era in grain crop production. Agricultural reformers urged the greater use of fertilizer, particularly barnyard manure, and marl and other types of available lime. Samples of guano were imported from South America as early as 1824, but commercial sales did not take place until 1843. By 1852, sales rose to 25,000 tons. The first chemical fertilizers were sold in Baltimore in 1849.

From 1800 to 1850, many implements and machines were being developed that were to bring about the agricultural revolution of the Civil War period. But relatively few were manufactured and sold commercially. In 1800, the only animal-drawn farm implement in general use was the plow, usually made of wood with a share and colter of wrought iron. The wrought iron shovel plow was used in the South, except in the lowlands of Georgia and South Carolina where hoes were used instead. After 1819, Jethro Wood's iron plow with interchangeable parts was widely adopted. Later, in the 1830's, steel plows were adopted for the heavy prairie soils.

Practicable harrows and seed drills were patented in the 1840's. Corn planters came rapidly into use in the 1850's. Corn cultivators had been developed somewhat earlier, but did not come into wide use

until after 1850. Mechanical reapers were patented by Obed Hussey in 1833 and Cyrus H. McCormick in 1834; McCormick sold one machine in 1840, fifty in 1844, and a thousand in 1851. A practical threshing machine, patented in 1837, came into use in the late 1840's.

The effects of this new technology were not to be felt until the period of the Civil War. No substantial rise in demand for grain products had occurred, and farmers generally felt no strong incentive to buy machines that would increase output. Besides, there was a general resistance to the adoption of new ideas.

This resistance was overcome through farm journals, the first of which began publication in 1810; local fairs and societies, beginning about 1810; and state agencies for promoting better agriculture, beginning with the New York Board of Agriculture, established in 1819. In 1839, \$1,000 was appropriated to the Patent Office for agricultural work.

THE FIRST AGRICULTURAL REVOLUTION

The twenty years from 1850 to 1870, during which real farm gross output rose from \$1.4 billion to \$2.5 billion, witnessed the first U.S. agricultural revolution. Real farm gross product per worker in agriculture rose from \$294 in 1850 to \$362 in 1870.

A considerable part of the increase appears to have taken place between 1850 and 1860. Both foreign and domestic demand increased at a time when new machines and techniques were available. In addition, the spreading network of railroads enabled farmers to get their products to market.

Although the figures show a greater increase in total real farm gross output in the 1850's than in the following decade, the expansion in northern agriculture during the 1860's continued at a substantial rate. In reflecting these gains the national output figures conceal a decline in the output of the South as a result of the Civil War.

In the North, the Civil War gave a tremendous impetus to the adoption of new machines and techniques as manpower became scarce and demand for farm products appeared unlimited. The South, on the other hand, had to turn its resources to producing a large proportion of its food requirements and did not have the manpower, machines, or fertilizer necessary to expand total output. Cotton production, the mainstay of Southern agriculture, was about the same in 1870, at 1.9 billion pounds, as in 1860. Output of the other major southern cash crop, tobacco, dropped sharply from 434 million pounds in 1860 to 309 million pounds in 1870.

Wool production, 1850-70, rose more than threefold from 52 million pounds to 162 million pounds, most of the rise occurring in the latter decade as a result of the military demand. Wheat output also rose

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substantially under the impetus of a strong European demand in the 1850's and a strong wartime demand in the 1860's. From 86 million bushels in 1850, output entering gross product rose more than 70 per cent by 1860, and by 1870 the level of output was about $2\frac{1}{3}$ times that of twenty years earlier. The expansion was achieved in large part by the adoption of many of the new machines—drills, reapers, and threshers. Also, the center of the wheat industry moved westward to the prairies, which were ideally suited to those machines. Of the ten leading wheat states in 1860, three were east of the Allegheny Mountains, and only one, Iowa, was west of the Mississippi River. By 1870, however, only one of the ten leading states was east of the Alleghenies, and four were west of the Mississippi.

The rate of real investment in implements and farm machinery increased markedly in 1845-55 from an average of \$11 million a year (in 1910-14 dollars) to \$23 million during the next ten years, and \$54 million in 1865-75. The machines purchased were in most cases improved models of earlier machines.

Expenditures for fertilizer and lime reached significant proportions for the first time in 1850, amounting to \$2 million (in 1910-14 dollars). During the next twenty years expenditures rose fourfold to an estimated \$9 million in 1870. During the last ten years, nearly all of the fertilizer used was of the mixed commercial type, imports of guano having dropped substantially because of relatively high prices and the cutting of the supply line to the South, a heavy user, during the Civil War.

In 1862, four laws were passed that were to have considerable influence on agricultural production. The Homestead Act encouraged western settlement; the Morrill Land Grant College Act encouraged agricultural education; the act establishing the Department of Agriculture recognized the importance of assisting farmers to adopt better methods; and the act chartering the Union Pacific Railroad assisted in opening western land.

Thus, the 1850's and 60's witnessed the propitious joining of forces which were to bring about profound changes in American agriculture. The technology was available at a time when social, economic, and political forces, particularly the industrialization of the East, the settling of the West, and the Civil War, provided growing markets.

EMPHASIS UPON COMMERCIAL AGRICULTURE

During the last thirty years of the nineteenth century, the long-term expansion continued, with real farm gross product increasing 130 per cent, from \$2,479 million in 1870 to \$5,740 million in 1900. Output per farm worker rose 45 per cent, from \$362 to \$526. This reflected (1) the restoration of commercial agriculture in the South, (2) the continuation of the westward movement and the opening of new land to agriculture.

(3) improvements in transportation, (4) increasing population and further industrialization of the nation, (5) the expansion of European markets, and (6) continually improving practices and greater use of machinery.

The restoration of cotton and tobacco production in the South was a part of the Reconstruction. Between 1870 and 1880, cotton production rose 59 per cent, from 1,906 million pounds to 3,028 million pounds; tobacco production increased 52 per cent, from 309 million pounds to 470 million pounds. By 1900, cotton output had expanded to 4,700 million pounds, almost $2\frac{1}{2}$ times the level of 1870. Tobacco production was more than $2\frac{3}{4}$ times that of thirty years earlier. Share cropping increased the emphasis upon commercial agriculture, with the tenants' entire energies being turned to cash crops. This emphasis upon commercial agriculture and the opening of new cotton lands in the South, rather than the adoption of machinery or better methods, accounted for most of the expansion, although fertilizer use was also increasing.

The march to the West continued during the 1870's, 1880's, and 1890's. Although the Census Bureau declared that the frontier as a line of settlement had come to an end by 1890, more land was settled under the Homestead Act after 1890 than before. After 1870, settlement was concentrated in the Great Plains, where conditions favored commercial rather than self-sufficient agriculture. Wheat production, which became centered in the Great Plains and prairie states, more than doubled between 1870 and 1900. By 1900, Minnesota was the leading wheat producer, with North Dakota second. Of the ten leading states, eight were west of the Mississippi River. Meat animal production also reflected the influence of the West, the value of meat animals increasing from \$964 million in 1870 to \$1,585 million in 1900. Cattle and calves, many of which were raised on the Great Plains, increased in value from \$272 million to \$679 million.

The web of railroads spanning the country provided rapid and relatively cheap transportation for western grain and livestock to eastern markets. The development in the 1880's of practical refrigerated transportation by railroad and steamship encouraged the rise of Chicago as a great meat processing center and permitted U.S. meat packers to ship their products to Europe at a cost much less than that for shipping live animals.

The growing industrialization and increasing population is reflected by the increase in the value of production of (1) poultry and eggs, from \$158 million in 1870 to \$571 million in 1900, (2) dairy products, from \$264 million to \$826 million, and (3) vegetables, from \$124 million to \$434 million. Total population almost doubled, increasing from 39.8 million persons in 1870 to 76 million in 1900. More notably, the urban population increased more than 200 per cent, from 9.9 million to 30.7

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million, compared with a rise of about 100 per cent in the rural population. In 1870, more than 47 per cent of persons gainfully employed were in agriculture; by 1900, only 36 per cent were so employed. The urban population was beginning to provide a wider market for poultry, eggs, dairy products, and vegetables—commodities which had been produced at home in an earlier, more self-sufficient agricultural economy.

In Europe, also, energies and resources were increasingly directed toward a growing industrialization. European farmers were unable to compete with the extensive agriculture practiced in the western United States in growing wheat and meat animals, so that the foreign market regularly absorbed about 18 per cent of the value of U.S. agricultural production. Exports provided the greatest outlets in cotton, tobacco, wheat, and meat products.

The gains in total production and, even more notably, the gains per worker in agriculture reflected continuing effects of the agricultural revolution. However, the period of radical change was followed by a period of consolidation in which growth continued at the rate established during the early phases. Improvements were made in many machines, but no radically new ones were invented. A successful wire binder was placed on the market in 1873, to be followed a few years later by a twine binder. Combines were further developed and were used to some extent, particularly in California. Steam power came into use in some farm operations, particularly for threshing machines. Movable engines, which at first were mounted on wheels and pulled from place to place by horses, eventually gave way to self-propelled farm steam engines. The cumbersome steam engine, too, was replaced before long by the internal-combustion powered tractor marketed shortly after 1900.

Total expenditures for farm implements and machinery rose steadily, continuing the trends established during the 1860's. Average yearly expenditures for farm implements and machinery (in 1910-14 dollars), rose from \$54 million in 1870 to \$202 million in 1900.

The use of fertilizer and lime increased phenomenally after 1870, with expenditures increasing ten-fold to \$90 million in 1900. A considerable part of this increase was the result of the production of cotton and tobacco in the South on lands that had lost much of their fertility. Commercial farmers in the North Central states and truck gardeners in New England also found that the resulting increase in output would more than repay the cost of the fertilizer.

During the thirty years, the number of institutions for agricultural improvement also continued to grow. Farm journals urged their readers to adopt better practices. Specialized farm journals, such as dairy papers, made their appearance, appealing to particular agricultural groups. Farm organizations, particularly the Grange, which was

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organized in 1867, were urging members to adopt new methods. State colleges and experiment stations, aided by the Hatch Experiment Station Act of 1887, conducted experiments and made the results known. The Department of Agriculture was raised to cabinet status in 1889, and worked toward an improved agriculture.

Although short-term rates of growth varied with cyclical fluctuations in general economic conditions, the general trend was a steady rise in total production and production per worker. This trend continued until World War II, when the second U.S. agricultural revolution, which saw total production per worker trend sharply upward, began. The new revolution is still under way.

Derivation of Estimates of Farm Gross Product and Investment

TOTAL FARM OUTPUT

Sales and Home Consumption of Farm Products

The commodity component of farm gross national product includes sales of farm commodities to the nonfarm population and the value (at farm prices) of farm commodities consumed by the farm population, including slaves. In general, the value of sales and home consumption of a commodity is derived as the product of an estimated farm price and an estimated quantity produced, after deduction of amounts used on farms as feed or seed. The net proportion of a crop after deduction of feed or seed is termed the percentage entering gross product; in most cases the percentage was taken from Strauss and Bean.

Summary values in current and constant dollars and the price deflators used are shown in Table 1 for crops and livestock separately and for their combined total. Estimates for individual commodities appear below in the section on commodity detail.

For the decade years 1870–1900, the calendar-year production and farm price estimates of Strauss and Bean were adopted for the current dollar estimates of output. These were adjusted to the level of the current Agriculture series for commodities for which there was a significant difference between Strauss and Bean estimates and the current Agriculture estimates for 1910. For 1840, 1850, and 1860, the censuses of agriculture were the basis of most of the quantity estimates. For 1800–30 quantities produced were to a large extent estimated on the basis of population and per capita output or disappearance trends shown by the census data of 1840 to 1860, although other sources were employed for some important crops such as cotton, wool, and sugar.

Price data for 1800–60 were developed by extrapolating the 1870 farm prices of Strauss and Bean backward by use of changes in various individual commodity price series. For 1851–70 unpublished average farm prices estimated by Arthur Peterson were employed. For years

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TABLE 1
Farm Gross Product, Decade Years, 1800-1900
(dollar figures in millions)

Item	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900
Sales and home consumption:											
1. Livestock	127	186	178	251	431	414	700	1,393	1,498	1,515	2,047
2. Crops	93	125	130	176	268	423	769	1,160	1,523	1,591	1,865
3. Total ^a	220	311	308	427	699	837	1,469	2,553	3,021	3,106	3,912
4. Net change in livestock inventories	6	9	10	15	14	10	21	52	39	44	79
5. Gross rental value of farm dwellings	10	16	20	24	44	57	89	169	203	247	307
6. Total gross output, excl. improvements and home manufactures ^b	236	336	338	466	757	904	1,579	2,774	3,263	3,397	4,298
7. Intermediate products consumed	6	12	15	21	37	53	95	232	296	362	499
8. Farm gross product, excl. improvements and home manufactures ^c	230	324	323	445	720	851	1,484	2,542	2,967	3,035	3,799
Value of:											
9. Improvements made on farms	7	9	12	17	22	34	47	67	68	67	55
10. Home manufactures	18	30	29	29	27	29	25	22	10	5	3
11. Farm gross product, incl. improvements and home manufactures ^d	255	363	364	491	769	914	1,556	2,631	3,045	3,107	3,857
Sales and home consumption:											
1. Livestock	194	260	345	462	651	826	1,088	1,436	2,006	2,612	3,100
2. Crops	113	155	210	302	452	553	897	1,000	1,778	1,992	2,803
3. Total ^a	307	415	555	764	1,103	1,379	1,985	2,436	3,784	4,604	5,903
4. Net change in livestock inventories	13	16	22	34	33	42	60	74	68	70	109
5. Gross rental value of farm dwellings	23	32	42	56	76	100	141	184	277	316	397
6. Total gross output, excl. improvements and home manufactures ^b	343	463	619	854	1,212	1,521	2,186	2,694	4,129	4,990	6,409
7. Intermediate products consumed	10	15	24	35	56	79	127	215	359	463	669

(1910-1914 dollars)

continued on next page

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TABLE 1 concluded

Item	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900
8. Farm gross product, excl. improvements and home manufactures ^c	333	448	595	819	1,156	1,442	2,059	2,479	3,770	4,527	5,740
Value of:					(1910-1914 dollars)						
9. Improvements made on farms	21	26	33	44	47	69	76	106	128	106	94
10. Home manufactures	8	11	14	16	19	25	21	12	8	5	3
11. Farm gross product, incl. improvements and home manufactures ^d	362	485	642	879	1,222	1,536	2,156	2,597	3,906	4,638	5,837
Sales and home consumption:					(implicit price deflators, 1900-14 = 100 ^e)						
1. Livestock	65	72	52	54	66	50	64	97	75	58	66
2. Crops	82	81	62	58	59	76	86	116	86	80	67
3. Total	72	75	55	56	63	61	74	105	80	67	66
4. Net change in livestock inventories	46	56	45	44	42	24	35	74	57	63	72
5. Gross rental value of farm dwellings	43	50	48	43	58	57	63	92	73	78	77
6. Total gross output, excl. improvements and home manufactures	69	73	55	55	62	59	72	103	79	68	67
7. Intermediate products consumed	60	80	62	60	66	67	75	108	82	78	75
8. Farm gross product, excl. improvements and home manufactures	69	72	54	54	62	59	72	103	79	67	66
Value of:											
9. Improvements made on farms	33	35	36	39	47	49	62	63	53	63	59
10. Home manufactures	225	273	207	181	142	116	119	183	125	100	100
11. Farm gross product, incl. improvements and home manufactures	70	75	57	56	63	60	72	101	78	67	66

^d Line 8 plus lines 9 and 10.

