

This PDF is a selection from an out-of-print volume from the National Bureau of Economic Research

Volume Title: The Growth of Physical Capital in Agriculture, 1870-1950

Volume Author/Editor: Alvin S. Tostlebe

Volume Publisher: UMI

Volume ISBN: 0-87014-358-1

Volume URL: <http://www.nber.org/books/tost54-1>

Publication Date: 1954

Chapter Title: Introduction to "The Growth of Physical Capital in Agriculture, 1870-1950"

Chapter Author: Alvin S. Tostlebe

Chapter URL: <http://www.nber.org/chapters/c5908>

Chapter pages in book: (p. 1 - 15)



Introduction

I

This paper is one of a series, presenting in advance of full publication some results of an inquiry on trends in capital formation and financing in the United States. The project was initiated at the National Bureau of Economic Research in mid-1950 at the suggestion of the Life Insurance Association of America and with its generous assistance.

In the conduct of the inquiry, it was found advisable to analyze the accumulation of capital by each major capital-using and -demanding sector of the economy and to attempt to trace trends in the ways the accumulation of real capital and other assets was financed. Among the several sectors thus recognized as subjects of separate studies, each under a senior investigator, agriculture was naturally one. We were fortunate to be able to conduct the study in cooperation with the Bureau of Agricultural Economics. Dr. Alvin S. Tostlebe, the author, serves jointly as member of the staff of the National Bureau of Economic Research and as principal agricultural economist in the Division of Agricultural Finance of the Bureau of Agricultural Economics.

While the detailed presentation of the data and analysis must be deferred until the full study is completed by Dr. Tostlebe, his new estimates on changes in physical assets and the findings suggested by them seem of sufficient interest to warrant this report.

The full significance of the findings on capital formation in agriculture can be clearly perceived only in relation to the results for other sectors in the economy. It is hoped that, as the series of Occasional Papers nears completion, the meaning and potential value of the separate findings will become clearer. This statement is not intended as an apology: the conclusions that emerge for each sector and in each Occasional Paper are of sufficient interest in and of themselves. But it should serve to indicate that these find-

ings suggest wider questions which cannot be treated here or may not even become apparent; some of these questions, it is hoped, will emerge and find fuller treatment in the monographs reporting the complete studies; some may be left open even when the inquiry as a whole—an undertaking, like all human enterprises, with limited resources—comes to an end.

II

Dr. Tostlebe's paper deals with trends in the accumulation of real or physical assets in agriculture—land and buildings, implements and machinery, livestock, and crop inventories—most but not all of the assets used by farmers in their business. With the data extending back to 1870, although for most of the period only at decennial intervals, with the growth of physical assets set against the background of the development of agriculture as a whole, and with the distinction of ten regions with diverse types of agricultural production within the country, Dr. Tostlebe's paper provides a wealth of statistical information that should produce rich yields.

Two major conclusions stand out clearly. The first is the marked change in the character of agricultural growth over the eighty-year span of the study period. During the first forty years (1870–1910) the agricultural plant grew at high rates: both the number of farms and total capital, in constant prices, more than doubled, and the number of persons engaged increased almost 70 per cent. During the second forty years (1910–1950) the number of farms declined; the number of persons engaged declined sharply, so that it was not much larger in 1950 than in 1870; and while real capital still grew, the rise of less than 20 per cent was in contrast with the rise of almost 130 per cent in the first forty years.

The second major conclusion is closely tied in with the first. When capital is related to either the number of farms or persons engaged, the two forty-year periods are still distinct but the contrast between them is of a different order. From 1870 to 1910 total capital per farm declined about 4 per cent, a combination of a sizable decline in value of land per farm and of a slight rise in value of reproducible capital per farm. By contrast, from 1910 to 1950 total capital per farm rose about 40 per cent. There is a similar contrast between the first and second halves of the period in the

movement of capital per person engaged. From 1870 to 1910 it rose about 35 per cent, but from 1910 to 1950 it almost doubled. These movements clearly reflect extensive expansion during 1870–1910 and intensive growth during 1910–1950.

