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Chapter Author: Simon Kuznets, Elizabeth Jenks

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CHAPTER 7

Long Swings in Population Growth, Capital Formation, and National Product

In Chapter 2 we discussed the existence of long swings in the rate of growth, a component of change that has to be recognized when we distinguish long-term trends from the shorter fluctuations. If long-term trends mean movements that persist in one direction over periods as long as twenty-five to thirty years, and if we describe those long-term trends and remove them, the residuals reveal that in addition to the shorter fluctuations associated with business cycles there are longer up-and-down movements. Their amplitude is not insignificant and an analysis of long-term changes—longer than business cycles—must take them into account. Charts 2 and 3 illustrated such long swings in gross national product, in constant prices. It was to eliminate those long swings that the analysis in Chapters 3 and 4 was based largely on thirty-year averages, and that in the analysis in Chapters 5 and 6 we studied the longer periods, or shorter periods selected to represent possibly similar levels in the long swing.

We now consider directly these up-and-down movements in the volume or rate of growth of the economic variables of importance in connection with past and prospective trends in capital formation and financing. In the discussion that follows, we cannot hope to give a complete picture of the prevalence of long swings in the movement over time of the various aspects of the country's economy. For this purpose the data should cover a much longer period and should relate, on a continuous, almost annual, basis to many more aspects of the economy than they do. The analysis requires laborious statistical manipulation, the application of which to a large number of series

becomes a forbidding chore. An even greater difficulty lies in the fact that the analytical literature on this topic is only in its very beginnings, and we have no large stock of accumulated findings to draw upon.[1] Under the circumstances, we can only suggest the broad outlines of the long swings as they can be observed in the countrywide aggregates with which we deal, to provide at least an indication of the magnitude of this particular pattern of change over time, the mechanism of relations among various components in the economy during these swings, and the importance to be assigned to them in any consideration of the bearing of past trends upon the future.

The present chapter is devoted to an attempt to describe the long swings in the real flows, that is, in capital formation, national product, and the related components and variables. Chapter 8 will deal with the long swings in financial flows.

Population Movements

Population offers the best way of breaking into the chain of interconnections among the several economic variables that is involved in any pattern of movement over time—long swings included. Population estimates also happen to be one of our best series, independent of the sources from which capital formation and national product estimates are derived, and they are less subject to imaginative piecing out and to limiting theoretical assumptions than the more synthetic economic totals.

Additions to population are clearly an important factor in the demand for new housing and for additional consumer goods, and in eventually providing additions to the labor force. We begin therefore

[1] An early survey of the problem of long swings is given in Wesley C. Mitchell, *Business Cycles: The Problem and Its Setting* (New York, NBER, 1927), pp. 226–230. Later discussions include Simon Kuznets, *Secular Movements in Production and Prices* (Houghton Mifflin, 1930), pp. 200–267; Arthur F. Burns, *Production Trends in the United States Since 1870* (New York, NBER, 1934), pp. 174–252; and more recently, Brinley Thomas, *Migration and Economic Growth* (Cambridge, England, 1954), and W. Arthur Lewis, "Secular Swings in Production and Trade" (*Manchester School of Economic and Social Studies,* May 1955).

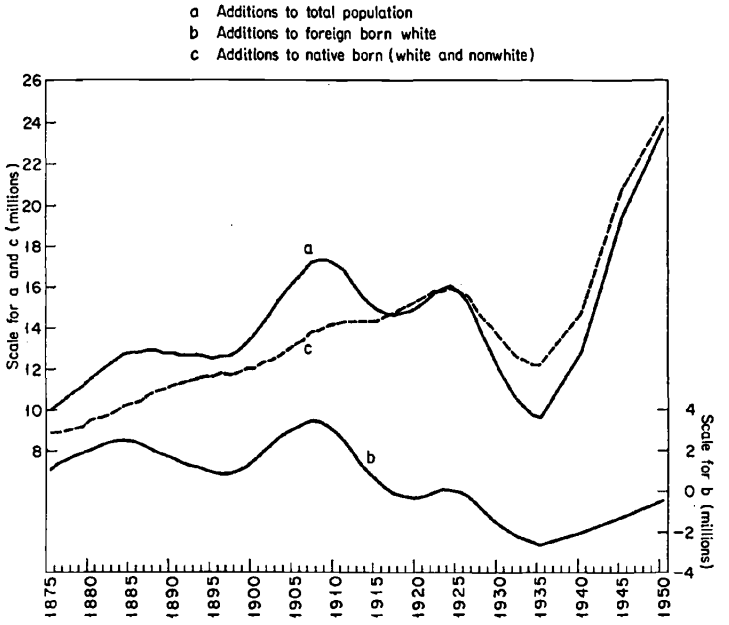
Since this chapter was written, Moses Abramovitz has initiated a comprehensive analysis of long swings in the growth of the American economy, with particular emphasis on capital formation. Some preliminary results of the analysis appear in the following annual reports of the National Bureau: 38th, May 1958, pp. 47–56; 39th, May 1959, pp. 23–27; and 40th, May 1960, pp. 19–21. It has not been possible here to take advantage of Abramovitz' suggestive findings, which may lead to analytical hypotheses somewhat different from those suggested in the text.