^e Derived by dividing the current dollar estimates by the constant dollar estimates.

^a Line 1 plus line 2.

^b Line 3 plus lines 4 and 5.

^c Line 6 less line 7.

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before 1851 extensive use was made of prices from the Aldrich Report and from the compilations of Cole and Hansen as well as from historical bulletins for various states.⁴ Additional price data were obtained from various Agriculture circulars and bulletins and from other sources referred to below.

In general, dollar estimates for most crops were derived by multiplying the estimated output entering gross product of each commodity by the 1910-14 average of Agriculture prices received by farmers. Exceptions to this procedure were made in the development of constant dollar estimates for nursery products and miscellaneous minor crops, and the output of sugar cane or its products which was deflated by estimated relatives of prices of sugar based on 1910-14 = 100.

Net Change in Livestock Inventories

The value of net changes in inventories was derived for each kind of livestock as the product of the change in number on farms during the calendar year and the average calendar year value per head on farms.

For 1870 to 1900, Agriculture historical inventory data appearing in the 1952 issue of *Agricultural Statistics* were employed. The annual change was estimated as the difference between January 1 inventories. The average calendar year value per head is the average of the January 1 value for the current and succeeding years. For 1840-60, census numbers on farms formed the basis of the estimates, after adjustment for underenumeration of young animals and for the June enumeration date of the census. (This treatment is that used by Gallman; see his paper in this volume.) Livestock on farms for 1800-30 was estimated from population estimates and the per capita numbers of livestock on farms for 1840-60. The average rate of growth for each decade was taken as a tenth of the change in numbers on farms so derived. In order to center the averages on decade years, a two-period moving average of the average annual rates of growth in numbers was computed to represent the rate of increase for the decade years covered. Average values per head for decade years 1800-60 were extrapolated from the 1870 inventory value per head, as estimated by the Department of Agriculture, by means of changes in average prices used for estimating the value of "sales and home consumption" of the respective species of livestock.

Gross Rental Value of Farm Dwellings

The current Agriculture estimates of imputed gross rental value of farm dwellings were used to derive an average rent per farm for 1910-14.

⁴ *Wholesale Prices, Wages and Transportation*, Senate Committee on Finance, 52d Cong., 2d sess., S.R. 1394, 1893, hereafter cited as the Aldrich Report; Arthur Harrison Cole, *Wholesale Commodity Prices in the United States, 1700-1861, Statistical Supplement*, Harvard University Press, 1938; and Alvin H. Hansen, *Wholesale Prices in the United States, 1801-1840*, in Bureau of Labor Statistics, Bull. 367, 1925, pp. 235-248.

This average was multiplied by the estimated number of farms for each of the decade years 1800–1900 to estimate gross rental income in 1910–14 dollars.

Estimates of the number of farms for 1850 to 1900 are from the censuses. Estimates for 1800–40 were derived by assuming that the number of persons engaged in agriculture per farm was the same as in 1850, and dividing the “persons engaged” series by this average. The series on persons engaged in agriculture for 1820–1900 is from *Historical Statistics*, series D–5.⁵ The estimates for 1800 and 1810 were derived as a product of the population of the United States and the number of persons engaged in agriculture per member of the population in 1820. (Estimates of persons engaged in agriculture and numbers of farms appear in Table 2.)

Rental income (in current dollars) per farm from 1910 forward was found to be closely correlated with the construction cost index used by the Department of Agriculture in developing estimates of repairs for the current years. Therefore, a construction cost index for 1800 to 1900 (1910–14 = 100) was constructed and employed to estimate gross rent per farm in current dollars by reading from a freehand line of average regression between the index of construction costs and gross rent per farm in current dollars fitted to observations for the quinquennial years for 1910–50. These per farm estimates in current dollars were then multiplied by the estimated number of farms for the decade years 1800–1900.

The construction cost index for 1800 to 1900 was derived by combining the Warren and Pearson price index for building materials with an index of farm wage rates, using the weights of 0.75 for building materials and 0.25 for wage rates.⁶ For the wage rate index, unpublished estimates of farm wages with board developed by Stanley Lebergott were used for 1830–1900 (see his paper in this volume). Estimates of wage rates for 1800–20 were extrapolated backward from 1830 by changes in the Vermont wage series.⁷ (The wage rate index and the construction cost index are shown in Table 24.)

Value of Improvements Made on Farms

The value of farm land improvement is measured as the labor value of clearing and fencing new land, erecting the first crude structures, and initially breaking the soil. Our quantitative measure is based on census data on acres of improved land from 1850–1900. For 1800–40, the

⁵ *Historical Statistics of the United States, 1789–1945*, Dept. of Commerce, 1949.

⁶ G. F. Warren and F. A. Pearson, *Wholesale Prices for 213 Years, 1720–1932*, Cornell University Agricultural Experiment Station, Mem. 142, 1932.

⁷ T. M. Adams, *Prices Paid by Vermont Farmers for Goods and Services and Received by Them for Farm Products, 1790–1940; Wages of Vermont Farm Labor, 1780–1940, Statistical Supplement*, Vermont Agricultural Experiment Station Bull. 507—Supplement, 1944.

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TABLE 2
Miscellaneous Statistical Series Used in Derivation of Estimates, Decade Years, 1800-1900

Item	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900
1. Farm population (millions)	4.3	5.8	7.7	9.8	12.3	15.8	20.1	22.4	27.1	29.4	31.2
2. Persons engaged in agriculture (thousands)	1,140	1,550	2,069	2,772	3,720	4,902	6,208	6,850	8,585	9,938	10,912
3. Number of farms (thousands)	335	456	609	815	1,094	1,449	2,044	2,660	4,009	4,565	5,737
4. Index of farm wage rates (1910-14 = 100)	33	36	38	38	47	49	62	63	53	63	59
5. Index of farm machinery prices (1910-14 = 100)	250	221	241	207	182	187	161	251	124	101	94
6. Index of construction cost (1910-14 = 100)	46	53	49	45	60	58	64	92	74	79	78
7. Gross product per worker (1910-14 dollars)	292	289	288	295	311	294	332	362	439	456	526

For the source or method of deriving these series, see the following subsections: *Line 1*—Value of home manufactures, below. *Lines 3, 4, and 6*—Gross rental value of farm dwellings. *Line 5*—Implements and machinery, below, in the discussion of gross investment. *Line 7*—*Line 8* of the 1900-14 dollars estimates of Table 1 divided by line 2 above.

number of improved acres in agriculture per person in the total population was assumed to be approximately the same (five acres) as in 1850, 1860, and 1870 (4.9, 5.2, and 4.9 respectively).

Labor expended on land improvement is value at the estimated wage rates for farm labor. Slave labor is valued at the cost of employing free labor. The labor cost per acre is estimated as a tenth man-year per acre for forest lands. This is based on a judgment by Hedrick that in one year an average settler could clear and sow ten acres and erect a cabin.⁸ The cost per acre for farm formation in prairie lands is based on estimates by Solon Robinson regarding the cost of establishing a farm of 160 acres in Indiana, which averaged \$3.83 per acre with labor cost averaging about \$10 a month.⁹ The cost per acre of improving prairie land in man-years is derived as the ratio of the cost per acre to twelve months' farm wages: $3.83/120.00$ or 0.032 man-years. Since the cost was 0.100 man-years per acre for forest land, the acreage improved was put on a uniform "forest-land equivalent" basis by counting prairie land acres as one-third of a unit and forest land as one unit. Areas classified as "prairie" for this purpose are the Pacific, Mountain, and Great Plains regions, and Texas, Oklahoma, Indiana, Illinois, and Iowa. Census data on improved land by regions and states were used for 1850 to 1900. Before 1850, the estimated total acres of improved land were assumed to be distributed regionally in the same proportions as persons engaged in agriculture. One-tenth of the decade increment in improved land was taken as the average annual rate of growth and a two-period moving average of these rates was used to represent the decade years.

Seaman's estimate of \$12 cost per acre for clearing land around 1840 was consistent with the man-year requirements per acre of forest land and the estimated approximate wage rate.¹⁰ The \$12 per acre, therefore, was adopted as the bench-mark estimate for 1840 and extrapolated to earlier and later decade years by an index of farm wage rates based on Lebergott's series (Table 2).

The imputed value of land improvement was estimated simply as the product of the per-acre cost and the average annual increment of improved acres (forest land equivalent) during the ten-year periods centering on the decadal years.

Value of Home Manufactures

Estimates of the value of home manufacture produced on farms are based upon a survey of 1810 and upon census values of home

⁸ Ulysses P. Hedrick, *A History of Agriculture in the State of New York*, New York State Agricultural Society, 1933, p. 110.

⁹ Solon Robinson, *Pioneer and Agriculturist, Selected Writings*, Herbert A. Kellar, ed., Indiana Historical Bureau, 1936, Vol. 1, pp. 327 and 356.

¹⁰ Ezra C. Seaman, *Essays on the Progress of Nations, in Civilization, Productive Industry, Wealth and Population*, Scribner, 1868.

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manufactures for the census years 1840-70.¹¹ Estimates were derived for 1800, 1820, 1830, and 1880 as the product of farm population and estimated per capita value of home manufactures in constant dollars. For 1890 and 1900, nominal estimates reflect an assumed tapering off or virtual disappearance of home manufactures as a significant type of productive activity on farms.

Output per capita in constant dollars was estimated to be the same in 1800 as in 1810; for 1820 and 1830 per capita estimates were interpolated between the 1810 and 1840 bench-mark estimates; for 1880, it was assumed that per capita output declined by the same percentage from 1870 as from 1860 to 1870. Since home manufactures consisted primarily of cloth, the Warren and Pearson monthly index of textile prices was used to shift the census year reported values to a calendar year basis, to deflate both the survey and census totals, and to convert the constant dollar estimates to a current dollar basis. Estimates of the farm population were taken from Cooper for 1820 to 1900, and were extrapolated to 1800 by assuming farm population to be the same percentage of rural population as in 1820 (Table 2).¹²

INTERMEDIATE PRODUCTS CONSUMED

The value of intermediate products consumed in agriculture production is shown in Table 3.

Rent Paid to Nonfarm Landlords

Rent paid to nonfarm landlords (net of current operating expenses) as a percentage of the current dollar value of commodity output was found to be correlated with the percentage of farms operated by tenants, for the census years 1925-50. A freehand curve was fitted to these observations, and estimated gross rent percentages of commodity output were read from the curve for known or estimated tenancy rates during the decade years of the nineteenth century. The tenancy rates were taken from census data for 1880, 1890, and 1900. For earlier decades, the U.S. tenancy rate was estimated on the basis of assumed trends in regional tenancy rates, allowing for lower value in the South than in the North.

The estimated gross rent percentages taken from the regression chart were applied to the value of marketings and home consumption of farm products in current dollars to obtain estimates of gross rents to nonfarm landlords in current dollars. The same percentages were applied to commodity output in 1910-14 dollars to obtain estimates of gross rent in 1910-14 dollars.

¹¹ Rolla M. Tryon, *Household Manufactures in the United States, 1640-1860*, University of Chicago Press, 1917, p. 167.

¹² Martin R. Cooper, Glen T. Barton, and A. P. Brodell, *Progress of Farm Mechanization*, Dept. of Agriculture, Misc. Pub. 630, 1947, p. 7.

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TABLE 3
Intermediate Products Consumed, Decade Years, 1800-1900
(millions of dollars)

Items	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900
Repairs to farm structures	2	4	6	7	14	20	35	76	92	112	139
Repairs to implements and machinery	1	2	2	3	3	5	7	8	12	15	23
Fertilizer and lime						2	6	16	29	55	82
Cotton ginning	^a	^a	^a	^a	^a	1	1	19	20	22	26
Horseshoeing	1	2	2	3	4	4	7	11	10	15	18
Miscellaneous	^a	1	1	1	2	2	3	6	8	8	10
Total, excl. rent	4	9	11	14	23	34	59	136	171	227	298
Rent paid to nonfarm landlords	2	3	4	7	14	19	36	96	125	135	201
Total, incl. rent	6	12	15	21	37	53	95	232	296	362	499
					(current dollars)						
Repairs to farm structures	5	8	11	16	24	34	54	83	124	142	178
Repairs to implements and machinery	1	1	2	2	3	4	7	5	14	18	30
Fertilizer and lime						2	5	9	22	48	90
Cotton ginning	^a	^a	^a	^a	1	1	1	13	21	28	33
Horseshoeing	1	1	2	3	4	4	6	8	12	17	20
Miscellaneous	^a	1	1	1	2	2	4	5	8	9	12
Total excl. rent	7	11	16	22	34	47	77	123	201	262	363
Rent paid to nonfarm landlords	3	4	8	13	22	32	50	92	158	201	306
Total, incl. rent	10	15	24	35	56	79	127	215	359	463	669
					(1910-1914 dollars)						

^a Less than \$500,000.