III

Dr. Tostlebe's estimates for different regions are of particular value. They permit analysis of trends in capital for various types of agriculture, as well as for areas with different rates of growth during the several periods. It is hardly possible to discuss here even a small part of the findings that the regional estimates suggest. But their major contribution to the findings already stated in terms of the countrywide totals can be observed from Table A, which assembles the bare minimum of information about the ten regions. For an adequate description of the regions and more detailed data on them, the reader should turn to Dr. Tostlebe's paper. The basic data on the distribution of capital between land and other capital will be presented in his monograph.

Part 1 of Table A shows the percentage shares by regions in number of farms, persons engaged in agriculture, total real capital in land, and capital excluding land for the three dates, 1870, 1910, and 1950, that permit us to distinguish the two subperiods marked by extensive and intensive growth. Here are some of the findings suggested by these data.

1. There are marked shifts from 1870 to 1950 in the percentage shares of the several regions, indicating marked differences in their rates of growth. As one would expect, the older, earlier settled regions—the Northeast, the Corn Belt, the Appalachian—grew more slowly and their shares in countrywide totals of farms, persons engaged, and capital declined. By contrast, the younger and later settled regions—the Lake States, Texas-Oklahoma, Great Plains, Mountain, Pacific—grew more rapidly and accounted for increasing shares of farms, workers, and capital.

2. By and large the changes, if not necessarily the levels, of the shares of regions in the various countrywide totals are similar. Rises and declines in the shares in farms and persons engaged are accompanied by roughly similar changes in the shares in capital.

3. The timing of the shifts in the percentage distribution among

TABLE A, PART I

PERCENTAGE DISTRIBUTIONS OF NUMBERS OF FARMS, PERSONS ENGAGED IN AGRICULTURE AND CAPITAL, TEN REGIONS, 1870, 1910, AND 1950

	U.S. Total	Northeast	Corn Belt	Lake States	Appalachian	Southeast	Delta	Texas-Oklahoma	Great Plains	Mountain	Pacific
Number of farms:											
1. 1870	2,700,000	22.6	31.0	9.3	18.0	7.5	5.5	2.3	2.0	.5	1.3
2. 1910	6,400,000	10.3	19.4	8.5	17.3	12.3	9.6	9.5	7.2	2.9	3.0
3. 1950	5,400,000	7.4	18.5	9.4	18.8	11.3	10.4	8.8	6.9	3.6	5.0
Persons engaged:											
4. 1870	6,850,000	16.2	24.3	6.8	21.8	15.8	9.2	2.7	1.6	.7	1.0
5. 1910	11,600,000	8.7	16.3	7.2	17.4	16.2	11.9	10.3	5.9	2.8	3.1
6. 1950	6,910,000	7.2	17.0	9.7	16.8	12.2	10.0	8.7	7.4	4.6	6.4
Total real capital, 1910-1914 prices:											
7. 1870	\$19.8 bill.	19.5	44.4	7.6	11.9	4.5	2.7	2.5	1.9	.4	4.6
8. 1910	45.4 bill.	9.1	32.6	9.9	7.9	3.8	2.8	7.7	15.1	4.1	7.0
9. 1950	53.7 bill.	5.9	27.8	10.5	7.3	4.0	3.0	8.6	15.8	7.8	9.3
Total land, 1910-1914 prices:											
10. 1870	\$13.6 bill.	14.6	49.1	7.2	12.1	4.9	2.6	1.9	1.9	.2	5.5
11. 1910	30.2 bill.	6.2	35.1	9.0	7.0	3.3	2.4	8.2	16.5	3.8	8.4
12. 1950	34.5 bill.	3.8	28.6	8.9	5.4	3.3	2.3	9.3	18.8	8.5	11.0
Total real capital, excl. land, 1910-1914 prices:											
13. 1870	\$ 6.1 bill.	30.5	33.9	8.6	11.3	3.6	2.9	3.7	1.8	1.0	2.7
14. 1910	15.1 bill.	14.8	27.6	11.7	9.8	4.6	3.6	6.8	12.5	4.5	4.0
15. 1950	19.2 bill.	9.8	26.5	13.3	10.6	5.1	4.3	7.2	10.6	6.4	6.2

TABLE A, PART 2

PERSONS ENGAGED IN AGRICULTURE AND CAPITAL PER FARM, AND CAPITAL PER PERSON ENGAGED,
EXPRESSED AS RATIOS OF COUNTRYWIDE AVERAGE, TEN REGIONS, 1870, 1910, AND 1950