by observing the rate of additions to the population of the United States (Chart 4).

The measures of population growth used here are the changes between quinquennial averages ten years apart. The only exception is the use at each end of the series, when quinquennial averages are not

CHART 4

Decadal Additions to Native Born, Foreign Born White, and Total Population, 1870–1955



available, of changes over ten-year spans between single years (one entry at each end) and between three-year averages (one penultimate entry at each end). The use of quinquennial averages tends to smooth out the rather mild short-term changes in the annual population figures. Since we use the increment over ten-year periods, the absolute growth is large relative to any short-term fluctuations that may still remain in the five-year moving averages—provided, of course, that long-term growth has been substantial, as it has been in this country's population. Hence these measures of absolute additions to population, over decennial intervals taken successively with an overlap of one year,

are largely free from effects of short-term changes of the kind associated with business cycles.[2]

The long swings in additions to population are clearly shown in Chart 4. Thus for total population, the additions rise to a peak in the mid- or late 1880's (each addition is centered in the middle of the decade for which it is calculated), decline to a trough in the mid-1890's, rise to another peak in 1909, decline again to a trough in 1917, rise moderately to another peak in the mid-1920's, show a sharp dip in the mid-1930's and then a sharp rise with its crest not yet in sight. Similar long swings can be observed not only in additions to the foreign born white population—in which they are quite prominent before the legal limitations on immigration that began in the 1920's and continued with progressing severity—but also in additions to the native born population, in which they tend to be less pronounced.

Nothing in the procedure used to calculate the additions to population would, in and of itself, produce the long swings. In fact, we know that immigration, for which annual data are available, did fluctuate in highly pronounced twenty-year swings,[3] and it is their effect that is reflected in the additions to the foreign born white population. These up-and-down movements in the volume of immigration and the stock of foreign born would themselves produce swings in additions to native born children of foreign born. Moreover, available data on the native born children of native parentage give evidence of long swings in the additions to their numbers.[4] So far as the procedure is concerned, the additions to population in Chart 4 could look like roughly straight lines, or lines with continuous acceleration or deceleration. Whatever swings are shown must be in the original data.[5]

[2] Of the reference cycles in the United States from 1869 through 1955, counting from trough to trough or peak to peak, only 7 were longer than five years. The alternative procedure, using average values for successive reference cycles, would not change the results significantly, as was illustrated in Chart 2. Nor would the results be very different if seven-year or nine-year moving averages—also a decade apart—were used.

[3] See Simon Kuznets and Ernest Rubin, *Immigration and the Foreign Born,* Occasional Paper 46 (New York, NBER, 1954), particularly Table 4 and Chart 3, pp. 28–29.

[4] See Kuznets, "Long Swings in the Growth of Population and in Related Economic Variables," *Proceedings of the American Philosophical Society,* February 1958, pp. 25–52. Much of the following discussion relating to population can be found in greater detail in that paper.

[5] In fact, the danger is not that the procedure introduces swings where they did not exist, but that it fails to reveal swings of a specified character. Assume that there was a highly symmetrical and regular ten-year swing in population additions

Granting the existence of these long up-and-down movements in additions to population, we record some of their quantitative characteristics (Table 59). In part A we attempt to date the troughs and peaks of the long swings by inspection of Chart 4. Precise dating is not always easy or necessarily meaningful, because each entry represents a decadal average. Furthermore, there is the problem of establishing the turning points at the ends of the series. In general, to avoid losing too much of the available record, we assumed that the first and the last year represented turning points—even though the phases may have begun earlier or ended later. In any case, we cannot provide accurate and specific measures but only suggest rough orders of magnitude.