Fertilizer and Lime

For the decade years 1850–1900, farmers' expenditures, in current dollars, for fertilizer and lime were estimated by extrapolating the Agriculture estimate for 1910 backward by use of a value index reflecting movements in the quantity consumed and in prices. The relative movements of the quantity consumed during the decade years 1850–1900 are based on estimates of U.S. consumption of fertilizer in the *Commercial Fertilizer Yearbook*.¹³ Price movements from 1880 to 1900 are based on price data appearing in the *American Fertilizer*; from 1850–70, they are based on the movements of the Warren and Pearson all-commodity index.¹⁴ The value of fertilizer and lime used for the decade years before 1850 was carried nominally at zero since consumption is generally believed to have been insignificant.

The constant dollar estimates were obtained by extrapolating the Agriculture estimate for 1910 (in 1910–14 dollars) backward to 1850 by use of the quantity relatives described above.

Repairs to Implements and Machinery

The current dollar cost of repairs to farm implements and machinery for 1850–1900 was estimated at 3 per cent of the census value of implements and machinery on farms. This percentage is the average shown in the current Agriculture repair series for the quinquennial years 1910–35.

For 1800–40, the amount of repairs per farm was assumed to be the same as in 1850. Current dollar estimates for these years were derived by inflating the constant dollar figures by a machinery repair cost index. This was constructed for 1800–1900 by averaging the index of farm wage rates and a price index for farm implements and machinery (described below under investments). This index was also used to convert the current dollar estimates for 1850–1900 to 1910–14 dollars.

Repairs to Farm Structures

Department of Agriculture estimates of repairs to farm structures were used to calculate an average repair expense per farm for each of the years 1910–14. The five-year average was multiplied by the estimated number of farms for 1800–1900 to determine the estimated expense for structural repair in 1910–14 dollars, assuming a constant physical volume of repairs per farm. The index of construction costs, described earlier, was used to inflate this series to current dollars.

Both the current dollar and the constant dollar series were then adjusted for changing percentage of inputs from nonagricultural sectors.

¹³ *Commercial Fertilizer Yearbook*, Walter W. Brown Publishing Co., 1939.

¹⁴ A. L. Mehri and B. T. Shaw, "Relationship between Farm Income and Farmers' Expenditures for Fertilizer," *American Fertilizer*, April 8, 1944.

Several factors operated during the first half or two-thirds of the century to place a relatively smaller share of the total repair inputs in the off-farm source category compared with the end of the century. These included slave labor, primitive frontier conditions, and the gradual transition to commercial agriculture, with an accompanying increase in specialization and economic interdependence. Considering these factors, the percentage of inputs from the nonfarm sector were interpolated on a straight-line basis between 50 per cent for 1800 and 100 per cent for 1870.

Cotton Ginning

The cost of cotton ginning (in 1910-14 dollars) was estimated for 1870-1900 as the product of estimated cotton production and Agriculture estimates of 1910-14 average ginning cost per bale. For 1800-60, estimates were derived in the same way, except that only 10 per cent of total cotton production was used to derive ginning costs, since in the antebellum period nearly all ginning is generally believed to have been done on plantations. Because ginning services were usually paid for in cotton, the constant dollar estimates of ginning costs were converted to current dollars by multiplying them by relatives of cotton prices on a 1910-14 base.

Horseshoeing

Expenditures for horseshoeing, in 1910-14 dollars, were estimated for 1870-1900 as the product of the estimated number of horses and mules on farms and 1910-14 average expenditure per head. Average expenditure per head in 1910-14 was derived by dividing the Agriculture estimate of horseshoeing expenditures by the number of horses and mules on farms. For 1800-60, constant dollar estimates were derived by deducting from the total number of horses and mules on farms in the United States the estimated number on farms in the southeastern states. This allowance was made because such activity during the pre-Civil War period was largely performed on the plantations rather than provided by nonfarm enterprise.

Constant dollar estimates were placed on a current dollar basis by inflating by an index of Adam's estimated prices paid for shoeing horses in Vermont.

Miscellaneous Intermediate Products

This category includes such minor items as veterinary services, containers, and binding twine. In 1910, Agriculture estimates for these miscellaneous items (other than those estimated above) amounted to about 2 per cent of the value of farm marketings and home consumption. Estimates of the value of miscellaneous intermediate products or services

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consumed for the decade years were made globally. On the assumption that the volume of all such inputs varied with the scale of production, estimates for their combined value in 1910-14 dollars were made by applying the 1910 percentage to the constant dollar value of sales and home consumption for each of the decade years 1870, 1880, and 1900. For the earlier decade years back to 1800 this percentage was reduced gradually to 1 per cent in 1800 on the assumption that few of such inputs were of nonfarm origin. Current dollar estimates were obtained by inflating the constant dollar figures by the Warren and Pearson all-commodity price index.

GROSS INVESTMENT, DECADE AVERAGES

Our estimates of investment represent annual average rates for ten-year periods centered on decade years (Table 4). Estimates were made of (1) capital expenditures for farm implements and machinery, (2) expenditures for harness and saddlery, (3) the value of net changes in livestock inventories, and (4) major improvements to land and structures. The basic data employed for the investment series consist of census data or the authors' own estimates of land improved or manufactured output for decade years. In centering the estimates at particular decade years, moving averages of three decade years were calculated, employing a weight of two for the center year and of one for the first and third year. This general procedure was followed in deriving constant dollar investment rates. For conversion to current dollars, averages of price indexes for corresponding ten-year periods were used.

Average annual rates based on estimates of quantities and values for individual years were virtually impossible because of the limitations of available source materials. The estimation of decade averages of the value of net livestock changes for 1870 to 1900, however, were made on the basis of annual figures since data was available.

Improvements to Land and Buildings

Improvements were separated into three categories for estimating purposes: land clearing, improvement of new farms, and improvement of old farms. Estimates of investment in land clearing were based on the same data employed in deriving the estimate of "value of farm-produced improvements" described earlier. However, the decade average rates were obtained by methods similar to those outlined above for farm machinery. The value of improvements on new farms was estimated at 1840 prices at \$300 per farm. This was the estimated cost of a frame farm house referred to by Solon Robinson. In 1910-14 dollars this amounted to \$517 when adjusted by a construction cost index. New farms were defined as having been formed five years previously, since it was assumed that major improvements were made

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TABLE 4
Gross Investment, Decade Average Rates, 1800-1900
(dollar figures in millions)

Item	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900
Improvements to land and buildings	14	19	24	33	45	69	102	161	198	174	218
Implements and machinery	5	7	9	10	13	20	44	119	158	163	198
Harness and saddlery	2	3	4	5	7	10	24	33	37	38	45
Livestock inventory changes	6	7	9	12	13	16	28	42	74	28	52
Total	27	36	46	60	78	115	198	355	467	403	513
					(current dollars)						
Improvements to land and buildings	3	44	56	76	89	124	157	207	293	255	295
Implements and machinery	2	3	4	5	7	11	23	54	105	155	202
Harness and saddlery	2	4	5	6	10	14	20	25	35	48	60
Livestock inventory changes	13	17	22	35	32	41	60	65	116	42	74
Total	51	68	87	122	138	190	260	351	549	500	631
					(1910-1914 dollars)						
Improvements to land and buildings	41	43	43	43	51	56	65	78	68	68	74
Implements and machinery	250	233	225	200	186	182	191	220	150	105	98
Harness and saddlery	100	75	80	83	70	71	120	132	106	79	75
Livestock inventory changes	46	41	41	34	41	39	47	65	64	67	70
Total	53	53	53	49	57	61	76	101	85	81	81
					(implicit price deflators, 1910-1914 = 100)						

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about five years after formation. Improvements on old farms were estimated at \$26 per farm at 1910-14 prices, based on the current Agriculture expenditure series for 1910-14, after allowing for estimated expenditures on new farms. The number of old farms existing at the start of a decade centered on the decade years was estimated as the average of decade year totals. For example, the number of old farms improved during the period 1875-85 was estimated as the average of farms existing in 1870 and 1880. For inflating the constant-dollar estimates, construction cost indexes were constructed employing ten-year averages of the Warren and Pearson annual price indexes for building materials, and a weighted three-decade average of the farm wage-rate index.

Implements and Machinery

Estimates of average annual rates of gross investment in farm implements and machinery were based upon adjusted census output estimates for the farm implement industry.¹⁵ The farm implement industry totals were smaller than the total output of farm implements by the value of output of industries not having implements as their major product. To allow for the omission of the output of these other industries, the average ratio of the value of total output to major-industry output which is implicit in the current Agriculture estimates of expenditures in 1910 and 1915 (1.37) was used to raise the totals. Next, the value of exports was deducted to estimate the output of agricultural implements and machinery for domestic use at manufacturers' prices. Since census data were available only for 1850-1900, estimates for 1800-40 were constructed by assuming that the constant dollar adjusted value of output of implements per person engaged in agriculture was the same as for the average of 1850 and 1860. The current dollar estimates were converted to constant dollar estimates by use of the farm machinery index described below. Next, a three-decade moving average was calculated, as mentioned above, to estimate decade average rates of gross investment in constant dollars at manufacturers' prices. These values were raised to retail level by the addition of 49 per cent, the Agriculture figure for transportation costs and dealers' markups for 1920-40. The estimates were placed on a current dollar basis by multiplication by decade averages of the farm machinery price index.

The farm machinery price index (see Table 24) was based on Holmes's data comprising historical prices reported by manufacturers for 1860, 1880, 1890, and 1900.¹⁶ These were converted to relative prices based on 1900 and combined into an index. Value weights for this price

¹⁵ 1921 *Census of Manufactures, Manufacture and Sale of Farm Equipment*, 1923, p. 7.

¹⁶ George K. Holmes, *The Course of Prices of Farm Implements and Machinery for a Series of Years*, Dept. of Agriculture, Division of Statistics, Misc. Series Bull. 18, 1901.

index were derived using census data on numbers of the different types of machines produced in 1870 and price data shown by Holmes for 1880. This index was rebased to 1910–14 = 100 by splicing it to a National Bureau of Economic Research price index of producers' goods, processed, appearing in Mills.¹⁷ An index number for 1870 was derived by raising the 1860 index by 56 per cent, the amount estimated by the Superintendent of Census as the average increase in price for manufactures between 1860 and 1870.¹⁸ The 1860 index was extrapolated to 1800 by changes in Adams's Vermont prices of scythes.

Harness and Saddlery

Gross investment in harness and saddlery was estimated as the product of the estimated number of horses and mules on farms and an estimated expenditure per head in 1910–14 dollars. For 1870 to 1900 the average expense per head shown by the current Agriculture series for 1910–14 was used. For 1860–1900 the constant dollar expenditure per head was graduated down to one-half of the 1870 expenditure by 1800, to reflect a relatively smaller demand for harness in the early part of the century, as suggested in Depew.¹⁹ The constant dollar estimates were converted to current dollars by Warren and Pearson's price index for hides and leather.

Livestock Inventory Changes

Average rates of investment in livestock inventories were estimated by averaging the values of annual net changes in numbers of livestock on farms for ten-year periods centered on the decade years. For 1870–1900 Agriculture annual estimates of animal numbers and values per head were employed to obtain annual values of inventory changes, which were then averaged. For 1800–60, in the absence of annual data, the average rates of inventory change were derived by computing a two-decade moving average of estimated annual increases based on inventories for decade years. The average rates of increase for 1800–60 were valued in current dollars by decade averages of estimated values per head. Average values per head for 1800–60 were estimated by extrapolating the 1870 Agriculture estimates by changes in the price series used for the sales and home consumption estimates for the respective kinds of livestock.

Investment in 1910–14 dollars for each kind of livestock was estimated

¹⁷ Frederick C. Mills, *Economic Tendencies in the United States: Aspects of Pre-War and Post-War Changes*, National Bureau of Economic Research, 1932.

¹⁸ *1870 Census of the United States*, Vol. III, *The Statistics of Wealth and Industry of the United States*, p. 379.

¹⁹ *One Hundred Years of American Commerce*, Chauncey M. Depew, ed., D. O. Haynes and Co., 1895, p. 575.

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by multiplying the estimated average decade rates of inventory change by the 1910-14 average value per head on farms.

COMPARISON WITH OTHER ESTIMATES

Our "farm gross product" estimates are an aggregative measure of output for the agricultural sector, as are also both the "gross farm income" series of Strauss and Bean and the "gross value added by agriculture" series of Robert Gallman presented in this volume. It may be of interest, therefore, to compare the concepts, coverage, and totals of the different estimates.

The estimates of Strauss and Bean represent only the value of agricultural commodity production. We include, in addition, estimates of gross rental value of farm dwellings and the cost of intermediate products employed in agriculture. One of our components of gross product, "value of sales and home consumption of crops and livestock," corresponds to the "gross income, including estimates for omitted products," of Strauss and Bean. For these two comparable measures of commodity output, the current dollar totals for the decade years 1870-1900 are nearly identical, with our estimates ranging from 0.4 to 1.1 per cent higher than those of Strauss and Bean. Although many of the Strauss and Bean commodity series were incorporated in ours without modification, others, particularly the livestock series, were adjusted with respect to either quantity or price so as to correspond more closely to the level of the current farm output estimates for the period from 1910 forward. Several of the commodities which were grouped by Strauss and Bean in "omitted products," for which a global estimate was made, we estimated individually. Moreover, for some commodities, somewhat different methods and source data were employed.