	<i>U.S. Average</i>	<i>North- east</i>	<i>Corn Belt</i>	<i>Lake States</i>	<i>Appalachian</i>	<i>South- east</i>	<i>Delta</i>	<i>Texas- Oklahoma</i>	<i>Great Plains</i>	<i>Mountain</i>	<i>Pacific</i>
Persons engaged per farm:											
1. 1870	2.58	.72	.78	.73	1.21	2.11	1.67	1.17	.80	1.40	.77
2. 1910	1.82	.84	.85	.85	1.01	1.32	1.24	1.08	.82	.97	1.03
3. 1950	1.28	.97	.92	1.03	.89	1.08	.96	.99	1.07	1.28	1.28
Total real capital per farm:											
4. 1870	\$7,428	.86	1.43	.81	.66	.61	.49	1.09	.98	.80	3.59
5. 1910	7,131	.88	1.68	1.16	.46	.31	.29	.81	2.09	1.42	2.33
6. 1950	9,976	.80	1.51	1.12	.39	.35	.29	.97	2.30	2.14	1.88
Land per farm:											
7. 1870	\$5,126	.65	1.58	.77	.67	.65	.47	.83	.95	.40	4.23
8. 1910	4,753	.60	1.81	1.06	.40	.27	.25	.86	2.29	1.31	2.80
9. 1950	6,418	.51	1.55	.95	.29	.29	.22	1.06	2.72	2.36	2.20
Total, excl. land, per farm:											
10. 1870	\$2,302	1.35	1.09	.92	.63	.48	.53	1.61	.90	2.00	2.08
11. 1910	2,378	1.44	1.42	1.38	.57	.37	.38	.72	1.74	1.55	1.33
12. 1950	3,558	1.32	1.43	1.41	.56	.45	.41	.82	1.54	1.78	1.24
Total real capital per engaged:											
13. 1870	\$2,884	1.20	1.83	1.12	.55	.29	.29	.93	1.18	.58	4.75
14. 1910	3,914	1.04	2.00	1.36	.46	.23	.24	.75	2.56	1.44	2.22
15. 1950	7,775	.83	1.63	1.08	.43	.33	.30	.98	2.14	1.69	1.45
Land per engaged:											
16. 1870	\$1,990	.90	2.02	1.06	.56	.31	.28	.70	1.19	.29	5.50
17. 1910	2,608	.71	2.15	1.25	.40	.20	.20	.80	2.80	1.36	2.71
18. 1950	5,003	.53	1.68	.92	.32	.27	.23	1.07	2.54	1.85	1.72
Real capital, excl. land, per engaged:											
19. 1870	\$ 894	1.88	1.40	1.26	.52	.22	.32	1.37	1.12	1.43	2.70
20. 1910	1,306	1.70	1.69	1.62	.56	.28	.30	.66	2.12	1.61	1.29
21. 1950	2,772	1.36	1.56	1.37	.63	.42	.43	.83	1.43	1.39	.97
Land as % of real capital:											
22. 1870	69.0	51.8	76.6	65.6	70.4	75.2	66.2	52.4	69.0	34.5	82.8
23. 1910	66.7	45.4	72.0	60.7	59.4	58.0	57.4	70.7	72.7	62.0	80.0
24. 1950	64.3	41.2	66.2	54.7	47.6	52.7	49.5	69.4	76.5	70.1	75.9

the regions is particularly interesting. They are much more marked from 1870 to 1910 than from 1910 to 1950. If we take the sum of absolute differences (signs disregarded) between the percentage shares at successive dates as an index of displacement, the resulting measures are:

	<i>1870-1910</i>	<i>1910-1950</i>
Farms	50.8	11.7
Persons engaged	39.5	19.4
Total real capital	53.8	17.2
Land	58.5	21.4
Capital excluding land	46.9	16.1

It is apparent that the differences in rate of growth among the ten regions were much greater in the period of extensive growth than in the following period of more intensive use of workers and capital.

4. There is a convergence among regions in the sense that as time passes their shares in the countrywide totals of farms, persons engaged in agriculture, or capital become less unequal. This is clearly shown if we take the sum of the differences (signs disregarded) between the percentage shares and the "equality" shares (i.e. 10 per cent for each region). Some inequality between regions is of course inherent in their basic resources and cannot be expected to disappear; the equality share is merely a statistical criterion against which changes in inequality may be measured.