The swings average about twenty years in duration, and their amplitude can be seen clearly from changes in the values entered in part B of the table. Thus, in column 1, additions to the foreign born white population are 1.1 million for the decade centered in the first trough (from 1870 to 1880, inclusive), but are more than double that, 2.5 million, for the decade centered in the following peak (from 1879 to 1889, inclusive). The alternations in additions from trough to peak and from peak to trough, on a per year basis, are entered in part C. Finally, the most complete measure of amplitude, the difference in the rate of change in additions between successive phases, is entered in part D.

The additions are measured on an absolute, not a percentage, basis. If a population is growing at a constant (or systematically accelerating or decelerating) percentage rate, we would expect the absolute additions per year to increase (or decrease) steadily. However, the actual additions per decade for total population rise and decline in swings of roughly twenty years' duration (column 3). The alternations in additions are quite substantial. In the first observed swing, the rate of additions increased from 10.0 to 12.9 million per decade, then declined to 12.5 million, and after the first swing the up-and-down movements were even more pronounced.

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reflected in the annual data. A five-year moving average would not eliminate such a swing completely; but additions over successive ten-year intervals would not reflect it, because the differences would be taken between points representing identical phases within the ten-year cycle. And what is true of a regular ten-year cycle would be roughly true of a cycle of approximately the same duration. This means that the procedure cannot reveal long swings with a duration of about a decade or less—a limitation that is not serious, because a distinction between swings of that duration and business cycles could not be drawn easily.

TABLE 59

TIMING AND AMPLITUDE OF LONG SWINGS IN ADDITIONS TO NATIVE BORN, FOREIGN BORN WHITE, AND TOTAL POPULATION, 1870–1955
(numbers in millions)

		Additions to:		
		Foreign Born White (1)	Native Born (2)	Total Population (3)
	A. DATES OF TURNING POINTS			
1. First trough		1875	1876	1875
2. Peak		1884	1888	1888 (1885)
3. Trough		1896	1897	1895 (1897)
4. Peak		1907	1911	1909
5. Trough		1920	1915	1917
6. Peak		1923	1924	1924
7. Trough		1935	1935	1935
8. Peak		1950	1950	1950
	B. VOLUMES PER DECADE AT DATES INDICATED			
9. First trough	(line 1)	1.1	8.9	10.0
10. Peak	(line 2)	2.5	10.9	12.9 (12.8)
11. Trough	(line 3)	0.8	11.7	12.5 (12.6)
12. Peak	(line 4)	3.4	14.3	17.3
13. Trough	(line 5)	−0.3	14.3	14.6
14. Peak	(line 6)	0.1	15.9	16.0
15. Trough	(line 7)	−2.6	12.2	9.6
16. Peak	(line 8)	−0.4	24.1	23.6
	C. CHANGES PER YEAR DURING SUCCESSIVE PHASES			
17. Trough to peak	(line 9 to line 10)	+0.16	+0.17	+0.22 (0.28)
18. Peak to trough	(line 10 to line 11)	−0.14	+0.09	−0.06 (−0.02)
19. Trough to peak	(line 11 to line 12)	+0.24	+0.19	+0.34
20. Peak to trough	(line 12 to line 13)	−0.29	0.00	−0.34
21. Trough to peak	(line 13 to line 14)	+0.13	+0.18	+0.20
22. Peak to trough	(line 14 to line 15)	−0.22	−0.34	−0.58
23. Trough to peak	(line 15 to line 16)	+0.15	+0.79	+0.93
	D. CHANGES BETWEEN SUCCESSIVE PHASES			
24. Trough to trough	(line 17 to line 18)	−0.30	−0.08	−0.28
25. Peak to peak	(line 18 to line 19)	+0.38	+0.10	+0.40
26. Trough to trough	(line 19 to line 20)	−0.53	−0.19	−0.68
27. Peak to peak	(line 20 to line 21)	+0.42	+0.18	+0.54
28. Trough to trough	(line 21 to line 22)	−0.35	−0.52	−0.78
29. Peak to peak	(line 22 to line 23)	+0.37	+1.13	+1.51

In this and the following tables and accompanying charts, the title dates cover the earliest and latest years in the moving averages underlying the computations.

The turning points are dated by inspection of Chart 4 and the underlying series.

Entries in parentheses, here and in the following tables, are alternative estimates, shown because there is no clear indication of when a given phase ends and another begins.