While Gallman's measure, "gross value added by agriculture," is similar in concept to ours, there are major differences in coverage which limit the usefulness of a direct comparison. For example, we include the estimated gross rental value of dwellings in the output total and deduct the estimated value of several intermediate products, whereas Gallman omits rental value from value of output and deducts only the cost of fertilizer as an intermediate product. Moreover, Gallman's estimates are on a census year basis while ours employ a calendar year. This gives rise in some instances to substantial differences in estimates of quantities produced as well as in prices employed in current dollar valuation. Despite these and other lesser differences, Gallman's "gross value added" series and our "gross farm product, including improvements and home manufactures" series, exhibit approximately the same trend. The following table compares indexes of the constant dollar totals of the two series:

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<i>Gallman</i>		<i>Towne-Rasmussen</i>	
Gross Value Added by Agriculture (1879 prices)		Farm Gross Product Including Improvements and Home Manufactures (1910-14 prices)	
<i>Census</i> <i>Year</i>	<i>Index</i> (1839 = 100)	<i>Calendar</i> <i>Year</i>	<i>Index</i> (1840 = 100)
1839	100	1840	100
1849	126	1850	126
1859	190	1860	176
1869	219	1870	213
1879	330	1880	320
1889	411	1890	380
1899	498	1900	478

Commodity Detail

In our detailed estimates for individual commodities, one important departure in coverage and concept was necessary in view of the nature of available data. This was the development of estimates for each major commodity of "output entering farm gross product," which differs, for several important commodities, from the individual commodity "building blocks" of quantities sold or consumed by farm households currently used in the derivation of estimates of farm gross product for the years 1910 to date.

For crops other than feed crops, output entering farm gross product measures that portion of the total output which is sold to the nonfarm sector or consumed on the farm. It excludes the portion of total output retained for seed by the entire farm sector. The quantity retained for seed is, in effect, a measure of one of the elements of real cost in producing the crop and, therefore, should be excluded from "value added" or gross product. For feed crops, output entering gross product excludes, in addition to the estimated portion retained for seed, the quantity used for the feeding of farm livestock. Thus, this approach reflects the value added in feed output through the sales and home consumption of meat animals, and also nets out one important element of the total costs of production, feed used for maintaining draft animals.

It is important to note, therefore, that the estimates of output entering gross product differ in coverage from Department of Agriculture estimates of the value of sales and home consumption for the years 1910 to date. The latter include all sales, whether to the farm sector or nonfarm sector. Current methods of deriving estimates of gross product for these years include interfarm sales in the value of sales and home consumption which are then offset by deducting such sales as

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intermediate products. No such deduction is made here since these interfarm sales are already netted out of output entering gross product.

In general, estimates of the quantity of each farm commodity entering farm gross product were derived by applying to total production a percentage representing the quantity of product not used for feed or seed. This percentage was estimated for each commodity by Strauss and Bean, largely on the basis of crop disposition estimates for periods subsequent to 1900. These estimates were generally adopted in our study.

For 1870 to 1900, the calendar year figures by Strauss and Bean of production percentage entering farm gross product, and U.S. average farm prices were adopted in toto for most commodities, although their price or quantity estimates for some products were adjusted upward to conform to the level of the more recent Agriculture estimates for 1910. Quantity estimates for 1840, 1850, and 1860 generally were based upon census of agriculture totals, employing production data for the census year ending June 1 to represent quantities sold or consumed by farm households during the calendar year in which the census year ended. Also, for some commodities, estimates of prices and output for 1840-60 were based on data contained in an unpublished doctoral thesis (University of Pennsylvania, 1956) on income originating in agriculture between 1840 and 1880 by Gallman. For several commodities, quantity estimates for 1800-30 were constructed as a product of (1) the estimated number of farm workers or of total population, and (2) estimated per capita output or disappearance. For some of the major commodities—sugar, cotton, and rice—other sources were employed.

Farm commodity prices for 1800-60 were extrapolated from the 1870 average prices estimated by Strauss and Bean employing relatives of changes in prices based on data obtained from various sources. For the period 1851-70, such relatives were computed from unpublished estimates of average farm prices developed by Arthur G. Peterson, formerly with the Department of Agriculture. These are referred to below as Peterson's prices. Other sources are specified in the following discussion of individual commodity estimates.

LIVESTOCK AND LIVESTOCK PRODUCTS

The value of livestock products entering gross product is shown in current and 1910-14 dollars in Table 5.

Cattle and Calves

Output of cattle and calves entering gross product was estimated as the total quantity (live weight basis) slaughtered or exported as live animals. For 1870-1900, estimates of Strauss and Bean were adopted. For 1840, 1850, and 1860, output was estimated by methods similar to

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 TABLE 5
 Livestock and Livestock Products, Value of Output Entering Gross Product, Decade Years, 1800-1900
 (millions of dollars)

Commodity	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900		
Cattle and calves	30.2	41.0	49.0	63.7	122.6	97.1	181.3	278.4	294.0	374.6	495.0		
Hogs	61.1	101.9	87.2	116.2	189.4	162.5	303.2	631.7	656.4	411.3	552.7		
Sheep and lambs	0.2	0.3	0.3	0.5	0.9	1.6	4.8	11.8	13.5	23.4	43.4		
Chickens	6.4	7.2	7.8	13.0	20.5	32.7	30.1	64.1	58.0	92.7	122.6		
Other poultry	1.0	1.1	1.2	2.0	3.1	4.9	4.5	9.6	8.7	13.9	18.4		
Eggs	2.9	4.7	5.8	6.2	9.3	12.5	20.7	65.8	70.6	145.3	210.0		
Dairy products	22.7	27.0	23.0	45.6	75.7	88.8	137.0	280.3	326.6	380.2	530.1		
Horses and mules	0.4	0.5	0.7	1.1	2.2	2.4	4.9	10.7	11.9	20.9	28.3		
Wool	1.7	1.9	2.7	2.2	5.6	9.6	11.1	36.0	53.6	47.2	39.5		
Miscellaneous	0.4	0.6	0.6	0.9	1.5	1.4	2.4	4.9	5.2	5.3	7.1		
Total	127.0	186.2	178.3	251.4	430.8	413.5	700.0	1,393.3	1,498.5	1,514.8	2,047.1		
					(current dollars)								
					(1910-1914 dollars)								
Cattle and calves	45.0	60.7	81.1	108.9	153.3	188.1	262.2	272.0	425.3	637.9	679.2		
Hogs	87.5	116.6	153.1	204.1	298.9	364.5	432.0	677.2	788.3	832.9	848.3		
Sheep and lambs	0.7	0.9	1.2	1.7	2.3	3.9	6.7	14.4	21.6	32.7	57.1		
Chickens	9.2	12.4	16.6	22.3	29.4	40.0	54.2	76.0	105.8	146.0	193.2		
Other poultry	1.4	1.9	2.5	3.3	4.4	6.0	8.1	11.4	15.9	29.0	29.0		
Eggs	6.9	9.3	12.5	16.6	22.2	30.0	40.6	71.1	127.0	224.2	348.8		
Dairy products	39.2	53.6	72.5	97.2	127.6	174.0	239.2	263.9	451.0	626.4	826.5		
Horses and mules	1.0	1.2	1.8	2.9	4.4	7.4	10.9	16.5	22.5	32.0	56.2		
Wool	1.9	2.3	2.5	3.2	6.4	9.3	10.7	28.8	41.3	49.1	51.3		
Miscellaneous	0.7	0.9	1.2	1.6	2.3	2.9	3.8	5.0	7.0	9.1	10.8		
Total	193.5	259.8	345.0	461.8	651.2	826.1	1,088.4	1,436.3	2,005.7	2,612.2	3,100.4		

FARM GROSS PRODUCT AND GROSS INVESTMENT

those of Strauss and Bean, that is, by applying an estimated slaughter rate to estimated cattle inventories. Estimates of cattle inventories were based on census numbers on farms, adjusting for date of enumeration and for the exclusion from the census totals for 1840, 1850, and 1860 of cattle under one year of age. Specifically, the number of cattle on farms reported by the census as of the June enumeration date was adjusted to a January 1 equivalent by dividing by an estimated average ratio of June cattle inventories to January inventories (1.06) adopted from Gallman. The number of calves was estimated as 31 per cent of cattle numbers, on the basis of later censuses. The live weight of cattle slaughtered for 1840-60 was estimated by assuming an annual slaughter rate of 20 per cent of cattle inventories and an average slaughter weight of 950 pounds. The live weight of calves slaughtered was estimated for 1840-60 employing a 10 per cent slaughter rate and an average weight of 170 pounds. For 1800-30, the live weight of cattle and calves slaughtered was estimated by assuming the average per capita disappearance to be about equal to that for 1840 and 1850.

The current dollar value of output of cattle and calves was computed as a product of total output and average prices received by farmers. For 1870-1900, calendar year average prices were those of Strauss and Bean, adjusted for level differences between their estimates and the Agriculture estimates for 1910-14. For 1800-60, adjusted 1870 average prices received for cattle and calves, respectively, were extrapolated to 1851 by changes in Peterson's price estimates and to 1800 by changes in Cole's prices of mess beef at New York.

Cattle and Calves

<i>Year</i>	Output Entering Gross Product (mill. lbs. live weight)	Price per Hundred- weight (\$)	Value in Current Dollars (\$ mill.)
1800	807	3.74	30.2
1810	1,094	3.75	41.0
1820	1,460	3.36	49.0
1830	1,961	3.25	63.7
1840	2,759	4.44	122.6
1850	3,386	2.87	97.1
1860	4,719	3.84	181.3
1870	4,897	5.69	278.4
1880	7,626	3.86	294.0
1890	11,415	3.28	374.6
1900	12,136	4.08	495.0

INCOME ORIGINATING, BY SECTOR

Hogs

Hog output entering gross product for 1870-1900 was estimated by Strauss and Bean by applying an average slaughter rate of 102.2 per cent of January 1 inventories to the Agriculture estimated numbers of hogs on farms for those years, the slaughter rate being based on Agriculture estimates for 1899-1910. The number slaughtered was then converted to a live weight basis employing average slaughter weights based, for earlier years, on data from the *Cincinnati Price Current*. These estimates were adopted with no adjustments for 1870-1900.

For 1840-60, the inventory estimating method and average slaughter weights developed by Gallman were adopted. June 1 inventories reported in the censuses were adjusted by the estimated average ratio of June numbers to January numbers (1.18). The same slaughter rate as was used for 1870-1900 (102.2) was applied to the January 1 inventories for 1840-60. The resulting slaughter totals were converted to a live weight basis employing Gallman's estimates.* Output entering gross product for 1800-30 was estimated as the product of total population for those years and average per capita consumption for 1840-60.

<i>Hogs</i>			
<i>Year</i>	Output Entering Gross Product (mill. lbs. live weight)	Price per Hundred- weight (\$)	Value in Current Dollars (\$ mill.)
1800	1,200	5.09	61.1
1810	1,600	6.37	101.9
1820	2,100	4.15	87.2
1830	2,800	4.15	116.2
1840	4,100	4.62	189.4
1850	5,000	3.25	162.5
1860	6,200	4.89	303.2
1870	9,290	6.80	631.7
1880	10,814	6.07	656.4
1890	11,425	3.60	411.3
1900	11,636	4.75	552.7

* *Editor's note:* In the editor's opinion, Gallman's estimates and those of Strauss and Bean are too high for the years before 1900. The adjustment of the census June inventories to a January base is derived from production relationships of a later period when concentration of pig births in the spring became common. The estimated live weights are derived from commercial slaughterings, while farm-slaughtered hogs, which formed over 90 per cent of slaughter in 1840, may have been lighter. An estimate based on other assumptions is presented in "Trends in Per Capita Food Consumption, 1840-1910," a paper presented at the meeting of the Econometric Society in September 1957.

FARM GROSS PRODUCT AND GROSS INVESTMENT

Estimates of current dollar value of hog slaughter was estimated as the product of output and estimated average prices received by farmers for hogs. Calendar year prices taken from Strauss and Bean for 1870-1900 were adjusted to the level of the current Agriculture series by overlapping the Strauss and Bean estimates and Agriculture estimates for 1910-14. For 1800-60, the adjusted 1870 average price was extrapolated to 1851 by changes in Peterson's price series for hogs, and from 1851 to 1800 by changes in Cole's prices of mess pork at New York.

Sheep and Lambs

Output of meat from sheep and lambs for 1870-1900 was estimated 5 per cent lower than the estimates of Strauss and Bean, based on the average ratio of their series to the Agriculture estimates for 1910-14. For 1800-60, preliminary output totals were first obtained by methods similar to those used by Strauss and Bean, and then adjusted downward by 5 per cent to adjust to Agriculture levels. To derive the preliminary figures, estimated per capita consumption figures for the farm and non-farm population were multiplied by their respective population totals employing 1.5 pounds per capita for the farm population and varying the nonfarm per capita estimate from 8 pounds in 1860 to 5 pounds for 1800-40. In obtaining current dollar estimates of value entering gross product, Strauss and Bean estimates of average prices received by farmers were raised 11 per cent on the basis of the average ratio between their estimates and Agriculture estimates for 1910-14. For 1800-60, the adjusted prices estimate for 1870 was extrapolated to 1860 by changes

Sheep and Lambs

<i>Year</i>	Output Entering Gross Product (mill. lbs. (live weight)	Price per Hundred- weight (\$)	Value in Current Dollars (\$ mill.)
1800	11	1.83	0.2
1810	15	1.83	0.3
1820	20	1.66	0.3
1830	29	1.60	0.5
1840	40	2.19	0.9
1850	66	2.39	1.6
1860	115	4.20	4.8
1870	247	4.77	11.8
1880	370	3.66	13.5
1890	560	4.18	23.4
1900	978	4.44	43.4

INCOME ORIGINATING, BY SECTOR

in the Aldrich Report estimated prices for sheep at Cincinnati, to 1840 by changes in Gallman's estimated mutton prices, and to 1800 by changes in Cole's prices of mess beef at New York.

Horses and Mules

The number of horses and mules sold off farms was estimated by adding exports to the estimated number sold domestically for nonfarm use.²⁰ Estimates of sales for domestic use were based upon a census estimate of 300,000 head in 1899-1900.²¹ Estimates of such sales for 1800-90 were extrapolated backward from 1900 by changes in the non-farm population assuming a constant rate of purchase per capita. The value of off-farm sales was estimated as the total of (1) the product of the estimated number sold (excluding exports) and an estimated price per head, and (2) the reported value of exports. Average price per head was calculated as a composite in which horses were weighted 0.85 and mules 0.15, the approximate proportions of horses and mules on farms for 1870-1900. For 1870-1900, the average price was estimated by multiplying a composite of the Agriculture average values per head on farms by 1.25, the approximate ratio of prices received per head to value per head on farms for 1910-14. For 1800-60, the estimated 1870 price was extrapolated backward by changes in the price series estimated for sales of cattle.