	<i>1870</i>	<i>1910</i>	<i>1950</i>
Farms	83.2	38.6	37.9
Persons engaged	76.1	44.4	32.0
Total real capital	91.6	55.4	48.2
Land	91.6	63.3	56.9
Capital excluding land	91.4	53.3	42.0

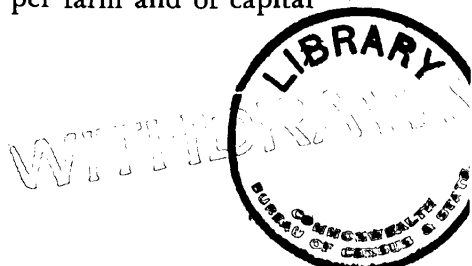
The major reduction in the inequality in shares of various regions occurred between 1870 and 1910, during the period of extensive growth. There are further but much narrower reductions between 1910 and 1950.

Does the increasing similarity of the shares of the regions in the countrywide totals of farms, persons, and capital mean increasing

similarity also in other quantitative characteristics of agriculture? Part 2 of Table A provides comparisons among the regions, at the three selected dates, of the number of persons engaged per farm, of capital per farm, of capital per worker, and of the distribution of capital between land and reproducible goods. From these data, in which the position of each region is expressed as a relative of the countrywide average (except for the percentage share of land), we can make the following observations.

5. While the countrywide number of workers (employees and proprietors) per farm declines from 2.6 in 1870 to 1.8 in 1910, and further down to 1.3 in 1950, the ten regions differ materially in this respect. But such differences tend to diminish. In the regions in which the number per farm was above the countrywide average in 1870 (Appalachian, Southeast, Delta, Texas-Oklahoma, Mountain), the ratio to the country's average declined; and in the regions in which the number per farm was below the country's average (Northeast, Corn Belt, Lake States, Great Plains, Pacific) the ratio to the country's average rose. This increasing uniformity among regions of number of workers per farm can be gauged by the average deviation of the ratios in Table A, Part 2, lines 1 to 3, from the countrywide average (i.e. 1.0), the deviation for each region being weighted by its share in the total number of farms. The results are .33 for 1870, .15 for 1910, and .084 for 1950. The movement toward increasing uniformity is almost as great relatively from 1910 to 1950 as from 1870 to 1910.

6. The deviations of the several regions from the countrywide average of *capital* per farm (Table A, Part 2, lines 4 to 12) are also pronounced. But they are quite different from those in the number of workers per farm, particularly in 1870 and 1910. Thus in most of the regions in which the number of workers per farm is above the countrywide average (Appalachian, Southeast, Delta, Mountain), capital per farm is *below* the countrywide average. By contrast, in some of the regions in which the number of workers per farm is below the countrywide average (Corn Belt, Pacific), capital per farm is above the average. This relation, and its reversal in 1950, is brought out by the coefficients of rank correlation (Spearman formula) between the ratios to their respective countrywide averages of the number of workers per farm and of capital



(total, land, and total excluding land) per farm. The coefficients are:

	1870	1910	1950
Number engaged per farm and total capital per farm	-.67	-.63	+.50
Number engaged per farm and land per farm	-.58	-.55	+.49
Number engaged per farm and capital excluding land per farm	-.52	-.89	+.30

The earlier negative relationship was due primarily to the large number of workers and low capital per farm in the southern regions and the small number of workers and high capital per farm in the Corn Belt and some of the younger regions in the West (Pacific, Great Plains). The reversal of the relationship by 1950 is due to the marked reduction in the number of workers per farm in the southern regions relative to that in regions with high capital per farm (e.g. Corn Belt, Pacific, Great Plains).

7. Unlike number of workers per farm, capital per farm reveals no movement toward greater uniformity among regions. On the contrary, as time passes, its distribution becomes more sharply differentiated. This is obscured in Table A, Part 2, because the ratios for the regions that were young in 1870 are quite erratic. The proper measure is again the average of the deviations of the capital ratios per farm for the several regions, weighted by the percentage share of each in the total number of farms:

	1870	1910	1950
Total capital per farm	.34	.55	.56
Land per farm	.44	.64	.67
Capital, excluding land, per farm	.28	.48	.44

Furthermore, the differences in the value of land are more marked than those in the value of reproducible capital.