SOURCE: The series used are the five-year moving averages of population from Table R-37 and the underlying annual estimates. For the years beyond 1939 for which no five-year averages are available we used the estimates for 1940, 1945, 1950, and 1955 given in the paper referred to in text footnote 4. The entries in lines 9 to 16 are changes between moving averages (or single years) ten years apart, centered in the middle of the decade. Entries in lines 24 to 29 are derived directly from those in lines 17 to 23.

Two further findings of interest are suggested by the entries in Table 59. First, the amplitude of the swings has increased, and more substantially than the base. Thus for total population the differential movement (part D) was at the rate of some 0.3 or 0.4 million per year (3 or 4 million per decade), when additions were between 10 and 13 million per decade—a ratio of about a third. In the last two swings, the differential amplitude was at a rate of either 8 or 15 million per decade and the average additions were between 10 and 24 million—ratios of from 0.6 to 0.8 and far higher than those for the earliest swings.

Second, the relative contributions of the foreign born white and the native born components to the long swings in additions to total population have shifted continuously. The differential amplitude in additions to native population relative to that in additions to foreign born white population rose steadily—from about one-fourth to over three times the latter (lines 24 and 29). To put it differently, before the 1920's the long swings in additions to the foreign born white population accounted for most of the long swings in additions to total population, and after the 1920's the relationship was reversed—long swings in additions to native born population dominating the swings in total population growth.

Above all, it must be stressed that these long up-and-down movements in additions to this country's population have not been due exclusively to the long swings in immigration. The rate of natural increase of the native born, i.e., if we disregard the direct effects of immigration, appears to be subject to long swings reflected largely in the birth rates. In other words, conditions that produced the movements in immigration produced similar movements (although of narrower amplitude) in the number of native born children of native born parents. These swings in native births to native born parents have certainly been the dominating component in recent swings in additions to total population, and they were not insignificant even before World War I.

Another aspect of population movements to consider here is internal migration within the country—shifts in residence, particularly long term rather than brief and temporary. Population may be constant in numbers but, if there are extensive shifts in residence, the demand for housing will grow in areas that gain from internal migration, even though there may be unoccupied houses in areas that lose. Internal migration may thus have an effect on demand for residential construction and related facilities not unlike that of additions to total population, especially if the movement is from areas of low capital invest-

ment per head (as the countryside) to high (as urban communities). Likewise, if internal migration is a response to differential economic opportunities it may be tantamount to an increase in the supply of labor, since labor is flowing to higher-income and, presumably, more productive uses. In this sense, too, internal migration may be like net additions to population, in that it contributes to an increase in the effective labor supply.

The available data permit estimates of internal migration in the United States only for the native born, for the approximate decade intervals between the successive population censuses. Furthermore, the estimates show only the net surviving balance of migrants, not the total migration into and out of various areas within the country. It is impossible here to describe the calculations in detail.[6] For interstate migration the general procedure was to allow for the deaths of native born in a given decade for each state, for whites and nonwhites separately, by age and sex, and compare the number of survivors with the number shown in the state at the next census. The difference is the number of survivors of the total to-and-fro migration that occurred over the period, on the valid assumption that few native born left the country. For the rural-urban migration the general procedure was to assume, quite crudely, that the natural increase in native born over the census interval was the same for the rural and urban populations enumerated at the beginning of each census decade. The application of that rate of increase to the rural and urban bases separately shows the deficiency in the rural population matched by the excess in the urban, and the deficiency was used as an approximation to the rural-urban net migration.

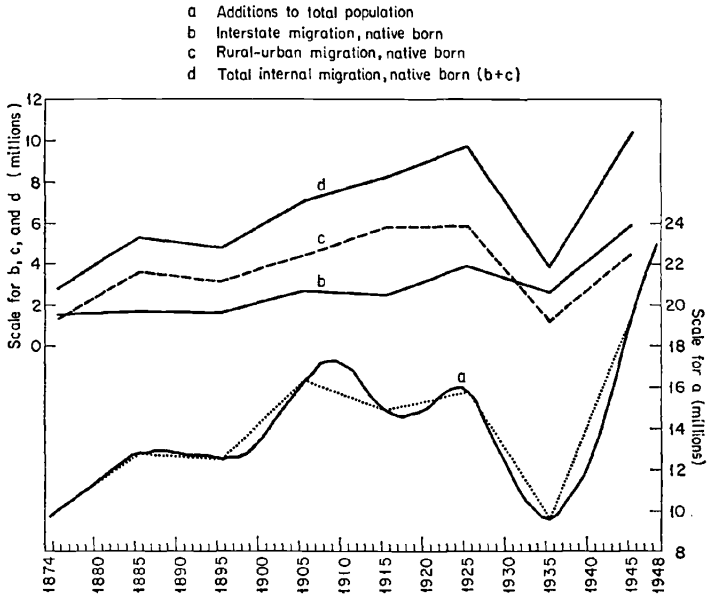
Both types of estimates understate the volume of internal migration by substantial fractions. The first, interstate migration, omits all migration within state boundaries. It is a measure of net shift, whereas a measure of gross in-migration to an area and one for the offseting out-migration would have been far more useful. The second, rural-urban migration, is an understatement because the true rates of natural increase tend to be significantly higher for the rural than for the urban sector, and because migration within the rural and, more importantly,