Horses and Mules

<i>Year</i>	Number Sold for Domestic Nonfarm Use (thous.)	Price per Head (\$)	Value of Domestic Sales (\$ mill.)	Value of Exports (\$ mill.)	Total Value in Current Dollars Entering Gross Product (\$ mill.)
1800	7	58	0.4	n.a.	0.4
1810	9	58	0.5	n.a.	0.5
1820	13	51	0.7	n.a.	0.7
1830	21	50	1.1	n.a.	1.1
1840	32	69	2.2	n.a.	2.2
1850	50	44	2.2	0.2	2.4
1860	76	59	4.5	0.4	4.9
1870	117	88	10.3	0.4	10.7
1880	155	69	10.7	1.2	11.9
1890	225	88	19.8	1.1	20.9
1900	300	56	16.8	11.5	28.3

n.a. = not available.

²⁰ *Exports of Farm Products from the United States, 1851-1908*, Dept. of Agriculture, Bureau of Statistics, Bull. 75, 1910.

²¹ *1900 Census of the United States*, Vol. v, *Agriculture*, Part 1, p. ccxxiii.

FARM GROSS PRODUCT AND GROSS INVESTMENT

Chickens

Output entering gross product of chickens was estimated for 1870 to 1900 by raising Strauss and Bean's estimates of chickens raised for slaughter by 8 per cent, the average difference between that series and the Agriculture estimates for 1910-14. Output for 1860 was estimated as a product of population and an estimated per capita disappearance of 15 pounds (live weight), which was derived by extending the trend in per capita disappearance reflected by the estimates for 1870-1900. For 1800-50, output was estimated as product of total population and an estimated per capita consumption kept constant at the 1860 level. For deriving current dollar value of output for 1870-1900, estimated average prices received were those of Strauss and Bean, adjusted for level differences on the basis of the average ratio of those prices to the Agriculture prices for 1910-14. For 1800-60, the estimated average price for 1870 was extrapolated backward to 1851 by changes in Peterson's prices, and to 1800 by changes in Adams's Vermont estimated prices received by farmers.

Chickens

<i>Year</i>	Output Entering Gross Product (mill. lbs. live weight)	Price per Pound (¢)	Value in Current Dollars (\$ mill.)
1800	80	8.0	6.4
1810	108	6.7	7.2
1820	144	5.4	7.8
1830	194	6.7	13.0
1840	256	8.0	20.5
1850	348	9.4	32.7
1860	471	6.4	30.1
1870	661	9.7	64.1
1880	920	6.3	58.0
1890	1,270	7.3	92.7
1900	1,680	7.3	122.6

Eggs

For eggs, output entering gross product was estimated for 1870-1900 by raising the production series of Strauss and Bean by 8 per cent, the average difference between their estimates and the Agriculture estimates for 1910-14. For 1800-60, output estimates were derived as a product of total population for those decade years and estimated per capita consumption of six dozen eggs. A constant rate of consumption of six

INCOME ORIGINATING, BY SECTOR

dozen eggs was employed on the basis of the trend shown in per capita disappearance, 1870-1900. Average prices used for valuing output in current dollars for 1870-1900 are those of Strauss and Bean. For 1800-60, the 1870 estimated average price was extrapolated to 1851 by changes in Peterson's price series, and to 1800 by changes in Adams's estimated prices received by Vermont farmers.

<i>Eggs</i>			
<i>Year</i>	Output Entering Gross Product (mill. doz.)	Price per Pound (¢)	Value in Current Dollars (\$ mill.)
1800	32	9	2.9
1810	43	11	4.7
1820	58	10	5.8
1830	77	8	6.2
1840	103	9	9.3
1850	139	9	12.5
1860	188	11	20.7
1870	329	20	65.8
1880	588	12	70.6
1890	1,038	14	145.3
1900	1,615	13	210.0

Dairy Products

Output of dairy products entering gross product was estimated in terms of fluid milk equivalent. For 1870-1900 the estimates of Strauss and Bean were adopted. For 1850-60, estimates were derived on the basis of (1) census estimates of production of cheese and butter, and (2) the product of population and Strauss and Bean's estimated per capita disappearance of fluid milk for 1870-74. The census cheese and butter totals were converted to fluid milk equivalents by use of the equation: 10 pounds butter = 21 pounds cheese = 100 pounds fluid milk. For 1800-40, output was estimated as the product of population and a constant per capita disappearance of dairy products equal to the 1850 level. Average prices received for estimating value of output were derived by adjusting the Strauss and Bean estimates for 1870-1900 on the basis of the difference between their estimate and the Agriculture estimate for 1910. For 1800-60, average prices received were estimated by extrapolating the 1870 average price to 1851 by changes in Peterson's estimated prices and to 1800 by changes in Cole's wholesale butter price at New York.

FARM GROSS PRODUCT AND GROSS INVESTMENT

Dairy Products

<i>Year</i>	Output Entering Gross Product (bill. lbs. milk equiv.)	Price per Hundred- weight (\$)	Value in Current Dollars (\$ mill.)
1800	2.7	0.84	22.7
1810	3.7	0.73	27.0
1820	5.0	0.46	23.0
1830	6.7	0.68	45.6
1840	8.8	0.86	75.7
1850	12.0	0.74	88.8
1860	16.5	0.83	137.0
1870	18.2	1.54	280.3
1880	31.1	1.05	326.6
1890	43.2	0.88	380.2
1900	57.0	0.93	530.1

Wool

The wool output estimates of Strauss and Bean were adopted for 1870–1900. For 1840–60, census data on wool production were used. For 1810–30, the estimates adopted were those of the National Association of Wool Manufactures as quoted in Depew. For 1800, estimated output was derived as the product of total population for 1800 and averaged per capita production for 1810 and 1820. Average prices received used for valuing output were adopted from Strauss and Bean

Wool

<i>Year</i>	Output Entering Gross Product (mill. lbs.)	Price per Pound (<i>c</i>)	Value in Current Dollars (\$ mill.)
1800	10.6	16.3	1.7
1810	13.0	14.9	1.9
1820	14.1	19.3	2.7
1830	17.8	12.1	2.2
1840	35.8	15.5	5.6
1850	52.5	18.3	9.6
1860	60.3	18.4	11.1
1870	162.0	22.2	36.0
1880	232.0	23.1	53.6
1890	276.0	17.1	47.2
1900	288.0	13.7	39.5

INCOME ORIGINATING, BY SECTOR

for 1870–1900. For earlier years, the estimated average price for 1870 was extrapolated to 1851 by changes in Peterson's prices, and to 1820 by changes in Cole's price of common wool at New York, to 1803 by changes in Adams's Vermont prices of washed wool, and to 1800 by changes in the Warren and Pearson index of prices of farm products.

Miscellaneous Livestock Products

The value of livestock products not estimated separately was estimated globally as a percentage of a livestock group, or of all livestock, on the basis of the ratio of the value of such products to the total value of all livestock products in 1910. Thus, turkeys and other omitted poultry products were estimated as 15 per cent of the value of chickens, in both current and constant dollars. Apiarian products were estimated as 0.35 per cent of all other livestock products, in both current and constant dollars.

Constant dollar estimates for all livestock products, except other poultry and apiarian products were derived by multiplying the output entering gross product of each commodity by the Agriculture estimates of average prices received by farmers for the respective commodities in 1910–14. For dairy products, prices received were estimated by dividing the Agriculture estimated value of sales and home consumption of dairy products for 1910–14 by the Strauss and Bean output estimates for the respective years.

Miscellaneous Livestock Products

<i>Year</i>	Value in Current Dollars (\$ mill.)	Value in 1910–14 Dollars (\$ mill.)
1800	0.4	0.7
1810	0.6	0.9
1820	0.6	1.2
1830	0.9	1.6
1840	1.5	2.3
1850	1.4	2.9
1860	2.4	3.8
1870	4.9	5.0
1880	5.2	7.0
1890	5.3	9.1
1900	7.1	10.8

CROPS

The value of crops entering gross product is shown in current and 1910–14 dollars in Table 6.

FARM GROSS PRODUCT AND GROSS INVESTMENT

TABLE 6
Crops, Value of Output Entering Gross Product, Decade Years, 1800-1900
(millions of dollars)

Commodity	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900
Wheat	23.6	36.6	18.8	31.8	45.0	68.7	151.0	216.5	397.1	306.8	328.6
Rye	2.3	4.3	3.7	5.3	8.8	7.4	12.0	10.6	11.5	10.6	11.3
Rice	2.1	1.9	1.3	1.3	1.6	2.7	3.2	2.4	4.4	3.8	8.9
Buckwheat	0.9	1.2	1.0	1.4	2.0	2.9	6.3	5.6	4.8	4.1	4.1
Total, food grains	28.9	44.0	24.8	39.8	57.4	81.7	172.5	235.1	417.8	325.3	352.9
Corn	14.1	18.6	13.9	20.2	27.5	44.0	69.1	110.9	173.4	145.4	136.4
Oats	5.2	6.4	6.4	7.3	10.0	13.9	16.4	35.0	39.6	60.5	61.4
Hay	2.3	3.7	4.8	6.5	13.7	21.0	33.4	53.0	66.0	75.0	102.0
Barley	1.0	1.2	1.2	1.4	2.1	3.2	6.9	15.4	17.4	16.2	16.6
Total, feed crops	22.6	29.9	26.3	35.4	53.3	82.1	125.8	214.3	296.4	297.1	316.4
Sugarcane and cane products			5.1	8.5	7.6	21.8	38.6	19.3	28.2	25.0	25.4
Maple sugar and syrup	1.8	2.1	3.2	2.7	4.0	3.5	5.2	4.2	4.5	3.8	2.6
Sorgo syrup							5.5	12.5	15.9	9.0	5.3
Sugar beets										0.2	3.8
Total, sugar crops	1.8	2.1	8.3	11.2	11.6	25.3	49.3	36.0	48.6	38.0	37.1
Irish potatoes	6.6	8.9	10.3	12.6	15.7	20.2	34.1	61.7	60.6	86.9	94.9
Sweet potatoes	6.2	8.4	9.6	11.7	15.0	16.8	18.4	24.5	18.2	21.9	21.0
Truck crops	1.1	1.4	1.7	2.1	2.6	5.1	14.5	22.0	40.1	66.8	146.5
Peas and beans	1.2	1.5	1.7	2.3	4.9	4.9	6.6	4.7	3.5	4.6	10.4
Total, vegetables	15.1	20.2	23.3	28.7	38.2	47.0	73.6	112.9	122.4	180.2	272.8
Fruits	2.2	2.8	5.4	4.6	6.8	8.8	15.6	30.1	69.3	81.3	121.0

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INCOME ORIGINATING, BY SECTOR

TABLE 6 continued

Commodity	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900
						(current dollars)					
Peanuts								2.0	2.0	6.0	11.0
Hops	0.3	0.2	0.1	0.2	0.4	0.4	1.0	1.5	3.5	3.9	4.0
Tobacco	5.5	6.0	8.3	6.9	15.3	19.6	37.3	32.1	33.8	43.8	60.3
Cotton lint	11.1	12.5	23.7	33.7	62.1	118.3	217.3	343.0	354.3	396.1	437.2
Hemp	0.2	0.4	0.5	2.0	4.2	3.5	5.0	2.4	0.5	1.5	0.6
Flax for fiber	0.5	0.4	0.5	0.4	0.6	0.8	0.3	4.1	0.2	a	
Flaxseed	0.3	0.6	0.4	0.5	0.5	0.6	0.6	3.3	7.9	21.8	22.1
Cotton seed									3.2	12.7	31.3
Forest products	3.6	4.8	7.3	10.8	14.4	25.6	50.4	97.4	106.6	110.4	116.4
Nursery products					0.5	4.8	13.0	33.9	41.3	56.6	63.0
Miscellaneous	0.9	1.2	1.3	1.8	2.7	4.2	7.7	11.6	15.2	15.9	18.6
Total, all crops	93.0	125.1	130.2	176.0	268.0	422.7	769.4	1,159.7	1,523.0	1,590.6	1,864.7
						(1910-14 dollars)					
Wheat	19.5	26.4	35.2	45.9	63.9	75.7	130.4	196.6	372.1	346.5	459.5
Rye	2.8	3.9	5.2	6.9	10.0	7.6	11.3	8.6	10.4	14.5	14.6
Rice	1.4	1.7	1.2	1.5	1.5	2.7	2.5	1.9	3.3	3.9	9.9
Buckwheat	1.0	1.5	2.0	2.6	3.7	4.6	8.9	5.0	5.7	5.9	5.8
Total, food grains	24.7	33.5	43.6	56.9	79.1	90.6	153.1	212.1	391.5	370.8	489.8
Corn	16.6	22.0	28.1	37.4	49.6	71.3	97.5	99.9	239.5	209.6	246.0
Oats	4.1	5.7	7.5	10.1	13.8	16.4	19.3	30.3	45.1	71.0	94.2
Hay	4.2	6.9	9.1	14.8	24.4	32.9	45.4	55.4	77.7	123.4	126.4
Barley	0.7	0.9	1.2	1.6	2.2	2.7	7.3	12.5	16.5	22.2	31.1
Total, feed crops	25.6	35.5	45.9	63.9	90.0	123.3	169.5	198.1	378.8	426.2	497.7
Sugarcane and cane products			1.7	4.5	7.1	15.6	17.8	6.7	13.8	18.5	22.5

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FARM GROSS PRODUCT AND GROSS INVESTMENT

TABLE 6 concluded

Commodity	1880	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900
Maple sugar and syrup	1.5	2.1	2.7	3.8	5.0	4.5	5.8	3.7	5.4	4.9	2.9
Sorgo syrup							3.4	8.2	14.4	12.3	8.6
Sugar beets										0.1	3.4
Total, sugar crops	1.5	2.1	4.4	8.3	12.1	20.1	27.0	18.6	33.6	35.8	37.4
Irish potatoes	11.4	15.5	20.6	27.5	36.6	37.0	62.5	70.9	93.4	109.2	149.7
Sweet potatoes	10.4	14.2	18.9	25.2	33.9	30.0	33.0	22.2	30.0	35.2	35.0
Truck crops	1.9	2.5	3.4	4.6	6.1	9.5	26.9	25.6	62.7	85.6	236.3
Peas and beans	1.9	2.5	3.5	4.5	6.1	8.2	13.4	5.1	4.3	5.3	13.0
Total, vegetables	25.6	34.7	46.4	61.8	82.7	84.7	135.8	123.8	190.4	235.3	434.0
Fruits	8.4	11.4	15.2	20.3	35.9	29.0	43.9	55.3	182.5	101.9	329.4
Peanuts								0.9	1.7	4.5	15.1
Hops	0.1	0.1	0.3	0.4	0.3	0.7	2.3	5.3	5.6	7.3	10.4
Tobacco	11.6	11.2	13.1	15.4	22.1	20.2	43.9	31.2	47.5	59.8	87.0
Cotton lint	3.6	10.0	19.3	42.2	82.1	119.3	224.9	226.8	360.3	476.1	559.5
Hemp	0.2	0.4	0.7	3.4	6.5	4.9	6.5	2.1	0.7	2.1	0.8
Flax for fiber	0.2	0.1	0.2	0.2	0.4	0.7	0.2	2.3	0.1	a	
Flaxseed	0.5	0.5	0.6	0.7	0.8	0.9	0.9	3.3	11.4	27.4	25.4
Cottonseed									3.8	19.6	47.9
Forest products	10.6	14.4	19.2	25.8	34.2	46.6	63.0	79.8	100.6	126.2	152.2
Nursery products					0.8	6.8	16.9	30.3	51.6	79.7	88.7
Miscellaneous	1.1	1.5	2.1	3.0	4.5	5.5	8.9	9.9	17.7	19.8	28.0
Total, all crops	113.7	155.4	211.0	302.3	451.5	553.3	896.8	999.8	1,777.8	1,992.5	2,803.3

Where there is no figure shown, the amount was so small as to be nominally zero.
 a \$20,000.