8. At first glance, unlike capital per farm, capital per worker, while differing substantially among regions (Table A, Part 2, lines 13 to 21), tends to converge with the passage of time. Thus the ratios for the Northeast and Pacific regions, which were high in 1870, decline perceptibly; and the ratios for the Southeast and Mountain regions, which were low in 1870, rise. But there are also

offsetting movements; the low ratio for the Appalachian region declines even further, and the high ratio for the Great Plains region rises. Here again the relevant measure is the weighted deviation:

	1870	1910	1950
Total capital per person engaged	.56	.67	.52
Land per person engaged	.60	.75	.64
Capital, excluding land, per person engaged	.58	.62	.41

It appears that capital, excluding land, per person engaged converges; and this convergence occurs from 1910 to 1950—*pari passu* with and for the same reasons as the reversal in the relationship between number of persons and capital per farm. At some time within the last forty years the high ratio of workers per farm in southern regions moved down toward the countrywide average while the ratio of capital per farm, and hence of capital per person engaged, moved *up* toward the average for the country. Although land per person engaged also converged from 1910 to 1950, this movement was not enough to offset the divergence that occurred from 1870 to 1910.

9. The share of land in the total capital of agriculture declined somewhat, from 69 per cent in 1870 to 64 per cent in 1950. The proportions in the various regions are quite different—generally lower in the older and higher in the younger (Table A, Part 2, lines 22 to 24). Furthermore, these differences among the regions in the structure of capital have not diminished with time. Thus the weighted average deviation was 8.7 per cent in 1870, 7.8 per cent in 1910, and 8.9 per cent in 1950.

One may thus conclude that although the shares of the regions in the total agricultural plant of the country have gradually become less unequal and although the relative differences among them in number of workers per farm have diminished, the regions continue to be different—indeed have become somewhat more different—with respect to capital per farm, capital per worker, and structure of capital (in its division between land and other real assets). In any analysis of the capital structure of agriculture these persisting, and sometimes widening, regional differences must continuously be kept in mind.

10. Since some regions are distinguished by high levels of capital per worker and others by low, it may be asked to what extent the shift in relative weights of regions (interregional shifts) and the increase in capital per worker within each region (intra-regional shifts) contribute to the countrywide rise in capital per worker in agriculture. The relevant calculations can be made by holding constant for each interval (i.e. 1870 to 1910, and 1910 to 1950) either the shares of regions within the country's total of persons engaged, or the capital per person engaged for each region, and letting the other characteristics vary. The results are:

	<i>1870-1910</i>	<i>1910-1950</i>	<i>1870-1950</i>
Total change in capital per person engaged	\$1,030	\$3,861	\$4,891
Due to intraregional shifts	1,048	3,209	4,257
Due to interregional shifts	-18	652	634
Total change in land per person engaged	618	2,395	3,013
Due to intraregional shifts	586	1,881	2,467
Due to interregional shifts	32	514	546
Total change in capital, excluding land, per person engaged	412	1,466	1,878
Due to intraregional shifts	462	1,328	1,790
Due to interregional shifts	-50	138	88

Despite their marked character, shifts in shares among regions between 1870 and 1910 contributed nothing to the rise in capital per person engaged in the country at large: presumably the shifts in favor of regions with high capital per worker were offset by shifts in favor of those with low capital per worker. From 1910 to 1950, shifts among regions did contribute to the rise in the countrywide average. They accounted for about 20 per cent of the total rise in the value of land per person engaged and about 10 per cent of the rise in other capital. For the most part, however, the observed upward movement in capital per worker was associated with similar movements within regions and was not appreciably affected by changes in relative weight among regions.