[6] See the parts dealing with population redistribution in *Population Redistribution and Economic Growth, United States, 1870–1950,* Vol. I, by E. S. Lee, A. R. Miller, C. P. Brainerd, and R. A. Easterlin, prepared under the direction of Simon Kuznets and Dorothy S. Thomas (Memoirs Volume 45, American Philosophical Society, 1957).

within the urban is not recorded. Understatement of the volume of internal migration is probably accompanied by an understatement of the amplitude of any long swings in that volume, not only because long, decadal intervals are used, but also because some of the more sensitive components of migration are not properly reflected.

CHART 5

Decadal Additions to Total Population Compared with Internal Migration of Native Born Per Decade, 1869–1955



These qualifications must be kept in mind when we compare internal migration with additions to total population (Chart 5). Internal migration (lines *b*, *c*, and *d*) had to be plotted in decadal units (with pro rata adjustments for the slight inequalities in the census decade intervals); and for additions to total population (line *a*), we added the line connecting the mid-points of the decadal intervals.

It is immediately apparent that even these rough measures of internal migration are subject to long swings, synchronous, on the whole, with those in additions to total population. There is one exception: during the decade including World War I, when additions to total population declined, the volume of rural-urban migration in-

creased—an expected and easily explained difference in movement. The impact of a great war, with the shift in production and population induced by military production and mobilization, intensifies internal migration, regardless of the movement in additions to total population. If the decade including World War II had fallen in the downward phase of a long swing in total population growth (as did the decade including World War I), we might have observed a second exception. But as the record stands, the synchronism appears significant.

As already indicated, our internal migration measures relate to native born population alone, while additions to total population include foreign born, and in fact the earlier long swings in total population were dominated by the long swings in immigration. Hence, in summary of the finding in Chart 5, the conditions that increased or retarded the pace of immigration and of additions to total population also increased or retarded the pace of internal migration of the native born population (largely adult, because the proportion of infant migrants is exceedingly low).

The comparison of internal migration with total additions to population is given in Table 60. The entries are for intercensal intervals, adjusted, when necessary, to precise decades.

Obviously, there is some overlap between interstate and rural-urban migration. Movement from one state to another may involve a shift from a rural to an urban area and, to that extent, adding the two totals leads to duplication. On the other hand since, for reasons indicated, each measure understates the true migration by a substantial fraction, there is little doubt that even the total of the two is an underestimate of the amount of net nontransient internal migration of the native born in each decade.

It is this observation that makes column 4 so impressive. Even these underestimates of decadal migration range from almost three-tenths to over six-tenths of the total additions to population. And I would not be surprised if the true volume of nontransient migration during any decade was at least equal to the total additions to population.

Several other findings are suggested by Table 60. (1) As part C shows, the changes between successive decades in total internal migration (column 4) and in interstate migration (column 2)—but not in rural-urban migration (column 3), because of the effect of World War I—are synchronous with changes in additions to total population (column 1). (2) The amplitude of long swings in internal migration is

TABLE 60

ADDITIONS TO TOTAL POPULATION COMPARED WITH INTERNAL MIGRATION OF NATIVE BORN, 1869–1952
(numbers in millions)