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Food Grains

For wheat, rye, rice, and buckwheat, estimates of Strauss and Bean of the quantities, average prices received and values of output entering gross product were adopted for 1870-1900. For 1800-60, the estimates were derived employing the Strauss and Bean estimates of percentages of total production entering gross product.

WHEAT. Wheat output entering gross product was estimated as 85.5 per cent of total production for the entire period. Census production data were employed for 1840-60. Production for 1800-30 was estimated as the product of total population and estimated per capita domestic consumption in 1840 of 4.3 bushels, plus exports. Estimates of average prices received for valuing output in current dollars for 1800-60 were derived by extrapolating the 1870 average price to 1851 by changes in Peterson's farm price of wheat, to 1840 by changes in the Aldrich Report wholesale (January) price of No. 2 wheat at Chicago, and to 1800 by changes in Cole's wholesale prices of Pennsylvania wheat at Philadelphia.

<i>Wheat</i>			
<i>Year</i>	Output Entering Gross Product (mill. bu.)	Price per Bushel (\$)	Value in Current Dollars (\$ mill.)
1800	22.1	1.07	23.6
1810	30.0	1.22	36.6
1820	40.0	0.47	18.8
1830	52.1	0.61	31.8
1840	72.5	0.62	45.0
1850	85.9	0.80	68.7
1860	148.0	1.02	151.0
1870	223.2	0.97	216.5
1880	422.4	0.94	397.1
1890	393.3	0.78	306.8
1900	521.6	0.63	328.6

RYE. Rye output entering gross product was estimated as 74 per cent of production. For 1840-60, census production data were employed. Production for 1800-30 was estimated as the product of total population and per capita production of one bushel (1840 rate). Estimates of average prices received for valuing output in current dollars were derived by extrapolating the 1870 estimated price to 1851 by changes in Peterson's farm price of rye, to 1840 by changes in Aldrich's wholesale (October) price of rye at New York, to 1830 by changes in Peterson's

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Virginia²² farm prices and to 1800 by changes in Adams's Vermont farm prices.

<i>Rye</i>			
<i>Year</i>	Output Entering Gross Product (mill. bu.)	Price per Bushel (¢)	Value in Current Dollars (\$ mill.)
1800	3.9	58	2.3
1810	5.4	79	4.3
1820	7.1	52	3.7
1830	9.5	56	5.3
1840	13.8	64	8.8
1850	10.5	70	7.4
1860	15.6	77	12.0
1870	11.9	89	10.6
1880	14.4	80	11.5
1890	20.0	53	10.6
1900	20.1	56	11.3

RICE. In view of the small seed requirements for rice, all of rice production was taken as entering gross product, following the procedure of Strauss and Bean. For 1800-60, production was estimated by converting Holmes's crop year production estimates to a calendar year

<i>Rice</i>			
<i>Year</i>	Output Entering Gross Product (thous. cwt.)	Price per Hundred- weight (\$)	Value in Current Dollars (\$ mill.)
1800	756.4	2.78	2.1
1810	922.9	2.08	1.9
1820	629.3	2.08	1.3
1830	838.4	1.53	1.3
1840	828.9	1.93	1.6
1850	1,477.9	1.82	2.7
1860	1,380.3	2.32	3.2
1870	1,012.5	2.36	2.4
1880	1,800.0	2.42	4.4
1890	2,115.0	1.82	3.8
1900	5,400.0	1.64	8.9

²² Arthur G. Peterson, *Historical Study of Prices Received by Producers of Farm Products in Virginia, 1801-1927*, Virginia Agricultural Experiment Station, Tech. Bull. 37, March 1929.

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basis, employing the conversion factors (60 per cent of current crop year and 40 per cent of preceding crop year) of Strauss and Bean.²³ Estimates of average prices used for valuing output in current dollars were developed by extrapolating Holmes's 1839 average farm price backward to 1800 and forward to 1860 by changes in Cole's wholesale prices of rice at New York.

BUCKWHEAT. Output of buckwheat entering gross product was estimated as 69 per cent of total production for all years. Census production data were used for 1840-60. For 1800-30, total production was estimated as the product of total population and per capita disappearance of 0.4 bushel (1840 rate). Estimates of average prices received used for valuing output in current dollars were derived by extrapolating the 1870 price to 1800 by changes in the corn price series, which was more closely correlated with changes in buckwheat prices during 1870-1900 than with series for other small grains.

<i>Buckwheat</i>			
<i>Year</i>	Output Entering Gross Product (mill. bu.)	Price per Bushel (¢)	Value in Current Dollars (\$ mill.)
1800	1.4	62	0.9
1810	2.0	62	1.2
1820	2.7	36	1.0
1830	3.5	40	1.4
1840	5.0	41	2.0
1850	6.2	46	2.9
1860	12.1	52	6.3
1870	6.8	82	5.6
1880	7.8	62	4.8
1890	8.1	51	4.1
1900	7.9	52	4.1

Feed Crops

Estimating the quantities of corn and oats entering gross product was complicated by the fact that significant amounts are purchased by farmers for feeding livestock. Estimates of proportion of feed crops available for repurchase by farmers from 1910 forward exhibited an upward trend during the years covered. On this basis, it was assumed that the proportion of interfarm sales had been moving upward since 1860 with only a small amount of such sales occurring before then.

²³ George K. Holmes, *Rice Crop of the United States, 1712-1911*, Dept. of Agriculture, Bureau of Statistics, Circ. 34, 1912.

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The estimated percentages of farm to total sales, therefore, were interpolated between the 1910-14 average and a nominal estimate of 5 per cent for 1870 and earlier decade years. The percentage of production of corn and oats entering gross product, as estimated by Strauss and Bean, was adjusted to an estimated proportion bought by farmers. For barley, the proportion of sales repurchased by farmers in 1910-14 was insignificant, and no adjustment for sales to farmers was considered necessary.

CORN. Corn output entering gross product was estimated at 15.5 per cent of production for domestic use in 1900. This percentage was increased by 5 per cent per decade back to 1860 and was leveled off at 17.5 per cent for earlier years. Total production estimates to which these were applied were from Strauss and Bean for 1870-1900, and from census production data for 1850-60. For 1800-40, total output for domestic human consumption was estimated at 4.4 bushels per capita based on estimates by Seaman. Total production was obtained by adding estimated exports. Average prices received used for valuing output were obtained from Strauss and Bean for 1870-1900. For 1800-60, they were estimated by extrapolating the 1870 price backward to 1860 by changes in Peterson's farm price, and to 1800 by changes in Cole's wholesale prices of northern corn at New York.

<i>Corn</i>			
<i>Year</i>	Output Entering Gross Product (mill. bu.)	Price per Bushel (¢)	Value in Current Dollars (\$ mill.)
1800	25.6	55	14.1
1810	33.9	55	18.6
1820	43.3	32	13.9
1830	57.7	35	20.2
1840	76.5	36	27.5
1850	109.9	40	44.0
1860	150.3	46	69.1
1870	154.0	72	110.9
1880	369.0	47	173.4
1890	323.0	45	145.4
1900	379.0	36	136.4

OATS. Oats output entering gross product was estimated at 25 per cent of production for 1900, 26 per cent for 1890, 27 per cent for 1880, and 28 per cent for 1800-70. The total production estimates to which these were applied are from Strauss and Bean for 1870-1900, and the

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censuses for 1840-60. For 1800-30, total production was estimated as the product of total population and the 1840 per capita production of seven bushels. For valuing output, the Strauss and Bean estimates of average prices were adopted for 1870-1900. For 1800-60, the estimated 1870 price was extrapolated to 1851 by changes in Peterson's U.S. farm price, to 1820 by changes in Peterson's Virginia farm price, and to 1800 by changes in the farm products price index of Warren and Pearson.

<i>Oats</i>			
<i>Year</i>	Output Entering Gross Product (mill. bu.)	Price per Bushel (¢)	Value in Current Dollars (\$ mill.)
1800	10	50	5.2
1810	14	45	6.4
1820	19	34	6.4
1830	25	29	7.3
1840	34	29	10.0
1850	41	34	13.9
1860	48	34	16.4
1870	76	46	35.0
1880	113	35	39.6
1890	178	34	60.5
1900	236	26	61.4

HAY. Estimates of hay entering gross product were adopted from Strauss and Bean for 1870-1900. For 1840-60, 20 per cent of the census production total was estimated as entering gross product. For 1800-30, the quantity of hay sold for nonfarm use was estimated directly as a product of the urban population and the estimated per capita nonfarm disappearance of hay in 1840. Average prices received by farmers are from Strauss and Bean for 1870-1900. For 1800-60, the estimated 1870 price was extrapolated back to 1851 by changes in Peterson's farm prices, and to 1800 by changes in Adams's Vermont prices.

BARLEY. Barley output entering gross product was estimated at 50 per cent of total production for 1890-1900. For 1840-80, the percentage estimates of Gallman were adopted—60 per cent for 1880, 70 per cent for 1860, and 85 per cent for 1850 and 1840. For 1800-30, the estimated rate of 85 per cent was maintained. For 1870-1900, the percentages were applied to total production estimates of Strauss and Bean, and for 1840-60, to census totals. For 1800-30, production was estimated by assuming the 1840 per capita rate of 0.24 bushels and multiplying by population estimates for those years. Prices for valuing output were adopted from Strauss and Bean for 1870-1900. For 1800-60, the 1870

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Hay

<i>Year</i>	Output Entering Gross Product (thous. tons)	Price per Ton (\$)	Value in Current Dollars (\$ mill.)
1800	354	6.51	2.3
1810	578	6.39	3.7
1820	762	6.33	4.8
1830	1,240	5.21	6.5
1840	2,050	6.69	13.7
1850	2,768	7.58	21.0
1860	3,817	8.76	33.4
1870	4,657	11.38	53.0
1880	6,528	10.11	66.0
1890	10,373	7.23	75.0
1900	10,625	9.60	102.0

estimated price was extrapolated back to 1851 by changes in Peterson's farm prices, to 1840 by changes in the Aldrich Report wholesale price of barley at New York, and to 1800 by changes in the price index of farm products of Warren and Pearson.

Barley

<i>Year</i>	Output Entering Gross Product (mill. bu.)	Price per Bushel (¢)	Value in Current Dollars (\$ mill.)
1800	1.1	88	1.0
1810	1.5	80	1.2
1820	2.0	61	1.2
1830	2.6	52	1.4
1840	3.5	58	2.0
1850	4.4	72	3.2
1860	11.9	58	6.9
1870	20.3	76	15.4
1880	26.8	65	17.4
1890	36.0	45	16.2
1900	50.4	33	16.6

Sugar Crops

SUGARCANE AND CANE PRODUCTS. Output of sugarcane and its products entering gross product was based principally on the historical cane sugar production estimates of the U.S. Beet Sugar Association for

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1820-1900.²⁴ These were converted to sugarcane equivalents by dividing by the average ratio of raw sugar production to sugarcane production for 1910-14. To these were added the estimated sugarcane equivalent of syrup production. Estimates of syrup production were based on census data for 1840, 1860, and 1880 and were derived for other decade years by employing the ratio of syrup production to sugar production for known years. Syrup estimates for 1820-30 were based on the syrup-sugar ratio shown by census data for 1840; for 1870, on the average ratio shown by the 1860 and 1880 censuses; and for 1890-1900, on

Year	<i>Cane Sugar</i>			<i>Cane Syrup</i>		
	Output Entering Gross Product (tons)	Price per Ton (\$)	Value in Current Dollars (\$ mill.)	Output Entering Gross Product (thous. gals.)	Price per Gallon (\$)	Value in Current Dollars (\$ mill.)
1820	15,000	222.50	3.3	1,500	1.00	1.5
1830	38,440	140.00	5.4	3,844	0.63	2.4
1840	57,743	80.00	4.6	5,775	0.36	2.1
1850	125,201	105.00	13.1	12,520	0.47	5.9
1860	135,346	162.50	22.0	17,460	0.73	12.8

Year	<i>Molasses</i>			<i>Sugarcane</i>		
	Output Entering Gross Product (thous. gals.)	Price per Gallon (c)	Value in Current Dollars (\$ mill.)	Output Entering Gross Product (thous. tons)	Price per Ton (\$)	Value in Current Dollars (\$ mill.)
1820	1,538	19.3	0.3			
1830	3,943	17.9	0.7			
1840	5,922	14.8	0.9			
1850	12,841	22.1	2.8			
1860	13,882	27.3	3.8			
1870				1,758	10.99	19.3
1880				3,594	7.85	28.2
1890				4,800	5.21	25.0
1900				5,818	4.37	25.4

²⁴ Concerning Sugar, U.S. Beet Sugar Association, Looseley Service Sheet E-54, June 1928.

readings from a scatter chart based upon census and other known data showing the relationship between sugar and syrup production for several pre-World War I years. Syrup production estimates were converted to sugar equivalents on the basis of nine pounds of sugar to one gallon of syrup and were then converted to sugarcane equivalents by dividing by the average ratio of raw sugar to sugarcane production for 1910-14 (0.071).