IV

Dr. Tostlebe's estimates permit much deeper probing into the course and conditions of past accumulation of real capital in agri-

culture. The rates of change from decade to decade, or more recently by five-year periods, can be examined for the countrywide totals and for regions; for all capital combined and for its various components; in constant prices, as has been done above, and in changing valuation, the latter properly stressed by Dr. Tostlebe. No note was taken above of the relation between real capital accumulation, in constant prices, and the possible demand for capital funds generated by agriculture. On a countrywide scale, and according to the accepted rules of social accounting, real capital accumulation and savings are identical; but even so, varying proportions of the latter may be used for internal financing, i.e. retained by the saver for investment in his own enterprise. In dealing with a single industry, we should recognize that not only its physical but also some of its financial assets (such as cash) are means of production and a basis for financing. In either case, it is additions in current prices, rather than in some arbitrarily fixed prices, that must be financed. Furthermore, violent price movements accompanied by turnover of assets may result in an accumulation or reduction of debt in an industry, a drain upon or contribution to the country's available capital funds that cannot even be suggested by changes in physical assets in constant prices. To use an obvious example: the change from 1910 to 1920 in total physical capital in constant prices of 1910-1914 is shown by Dr. Tostlebe to be between \$4 and \$5 billion, from \$45.4 to \$49.8 billion; the change in total physical capital in current prices over the same decade was from \$43.3 to \$83.8 billion. It is the contrast between the two pairs of figures, not merely the estimate in constant prices, that is relevant to an understanding of what happened during that decade to the debt structure of agriculture, to its demands for capital funds, and to its competition for savings with other industries in the economy.

However, it is out of place here to go beyond the bare indication that there are several variable links between accumulation of real capital and financing—particularly when we deal with a single industry rather than the economy as a whole. This introduction is limited to emphasis on one group of findings, those bearing upon physical capital in constant prices. The interested reader

will easily find indications of other directions for further research suggested and made possible by Dr. Tostlebe's estimates.

In conclusion, I would like to comment on the ratio of capital to output, a finding that had to be omitted because the statistical and conceptual difficulties required more detailed presentation than was feasible. The broad findings suggested by the data are as follows. If we begin with 1880 (rather than 1870, to permit comparisons of capital stock with output data averaged over intervals substantially longer than a year), total real capital, as estimated by Dr. Tostlebe, rises from 100 in 1880 to 163 in 1910, and further to 193 in 1950. Output of agriculture, in constant prices, adjusted for duplication within the industry but gross of payments to other industries, moves from 100 in 1874–1883 to 198 in 1904–1913 and to 351 in 1948–1952 (these are estimates by Barger and Landsberg¹ carried back by the Strauss-Bean index of farm production, and forward by the Bureau of Agricultural Economics index of farm output). If we set the ratio of total capital to gross value of agricultural output in 1880 at 100, it dropped to 82 (i.e. declined 18 per cent) in the 30 years from 1880 to 1910 and dropped further to 55 (i.e. declined 33 per cent) in the forty years from 1910 to 1950.

There is little doubt that over the entire period, the ratio of capital to gross value of output in agriculture declined fairly significantly. But should gross value of output be used in the capital-product ratio? There is much to be said for this inclusive definition of the denominator since certain types of capital are needed to handle the total product of an industry and should be related to that product, rather than to any more narrowly defined part of it. For example, the same amount of capital is needed to thresh and move a specified amount of grain regardless of the quantity of commercial fertilizer used, i.e. regardless of the value of grain *net* of fertilizer costs. But the chief reason for using gross output in this study is that, since our interest is in the past and prospective importance of various industries and in the factors that account for their growth and decay, the demand for their products must be considered first of all. The size of that demand

¹ Harold Barger and Hans H. Landsberg, *American Agriculture, 1899–1939* (National Bureau of Economic Research, 1942).

is gauged not by any net value originating in an industry but by the total value of its products. Indeed, from this standpoint we should include in the total value product of each industry not only its full cost at the producer's door but also transportation and distribution costs, and we should include in the capital account some portion of the capital used in transportation and distribution. Obvious difficulties, both statistical and analytical, would arise in such an attempt. But it is clear that, in viewing the factors on the demand side that determine the changing importance of various industries and hence the changing bases for their demand for capital, gross output is more revealing than any netter and more attenuated total.

On the other hand, if the denominator is the gross output, its changing structure with respect to purchases from other industries may affect the trends in the capital-product ratio. If an industry becomes more integrated vertically, i.e. absorbs into its own processes the production of materials formerly purchased, its capital-gross product ratio will tend to rise. Its gross output will remain unchanged, but its capital will be increased to take care of productive activities previously performed elsewhere. Contrariwise, if an industry becomes more specialized, i.e. purchases an increasing proportion of its materials instead of producing them, its capital-gross product ratio will tend to decline. With the same gross output, the industry will need less capital since some of its former functions will be performed elsewhere.