	Additions to Total Population (1)	*Native Born Migration* Interstate (2)	Rural-Urban (3)	Total Internal (2) + (3) (4)
	A. VOLUMES PER DECADE			
1. 1870–1880	10.0	1.52	1.30	2.82
2. 1880–1890	12.8	1.72	3.58	5.30
3. 1890–1900	12.5	1.64	3.13	4.77
4. 1900–1910	16.3	2.70	4.38	7.08
5. 1910–1920	14.9	2.48	5.78	8.26
6. 1920–1930	15.8	3.90	5.83	9.73
7. 1930–1940	9.6	2.63	1.26	3.89
8. 1940–1950	19.4	5.88	4.52	10.40
	B. INTERDECADE CHANGES, SUCCESSIVE PHASES			
9. Line 1 to line 2	2.8	0.20	2.28	2.48
10. Line 2 to line 3	−0.3	−0.08	−0.45	−0.53
11. Line 3 to line 4	3.8	1.06	1.25	2.31
12. Line 4 to line 5	−1.4	−0.22	1.40	1.18
13. Line 5 to line 6	0.9	1.42	0.05	1.47
14. Line 6 to line 7	−6.2	−1.27	−4.57	−5.84
15. Line 7 to line 8	9.8	3.25	3.26	6.51
	C. CHANGES BETWEEN SUCCESSIVE PHASES			
16. Line 9 to line 10	−3.1	−0.28	−2.73	−3.01
17. Line 10 to line 11	+4.1	+1.14	+1.70	+2.84
18. Line 11 to line 12	−5.2	−1.28	+0.15	−1.13
19. Line 12 to line 13	+2.3	+1.64	−1.35	+0.29
20. Line 13 to line 14	−7.1	−2.69	−4.62	−7.31
21. Line 14 to line 15	+16.0	+4.52	+7.83	+12.35

SOURCE, BY COLUMN

(1) Calculated from the five-year averages in Table R-37. For line 1, the entry was calculated as the difference between the five-year average centered at 1880 and the three-year average for 1869–1871, centered at 1870.
(2) Calculated from the study referred to in text footnote 6. Entries cover native white (from Table 1.11) and Negroes or nonwhites (from Table 1.14).
(3) Calculated from *ibid.*, Table P-4B, by method described in the text. Entries cover native whites and Negroes.

quite wide—indeed, wider on a relative basis than that in additions to total population (columns 4 and 1 in part C compared with the same columns in part A). With additions to total population running from about 1.6 to 3.5 times as large as total internal migration, the same relative amplitude of long swings should yield for column 4 of part C entries about three-tenths or six-tenths of those in column 1. Instead, the differential change for internal migration is in two cases (lines 16 and 20) either larger than or close to that in additions to total population; and in two other cases (lines 17 and 21), from about seven-tenths to over three-quarters as large. When population growth accelerates or decelerates, the volume of internal migration is affected even more, relatively.

Population and Capital Formation

Additions to population and its redistribution within the country obviously have far-reaching effects, direct and indirect, on the volume and structure of economic activity. Residential construction and many related types of capital formation are directly affected. True, the gross volume of residential construction is influenced even on the demand side by needs for replacement and by rising standards of living. On the supply side, in addition to the lag in the building industry's response to deficits and surpluses in supply, there are speculative excesses and financial ups and downs. Yet one may reasonably assume that population growth and internal migration are the major direct forces, and that long swings in population growth are probably followed by long swings in the volume of residential construction and related capital formation components.

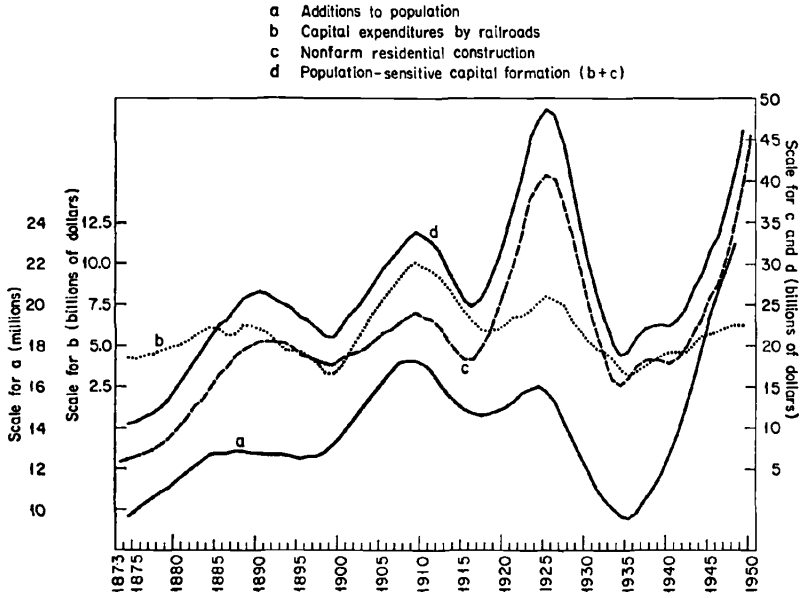
This assumption provides the rationale for Chart 6, in which we compare decadal additions to total population, as plotted in Charts 4 and 5, with corresponding totals in the two long series (among the few available to us) that might be said to represent population-sensitive capital formation—nonfarm residential construction, and gross capital expenditures (construction and equipment) by railroads, both in 1929 prices. (If our long series were more detailed, we might have been able to distinguish within capital formation other population-sensitive components, particularly within the large, miscellaneous "other" construction.) We assumed that railroad capital expenditures would be directly affected by population growth, and particularly by internal migration because expenditures for new construction and equipment would be responsive to demands created by additional population, in