The estimation of output entering gross product was placed on a different basis from 1870-1900 from that of 1800-60, since in the earlier period, according to Gray, the production of sugar, syrup, and molasses was a plantation activity and did not become an important nonfarm activity until after the Civil War. In view of this, sugar and syrup were treated as farm products for 1800-60, and for 1870-1900 only sugarcane was so treated. In addition, for 1800-60, by-product molasses was included in farm output, production being estimated on the basis of sixty pounds of molasses to one hundred pounds of sugar production. For valuing the plantation output of cane products for 1820-60, Gray's New Orleans price series for sugar was employed for cane sugar, as well as for syrup (on an equivalent basis). For valuing molasses, Cole's "on plantation" prices were used for 1820-40 and his New Orleans "on levee" prices for 1850-60.

Average prices of sugarcane for 1870-1900 were estimated by extrapolating the Agriculture estimate of the average price received by farmers in 1909 by changes in calendar year average wholesale prices of raw sugar at New York.

MAPLE SUGAR AND SYRUP. Census production estimates for maple sugar were adopted for 1850-1900. For 1840 output was estimated by deducting estimated cane sugar production from total sugar production reported in the census. For 1860-1900, maple syrup production estimates were taken from the censuses; for 1840-50, syrup production was estimated from sugar production, using the average of the ratios of syrup to sugar shown by the census data for 1860-80. For 1800-30, production of both sugar and syrup was estimated as the product of estimated total population and per capita production indicated by the 1840 estimate.

For valuing output, the average prices of sugar and syrup in the 1900 census data were adopted for 1900, and these were extrapolated to 1800 by changes in Adams's estimated prices received by Vermont farmers for maple sugar.

SORGO SYRUP. For 1860-1900, census production estimates of sorgo syrup were adopted. For 1850 and earlier years, sorgo production was carried nominally at zero, on the assumption that it was insignificant.

Average prices were estimated on the basis of the totals of quantity and value shown in the 1900 census. This was adopted for 1900, and a

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price series was derived by extrapolating it to 1860 by changes in the price series developed for sugar cane.

SUGAR BEETS. The value of sugar beet production entering gross product was adopted from Strauss and Bean. Estimated at \$3.8 million in 1900 and \$0.2 million in 1890, it was carried nominally at zero for the earlier years.

Maple Sugar and Syrup

Year	Output Entering Gross Product		Price per		Value in Current Dollars		
	Sugar (Mill. lbs.)	Syrup (Mill. gals.)	Pound Sugar (¢)	per Gallon Syrup (\$)	Sugar	Syrup (\$ mill.)	Total
1800	10.7	0.4	11.7	1.27	1.3	0.5	1.8
1810	14.5	0.6	9.9	1.07	1.4	0.6	2.1
1820	19.3	0.8	11.7	1.27	2.3	1.0	3.2
1830	25.9	1.0	7.2	0.78	1.9	0.8	2.7
1840	34.5	1.4	8.1	0.88	2.8	1.2	4.0
1850	34.3	1.4	7.2	0.78	2.5	1.1	3.5
1860	40.1	1.6	9.0	0.98	3.6	1.6	5.2
1870	28.4	0.9	10.8	1.17	3.1	1.1	4.2
1880	36.6	1.8	8.1	0.88	3.0	1.6	4.5
1890	32.9	2.3	7.2	0.65	2.4	1.5	3.8
1900	11.9	2.1	9.0	0.76	1.1	1.5	2.6

Sorgo Syrup

Year	Output Entering Gross Product (thous. gals.)	Price per Gallon (¢)	Value in Current Dollars (\$ mill.)
1860	6,749	82	5.5
1870	16,050	78	12.5
1880	28,444	56	15.9
1890	24,235	37	9.0
1900	16,973	31	5.3

Vegetables

POTATOES. Output of Irish potatoes and sweet potatoes entering gross product was estimated at 83 and 91 per cent of production, respectively. Production and price estimates for both types were adopted from Strauss and Bean for 1870-1900. For 1850-60, census

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production estimates were adopted. For 1840, the census estimate combined both Irish potatoes and sweet potatoes. This was divided by 60 per cent Irish potatoes and 40 per cent sweet potatoes, on the basis of the distributions shown by the censuses of 1870, 1860, and 1850. For 1800–30, production of each type was estimated as the product of total population and the 1840 per capita disappearance rates of 3.8 bushels of Irish potatoes and 2.5 bushels of sweet potatoes.

For 1800–60, average prices received for Irish potatoes were derived by extrapolating the 1870 average price to 1851 by changes in Peterson's potato price, and to 1800 by changes in Adams's Vermont price of potatoes. Average prices received for sweet potatoes for 1800–60 were estimated by extrapolating the average price for 1870 backward to 1800 by changes in the Irish potato price series.

Year	<i>Irish Potatoes</i>			<i>Sweet Potatoes</i>		
	Output Entering Gross Product (mill. bu.)	Price per Bushel (¢)	Value in Current Dollars (\$ mill.)	Output Entering Gross Product (mill. bu.)	Price per Bushel (¢)	Value in Current Dollars (\$ mill.)
1800	16.8	39	6.6	12.1	51	6.2
1810	22.8	39	8.9	16.5	51	8.4
1820	30.4	34	10.3	21.9	44	9.6
1830	40.6	31	12.6	29.3	40	11.7
1840	54.0	29	15.7	39.4	38	15.0
1850	54.6	37	20.2	34.9	48	16.8
1860	92.2	37	34.1	38.3	48	18.4
1870	104.6	59	61.7	25.8	95	24.5
1880	137.8	44	60.6	34.9	52	18.2
1890	161.0	54	86.9	40.9	54	21.9
1900	220.8	43	94.9	40.7	52	21.0

TRUCK CROPS. Production of truck crops was reported in each census from 1850 to 1890. Although the census schedules of 1840–70 indicated that both sales and home consumption were to be reported under market produce, the schedules for 1880–90 called for the value of sales only. Therefore, the total values of market produce reported in 1880 and 1890 for the census years were adjusted upward by the ratio of the total population to the nonfarm population, assuming that consumption per capita of the farm population was as high as that for the nonfarm population. Estimates of market produce on a comparable census year basis for 1800–30 were derived as a product of total population and the 1840 per capita production in 1840 dollars. These were

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converted to current dollars by multiplying by price relatives for potatoes. For 1900, census year totals were given for the value of both market produce and the produce of the farm gardens, both of which have been included in the gross product estimate. Estimates for all years were converted to a calendar year basis by means of the relationship between the average of potato prices in the two calendar years covered by each census year and the calendar year for which the estimate was to be derived. Estimates in 1910-14 dollars were derived by dividing the current dollar estimates by a price index for Irish potatoes.

Truck Crops

<i>Year</i>	Value in Current Dollars (\$ mill.)	Value in 1910-1914 Dollars (\$ mill.)
1800	1.1	1.9
1810	1.4	2.5
1820	1.7	3.4
1830	2.1	4.6
1840	2.6	6.1
1850	5.1	9.5
1860	14.5	26.9
1870	22.0	25.6
1880	40.1	62.7
1890	66.8	85.6
1900	146.5	236.3

PEAS AND BEANS. Output of dried field peas and dried beans entering gross product was estimated at 60 per cent of production. Census estimates of production were adopted for 1850-1900. For 1800-40, the combined production of peas and beans was estimated by carrying per capita production at the 1850 rate of 0.4 bushel and multiplying by the estimated total population.

Average prices received for peas were estimated by extrapolating the census average value for 1900 to 1850 by changes in Mortenson's prices of Wisconsin dried peas, to 1824 by changes in Peterson's prices of Virginia black-eyed peas and to 1800 by changes in Warren and Pearson's farm product price index.²⁵ Average prices received for dried beans were adopted from Peterson's prices for 1851-1900. For earlier years, the price for 1851 was extrapolated to 1825 by changes in Warren and Pearson's farm product price index, and to 1800 by changes in Hansen's

²⁵ W. P. Mortenson *et al.*, *Wisconsin Farm Prices—1841 to 1933*, University of Wisconsin Agricultural Experiment Station, Res. Bull. 119, 1933.

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estimates of prices of white beans at Boston. Average prices of beans and peas were weighted into a composite, using the census production estimates of 1890 and 1900 for those years and the census production estimates of 1880 for 1800-80.

Peas and Beans

<i>Year</i>	Output Entering Gross Product (mill. bu.)	Price per Bushel (\$)	Value in Current Dollars (\$ mill.)
1800	1.27	0.95	1.2
1810	1.71	0.86	1.5
1820	2.32	0.72	1.7
1830	3.04	0.77	2.3
1840	4.09	1.19	4.9
1850	5.53	0.88	4.9
1860	9.00	0.73	6.6
1870	3.45	1.37	4.7
1880	2.91	1.20	3.5
1890	3.59	1.28	4.6
1900	8.70	1.19	10.4

Other Crops

FRUITS. Output of fruits entering gross product was estimated for the entire period 1800-1900 as 100 per cent of production. The sum of Strauss and Bean estimated values for orchard fruits, grapes, and citrus

Fruits

<i>Year</i>	Output Entering Gross Product (mill. bu.)	Price per Bushel (<i>e</i>)	Value in Current Dollars (\$ mill.)
1800	10.6	21	2.2
1810	14.5	19	2.8
1820	19.3	28	5.4
1830	25.7	18	4.6
1840	45.4	15	6.8
1850	36.8	24	8.8
1860	55.5	28	15.6
1870	70.0	43	30.1
1880	231.0	30	69.3
1890	129.0	63	81.3
1900	417.0	29	121.0

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fruits was adopted for 1870–1900. For 1840–60, census estimates of the value of orchard fruits produced were adjusted to a calendar year basis by use of Adams's Vermont annual apple prices.

Current dollar estimates for 1800–30 were derived as the product of estimated production and average prices. The composite average price of orchard fruits was estimated by extrapolating the Strauss and Bean estimate of average price of orchard fruits for 1870 backward to 1801 by the Adams's Vermont estimates of apple prices. Production for 1800–30 was estimated as the product of total population and a per capita output of two bushels of orchard fruits, the latter being based on census values for 1840–60.

PEANUTS. Estimates of peanut output, prices, and values were taken from Strauss and Bean for 1870–1900. For 1860 and earlier periods, the estimates are carried nominally at zero.

<i>Peanuts</i>			
<i>Year</i>	Output Entering Gross Product (mill. lbs.)	Price per Pound (¢)	Value in Current Dollars (\$ mill.)
1870	16.0	11.0	2
1880	38.7	5.6	2
1890	94.0	6.4	6
1900	300.0	3.5	11

HOPS. Holmes's estimated output of hops entering gross product was adopted for 1890–1900, and from the censuses of agriculture for 1840–1880.²⁶ For 1800–1830, output was extrapolated by changes in hops output in Massachusetts and New York, employing data from Bidwell and Falconer. Average prices were estimated by taking as a bench mark the implicit average price for 1900 shown by census estimates and extrapolating it back to 1870 by changes in calendar year export prices derived from Holmes's fiscal year export prices. For 1840–60, price estimates were obtained by adopting Seaman's estimated average price for 1850 and extrapolating it forward to 1860 and back to 1840 by changes in Cole's New York prices of first sort hops. For 1800–30, estimates were obtained by extrapolating the 1840 estimated price back to 1801 by changes in Hansen's price series for hops. The average price for 1800 was assumed to be the same as for 1801.

TOBACCO. Output of tobacco was estimated at 100 per cent of production. For 1870–1900, the Strauss and Bean estimates of production, price and value were adopted. Census production totals were used

²⁶ George K. Holmes, *Hop Crop of the United States, 1790–1911*, Dept. of Agriculture, Bureau of Statistics, Circ. 35, 1912.

FARM GROSS PRODUCT AND GROSS INVESTMENT

Hops

<i>Year</i>	Output Entering Gross Product (thous. lbs.)	Price per Pound (<i>e</i>)	Value in Current Dollars (\$ mill.)
1800	582	59.0	0.3
1810	629	27.0	0.2
1820	1,646	6.5	0.1
1830	1,839	10.5	0.2
1840	1,239	30.0	0.4
1850	3,497	10.0	0.4
1860	10,992	9.0	1.0
1870	25,457	5.7	1.5
1880	26,546	13.2	3.5
1890	34,560	11.2	3.9
1900	49,609	8.1	4.0

for 1840-60. For 1800-30, production estimates were based on fiscal year exports reported in Gray which were converted to a calendar year farm equivalent and added to estimated domestic consumption. Domestic consumption for 1800-30 was estimated at 4.75 pounds per capita based on the 1840 census estimate of production less exports.

Average prices received for 1800-60 were derived by extrapolating the 1870 average price to 1860 by changes in export prices as estimated by Peterson, to 1830 by changes in the average of Peterson's Virginia

Tobacco

<i>Year</i>	Output Entering Gross Product (mill. lbs.)	Price per Pound (<i>e</i>)	Value in Current Dollars (\$ mill.)
1800	114.8	4.8	5.5
1810	110.5	5.4	6.0
1820	130.0	6.4	8.3
1830	152.3	4.5	6.9
1840	219.2	7.0	15.3
1850	199.8	9.8	19.6
1860	434.2	8.6	37.3
1870	309.0	10.4	32.1
1880	470.0	7.2	33.8
1890	592.0	7.4	43.8
1900	861.0	7.0	60.3

INCOME ORIGINATING, BY SECTOR

prices and Gray's New Orleans prices, and to 1800 by changes in the average of Cole's prices of Virginia tobacco and Gray's New Orleans prices.