In agriculture there has in fact been a tendency toward greater specialization with an increasing share of gross output accounted for by purchases from other industries—at least in recent decades. John Kendrick's estimates (*Survey of Current Business*, September 1951, pages 13-19), unfortunately available back only to 1909, indicate a ratio of net product (i.e. net of payments to other industries) to gross of 82 per cent in 1910 and of 60 per cent in 1950. If we apply these percentages to our indexes of gross value of output and then compute the ratio of total capital to net output thus estimated, the capital-output ratio still declined from 1910 to 1950, but only 9 per cent, whereas the ratio to gross value of output declined 33 per cent. If, to round out the picture, we assume that the percentage of net to gross value of output in 1880 was somewhat

higher than in 1910, say 90 per cent, the calculation of the capital-output ratio with net output as the base would suggest a decline from 111 in 1880 (i.e. $100/90$) to 101 in 1910 and to 91 in 1950—a drop that is short of two-tenths, rather than the drop of more than four-tenths in the ratio of capital to gross value of output.

The figures used above are illustrative rather than precise, although they approximate the magnitudes that will be revealed by the greater detail to be presented in the monograph. The purpose of these comments is, however, to emphasize the possible differences in movement between the ratios of capital to gross and to net value of output, differences which are likely to be greater for agriculture than for other major sectors in the economy. The general finding with respect to the differences between the capital-product ratios calculated on gross and net product bases has wider implications: it suggests a greater stability and relevance of the capital-*net* product ratios, even for single industrial sectors and especially when they are combined in considering the capital-product ratio for the economy as a whole. Obviously, if increasing specialization in one industry served to reduce its capital-gross product ratio, all other conditions being equal, capital elsewhere in the economy should increase, since it is needed for the productive functions sloughed off by that industry. For the economy as a whole, capital cannot be effectively related to any duplicated gross total derived as the sum of the gross products of the several industrial sectors; the more industries distinguished, the greater the duplication in the total and the lower the capital-duplicated product ratio. But if for the country as a whole the capital-*net* product ratio is relatively invariant to industrial classification, and is therefore meaningful, it will not necessarily be depressed if the capital-gross product ratios for the several industrial sectors decline, or raised if they rise.

But the pursuit of this line of reasoning raises uncomfortable questions. What is the proper definition of an industry's *net* product? It should presumably be net not only of purchases from other industries, but also of charges for current consumption of durable capital. Furthermore, it should be net not only of indirect taxes included in the valuation of gross product, but also of those taxes and government benefits that modify the payments to factors en-

gaged in the industry. In other words, the net product of an industry is a highly attenuated and complicated concept, and when we try to measure it in values unaffected by price changes, the difficulties multiply. But assuming that a definition can be agreed upon and a measure of net product originating in the industry can be derived, we then ask: Why relate the stock of capital to this total rather than to the contribution of capital alone? To say that so much net product was turned out with so much capital may mean little unless we also specify the amounts of labor and other factors used.

The point is that in deriving capital-product ratios for separate industries we should experiment with different definitions of the denominator (as well as of the numerator, in which we should distinguish types of capital). Gross product is a relatively simple concept and its use minimizes questions of definition and measurement. It has some rationale in that capital is in large part oriented toward the total product, not toward the net income part of it. Furthermore, it is not far removed from the concept of final expenditures and thus permits the linking of demand for finished products with the demand for capital. The use of net product, on the other hand, has obvious advantages when the capital-product ratio for the whole economy is considered.

Under the circumstances, it seems best to explore the relations flowing from diverse definitions of both numerator and denominator. The difficulties suggested are due at bottom to the fact that we must study each industry first as a distinct entity, representing a particular institutional complex with its own history, pattern of behavior, and quantitative constants, and in studying it, we tend to think of its gross output. Yet each industry is only one element in a network of production and marketing interrelations and in studying the economy as a whole, we are forced to think of the net output of the various industries. The solution lies in doing both and remembering that the movements of the capital-product ratios in some industries are both cause and effect of the movements of the capital-product ratios in others.

Simon Kuznets