the country as a whole and in areas gaining rapidly from internal migration. Conversely, once railroad construction was accelerated, it would in turn affect internal migration.

In Chart 6 the decadal volumes of gross nonfarm residential construction and of railroad construction and equipment expenditures are

CHART 6

Decadal Levels of Population-Sensitive Gross Capital Formation, 1929 Prices, Compared with Decadal Additions to Population, 1869–1955



compared with decadal additions to total population. More logically, net totals of capital formation might have been compared with net additions to population, but the former are estimated by deducting from the gross totals a rather approximate estimate of depreciation, and in trying to establish long swings, there is some advantage in using series that are not affected too much by crude statistical approximations. Needless to say, the long swings in the net volumes of nonfarm residential construction and of railroad capital expenditures would be even more marked than those in the gross series, and would perhaps have slightly earlier turning points.

The decadal totals of the capital formation components in Chart 6

are centered in the fifth year. Thus, additions to population from 1869 to 1879 inclusive, centered in 1874, are plotted against total nonfarm residential construction covering the years 1870 through 1879, centered in 1874. Because the population totals are mid-year figures, the exact center of the ten-year interval falls in the middle of 1874. Because the capital formation figures are for calendar years, the exact center of the ten-year period falls at the end of 1874. As plotted in Chart 6, the series allow for a lag of one-half year in capital formation behind the additions to population.

The series are statistically independent. The estimates of nonfarm residential construction for the years since 1884 are based largely on building permits and, for the earlier years, on crude breakdowns between residential and other construction, with the over-all construction totals derived largely from the flow of construction materials into domestic use. The capital expenditures by railroads were estimated on the basis of a large sample of reports by individual railroads. And the total additions to population are based on the decennial censuses and their age, sex, and other breakdowns.[7]

Both nonfarm residential construction and capital expenditures by railroads are subject to long swings, approximately the same in timing and duration as the long swings in additions to total population. The existence of these long up-and-down movements has been fairly firmly established, and is discussed in detail in the Grebler and Ulmer monographs.

The statistical measures relating to these swings in what we term population-sensitive capital formation are assembled in Table 61. The following findings are clearly indicated:

1. The timing of the long swings in nonfarm residential construction and in railroad capital expenditures is quite similar to that in the long swings in additions to population. During the nineteenth century, the turning points in the capital formation series tended to lag (see lines 2 and 3) (if there was such a lag in the 1870's, the record does not go back far enough to permit us to see it). The residential con-

[7] For details on the construction series, see Leo Grebler, David M. Blank, and Louis Winnick, *Capital Formation in Residential Real Estate: Trends and Prospects* (Princeton for NBER, 1956), pp. 34–37, and Appendixes A to F, pp. 327–386. The present study should also be consulted, particularly the notes to Tables R-14 and R-15, column 1, and Table R-30, columns 1 and 6. For the railroad series and its derivation, see Melville J. Ulmer, *Capital in Transportation, Communications, and Public Utilities: Its Formation and Financing* (Princeton for NBER, 1960), Appendixes A and C.