COTTON LINT. All of cotton lint production was treated as entering gross product. Estimates of production and prices for 1800-1900 were derived from Department of Agriculture crop year data.²⁷ Factors for converting crop year outputs and prices to a calendar year basis were derived from data on the monthly distribution of marketings of cotton by states for 1910-14. For application to 1800-40, the state average monthly marketings data were weighted by 1840 census data on cotton production by states.

Cotton Lint

<i>Year</i>	Output Entering Gross Product (mill. lbs.)	Price per Pound (¢)	Value in Current Dollars (\$ mill.)
1800	30.1	37.0	11.1
1810	84.1	14.9	12.5
1820	162.0	14.6	23.7
1830	354.7	9.5	33.7
1840	689.8	9.0	62.1
1850	1,002.4	11.8	118.3
1860	1,889.5	11.5	217.3
1870	1,905.8	18.0	343.0
1880	3,028.1	11.7	354.3
1890	4,000.9	9.9	396.1
1900	4,701.6	9.3	437.2

HEMP. Total production of hemp was treated as entering gross product. Estimates for 1860-1900 production were adopted from the censuses. For 1800-50, output estimates were derived by extrapolating the 1860 census estimate backward to 1800 by changes in the output of cotton, since one of the most important uses of domestic hemp was for baling cotton. For valuing output, the census average value per pound was adopted for 1900. For 1840-90, Seaman's estimated average price was extrapolated forward to 1890 and backward to 1840 by changes in the Aldrich Report price of rough hemp at Cincinnati. Louisville prices quoted by Gray for nearby years (1823-28) were taken as representing average prices for 1820 and 1830, respectively. Hansen's Boston prices of hemp were used to extrapolate back to 1801 and Warren and Pearson's farm product price index, to 1800.

²⁷ *Statistics on Cotton and Related Data*, Dept. of Agriculture, Bureau of Agricultural Economics, Stat. Bull. 99, 1951.

FARM GROSS PRODUCT AND GROSS INVESTMENT

Hemp

<i>Year</i>	Output Entering Gross Product (thous. tons)	Price per Ton (\$)	Value in Current Dollars (\$ mill.)
1800	1.5	117	0.2
1810	3.0	131	0.4
1820	6.7	67	0.5
1830	14.1	140	2.0
1840	27.5	151	4.2
1850	39.4	90	3.5
1860	74.4	67	5.0
1870	12.4	194	2.4
1880	5.4	95	0.5
1890	12.8	119	1.5
1900	5.9	93	0.6

FLAX FOR FIBER. Output of flax for fiber entering gross product was adopted from the censuses for 1850-80. For 1800-40, output was estimated as the product of total population and estimated output per capita (at the 1850 rate). For 1890 and 1900, production was carried nominally at zero.

An average price series was derived by extrapolating Seaman's estimated price for 1850 forward to 1870 and backward to 1840 by changes in the Aldrich Report prices of American flax at New York. The estimated price so derived for 1840 was extrapolated backward to 1800 and the 1870 estimated price forward to 1880 by changes in the price series for cotton.

Flax for Fiber

<i>Year</i>	Output Entering Gross Product (mill. lbs.)	Price per Pound (<i>e</i>)	Value in Current Dollars (\$ mill.)
1800	2.3	22.6	0.5
1810	4.2	9.1	0.4
1820	5.6	8.9	0.5
1830	7.5	5.8	0.4
1840	9.9	5.5	0.6
1850	13.4	6.0	0.8
1860	4.7	5.7	0.3
1870	27.1	15.0	4.1
1880	1.6	9.8	0.2

INCOME ORIGINATING, BY SECTOR

FLAXSEED. Flaxseed entering gross product was estimated as 91 per cent of production. For 1870–1900, production estimates were adopted from Strauss and Bean; for 1850–60, they were taken from the censuses. For 1800–40, production estimates were interpolated between the 1850 census total and an estimate for 1800 based on Pitkin's estimate of exports.²⁸

Average price received estimates are Strauss and Bean's for 1870–1900. The estimated average price for 1870 was extrapolated to 1840 by changes shown by the Aldrich Report New York flaxseed prices, to 1825 by changes in Cole's linseed oil prices at Philadelphia, and to 1802 by changes in Hansen's Boston prices of flaxseed. The 1802 price was used for 1800.

<i>Flaxseed</i>			
<i>Year</i>	Output Entering Gross Product (thous. bu.)	Price per Bushel (\$)	Value in Current Dollars (\$ mill.)
1800	300	1.16	0.3
1810	340	1.72	0.6
1820	380	1.17	0.4
1830	420	1.11	0.5
1840	480	1.05	0.5
1850	511	1.15	0.6
1860	516	1.15	0.6
1870	1,990	1.67	3.3
1880	6,770	1.17	7.9
1890	16,280	1.34	21.8
1900	15,120	1.46	22.1

COTTONSEED. For cottonseed, Strauss and Bean estimates of output entering gross product, price, and value were adopted for 1880–1900. For earlier years, output was carried nominally at zero.

<i>Cottonseed</i>			
<i>Year</i>	Output Entering Gross Product (thous. tons)	Price per Ton (\$)	Value in Current Dollars (\$ mill.)
1880	193	16.6	3.2
1890	993	12.8	12.7
1900	2,430	12.9	31.3

²⁸ Timothy Pitkin, *A Statistical View of the Commerce of the United States*, Durrie Peck, 1835.

FARM GROSS PRODUCT AND GROSS INVESTMENT

FOREST PRODUCTS. Estimates of the output of forest products were based on data from the 1880 census on the amount of cordwood cut and the value of forest products sold or consumed in 1879.

Production and consumption of wood were taken at one cord per capita. This per capita rate was carried for the entire period.

The average composite price series was based on the census estimates for 1879. This bench-mark level was extrapolated forward to 1900 and backward to 1800 by changes in Adams's estimated price received by Vermont farmers for cordwood. Current dollar estimates of the value of forest products sold or consumed were derived as the product of estimated average value of forest products per cord of wood produced and the estimated production of cordwood.

Forest Products

<i>Year</i>	Output Entering Gross Product (mill. cords)	Price per Cord (\$)	Value in Current Dollars (\$ mill.)
1800	5.3	0.67	3.6
1810	7.2	0.67	4.8
1820	9.6	0.76	7.3
1830	12.9	0.84	10.8
1840	17.1	0.84	14.4
1850	23.3	1.10	25.6
1860	31.5	1.60	50.4
1870	39.9	2.44	97.4
1880	50.3	2.12	106.6
1890	63.1	1.75	110.4
1900	76.1	1.53	116.4

NURSERY PRODUCTS. The current dollar estimates of values of output of nursery products for 1840, 1890, and 1900 were adopted from the census and adjusted to a calendar year basis by use of the Warren and Pearson monthly price index of farm products. Constant dollar estimates for these years were derived by deflating with the annual price indexes of farm products. For 1850-80, constant dollar estimates were obtained by interpolating on a straight line basis between per capita estimates for 1840 and 1890 and multiplying by total population. These were then converted to current dollar totals by inflating by the farm products price index. For 1800-30, output was carried nominally at zero.

MISCELLANEOUS. In addition to the major crops discussed above, an allowance was made for the aggregate of crops of minor importance,

INCOME ORIGINATING, BY SECTOR

Nursery Products

<i>Year</i>	Value in Current Dollars (\$ mill.)	Value in 1910-14 Dollars (\$ mill.)
1840	0.5	0.8
1850	4.8	6.8
1860	13.0	16.9
1870	33.9	30.3
1880	41.3	51.6
1890	56.6	79.7
1900	63.0	88.7

comprising tree nuts, broomcorn, popcorn, peppermint, and legume seed. These were included globally in both current and constant dollars, by multiplying the 1910 ratio of their value to the value of all other crops by the sum of the items estimated separately for each of the decade years.

Miscellaneous Minor Crops

<i>Year</i>	Value in Current Dollars (\$ mill.)	Value in 1910-14 Dollars (\$ mill.)
1800	0.9	1.1
1810	1.2	1.5
1820	1.3	2.1
1830	1.8	3.0
1840	2.7	4.5
1850	4.2	5.5
1860	7.7	8.9
1870	11.6	9.9
1880	15.2	17.7
1890	15.9	19.8
1900	18.6	28.0

C O M M E N T

CLARENCE H. DANHOF, Tulane University

Towne and Rasmussen have built up estimates of the gross value of the products of farms, estimated gross farm investment, and, for good measure, filled an awkward gap by contributing estimates of the number of farms for the years 1800-40. In placing available production and price data within a consistent framework and in supplying estimates where no true data exist, the paper makes a major contribution.

For the period 1870-1900, the estimates involve minor recastings of data drawn from the federal censuses, modified by various Department of Agriculture estimates, and particularly by the well-known work of Strauss and Bean. For the earlier years estimation was much more difficult. Data on production are drawn chiefly from the federal censuses, though supplemented by other estimates. In the absence of census data for the years before 1840, and for a number of commodities omitted in later censuses, the estimates have been derived on the assumption that disappearances per capita remained constant at rates computed from the available figures—generally for 1840 though in some cases as late as 1870.

Pricing national aggregates of farm products poses many serious problems. The authors have used the most reliable price information available but such prices are usually far removed from on-the-farm values. Their efforts emphasize the need for far more information on prices than is now available.

In cases where census data are not available, the estimates for quantity of product by commodity rest upon the assumption of constant per capita disappearance at the rate shown by the earliest available data. Since exports were in most cases not significant, that assumption rests upon the further assumption that there were no significant changes in productivity over the first four—in some cases five or more—decades of the century. With this I disagree.

There is some evidence of declining productivity, at least in northern agriculture, in the first two decades of the century, followed by significant increases. Of course, technology emerged at a rate substantially more rapid than the rate of its application, and the marked increase in productivity after 1860 represented, in part, a closing of this gap. There were, nevertheless, important changes earlier. The assumption of unchanging productivity suggests that the settlement of the fertile lands of the West had no effect on productivity; there is abundant evidence that it did.

Though the harvester, hay rake, and drill were not in significant use until after 1850, the iron plow reduced the labor required in plowing by about half with a consequent tendency toward increased acreage tilled per man. Similar changes occurred in the methods employed in cultivating cotton and corn while the displacement of the scythe by the cradle in harvesting small grain was similarly important. The widespread adoption of domesticated grasses—timothy and clover—and of more productive varieties of corn, wheat, and cotton, and improved strains of hogs and sheep, all increased productivity.

Contemporary estimates both of volume of production and of consumption also call for consideration. The census returns, too, are not free of doubt. Some contemporary estimates are clearly guesswork,

frequently with a strong chauvinistic coloration. Others, however, give evidence of careful analysis of familiar situations. Some antedate census data, others suggest corrections in census returns. In either case, they merit comparison with projections from later federal census returns.

By way of illustration, take the estimate for the gross value of chickens. The data given by Towne and Rasmussen are based on the rate of per capita disappearance indicated for 1870–1900, projected to 1800. For 1860, the value in current dollars obtained in this manner is \$30 million. That figure compares with an 1860 estimate of \$20 million as the market value of poultry in that year. Other contemporary estimates place the value of poultry consumed in 1855 at \$20 million, at \$11.7 million in 1848 and \$12 million in 1844.¹ These figures differ markedly from the \$32.7 million estimated in this paper as entering gross output in 1850. Since it is an established fact that a considerable boom in poultry production and marketings occurred in the late forties and early fifties, my inclination is to give the contemporary figures considerable weight. The estimates for 1850 and earlier years appear to be much too high. Similar comments can be made for many other products.

I have some doubts on a few other matters. In the case of the data on the farm value of livestock, I am skeptical of estimates for 1800–60 derived by extrapolation from 1870. Such extrapolation seems hazardous in the face of the fact that the coming of railroad transportation had a substantial effect on farm values of livestock. Moreover, there exists an abundance of value data for the earlier years. In the case of the estimates of farm investment, a fuller consideration of available data on land clearing costs might produce significant differences in the decennial figures. The estimates of farmer outlays for farm implements and machinery seem to be low. There appears to be no allowance in this category for such items as farm vehicles and small tools.

To summarize, it is my opinion that the estimates for gross farm product for 1820 and earlier may be somewhat exaggerated while those for 1830–50, and probably for 1860, are understated. For the 1840–60 period, this judgment is consistent with the common contemporary opinion that the returns of these censuses were significantly incomplete. This can be confirmed in a general way by a comparative analysis of the detailed census returns.

In probing into pre-statistical history, the statistician is applying his skills to what is clearly an act of creative historiography. Projecting a curve on a sheet of graph paper well to the left of a known point is obviously a useful way of establishing a hypothesis. An excellent

¹ Sources: 1860—*Report*, American Institute, 1860, p. 316. 1855 and 1848—*Working Farmer*, Vol. ix, 1857, p. 18. 1844—*Report*, U.S. Patent Office, 1844, pp. 407–408. See also *Report*, Commissioner of Agriculture, 1862, p. 358.

example occurs in this paper in the case of the estimates of rents paid to nonfarm landlords. These estimates involve two basic unknowns: the frequency of renting and the ownership of rented farms by nonfarm landlords.

There continues to exist among U.S. historians a conviction that there existed very little tenancy prior to 1860. The conviction rests on the assumption that the abundance of cheap land made renting unnecessary and irrational. There is, to the contrary, the logical inference that tenancy did not suddenly appear just in time to be recorded by the 1880 census. The free-hand projection of the 1880 data suggests that the leasing of farms in earlier years was in fact very common. For this there is some confirmation of a nonquantitative nature back to perhaps 1845. The growth of the leasing of farms, as it might be shown in the slope of a curve, is, in the present state of our knowledge, highly conjectural. As to rentals paid to nonfarm landlords, and particularly as to the sharp rise in such rentals between 1840 and 1870 shown in this paper, the estimates cannot be confirmed or rejected on the basis of any contemporary evidence with which I am familiar. This is, then, history via the French curve.

The curve reaching back into what is, from a statistical point of view, prehistory, is an intriguing device. Its preciseness does not discriminate between fact and fancy; it is most useful for suggesting probabilities, but the results require checking with all the available contemporary information.