TABLE 61

TIMING AND AMPLITUDE OF LONG SWINGS IN ADDITIONS TO POPULATION AND IN POPULATION-SENSITIVE CAPITAL FORMATION, 1869–1955

(numbers in millions; amounts in billions of dollars, in 1929 prices)

		Additions to Population (1)	Gross Nonfarm Residential Construction (2)	Gross Capital Expenditures by Railroads (3)	Gross Population-Sensitive Capital Formation (2) + (3) (4)
		A. DATES OF TURNING POINTS			
1. First trough [a]		1874	1874	1875	1874
2. Peak		1888 (1885)	1890	1889	1890
3. Trough		1895 (1897)	1899	1899	1899
4. Peak		1909	1909	1909	1909
5. Trough		1917	1916	1918	1916
6. Peak		1924	1925	1925	1925
7. Trough		1935	1934	1935	1934
8. Peak [b]		1948	1948	1948	1948
		B. VOLUMES PER DECADE AT DATES INDICATED			
9. First trough	(line 1)	9.7	6.2	4.2	10.5
10. Peak	(line 2)	12.9 (12.8)	20.6	6.2	26.6
11. Trough	(line 3)	12.5 (12.6)	17.7	3.3	21.0
12. Peak	(line 4)	17.3	23.9	10.0	33.9
13. Trough	(line 5)	14.6	18.3	5.9	24.8
14. Peak	(line 6)	16.0	40.7	8.0	48.7
15. Trough	(line 7)	9.6	15.2	3.2	18.8
16. Peak	(line 8)	23.0	34.9	6.3	41.2
		C. CHANGES PER YEAR DURING SUCCESSIVE PHASES			
17. Trough to peak	(line 9 to line 10)	+0.23 (0.28)	+0.90	+0.14	+1.01
18. Peak to trough	(line 10 to line 11)	−0.06 (−0.02)	−0.32	−0.29	−0.62
19. Trough to peak	(line 11 to line 12)	+0.34	+0.62	+0.67	+1.29
20. Peak to trough	(line 12 to line 13)	−0.34	−0.80	−0.46	−1.30
21. Trough to peak	(line 13 to line 14)	+0.20	+2.49	+0.30	+2.66
22. Peak to trough	(line 14 to line 15)	−0.58	−2.83	−0.48	−3.32
23. Trough to peak	(line 15 to line 16)	+1.03	+1.41	+0.24	+1.60
		D. CHANGES BETWEEN SUCCESSIVE PHASES			
24. Trough to trough	(line 17 to line 18)	−0.29	−1.22	−0.43	−1.63
25. Peak to peak	(line 18 to line 19)	+0.40	+0.94	+0.96	+1.91
26. Trough to trough	(line 19 to line 20)	−0.68	−1.42	−1.13	−2.59
27. Peak to peak	(line 20 to line 21)	+0.54	+3.29	+0.76	+3.96
28. Trough to trough	(line 21 to line 22)	−0.78	−5.32	−0.78	−5.98
29. Peak to peak	(line 22 to line 23)	+1.61	+4.24	+0.72	+4.92

Because of rounding, detail will not necessarily add to total.

[a] For first year included in all series.

[b] For last year included in all series.

NOTES TO TABLE 61

SOURCE, BY COLUMN

(1) See notes to Table 59.

(2) Ten-year moving totals calculated from the annual series underlying Table R-30. The totals are centered in the fifth year.

(3) Ten-year moving totals calculated from the annual series given through 1950 in Melville J. Ulmer, *Capital in Transportation, Communications, and Public Utilities: Its Formation and Financing* (Princeton for NBER, 1960), Table C-1, col. 4, p. 257. Ulmer's series on gross capital expenditures in current prices was extrapolated through 1954 by expenditures for new plant and equipment by railroads (*Statistical Abstract of the United States, 1956*, p. 498). His index of cost of road and equipment was extrapolated by the index implicit in railroad construction (*ibid.*, pp. 757 and 758). From these two series it was possible to calculate an extension of the 1929 price series on gross capital expenditures.

struction estimates before 1889 are rather crude, but the series on railroad capital expenditures is not. Offhand one might expect a lag in the response of construction and capital equipment expenditures to population increase, but its length would depend upon conditions of the productive system over the period—with which we are not familiar.

2. The amplitude of the long swings in both residential construction and railroad capital expenditures is far wider than the amplitude of the swings in additions to total population. This is not unexpected because increase in numbers is only one of several temporally correlated factors (internal migration, per capita income changes, and others) that would produce long swings in residential construction and in railroad capital expenditures.

3. The amplitude of the long swings in the capital formation components would have been far wider had we used net rather than gross volumes.

4. The amplitude of those long swings, relative to the average volume, widened over the period, as did the amplitude of long swings in additions to population. While this finding should be qualified in view of the crudity of the estimates of nonfarm residential construction during the first two decades, it has been established over the shorter period in the Grebler monograph, and merits consideration at least as a tentative finding.

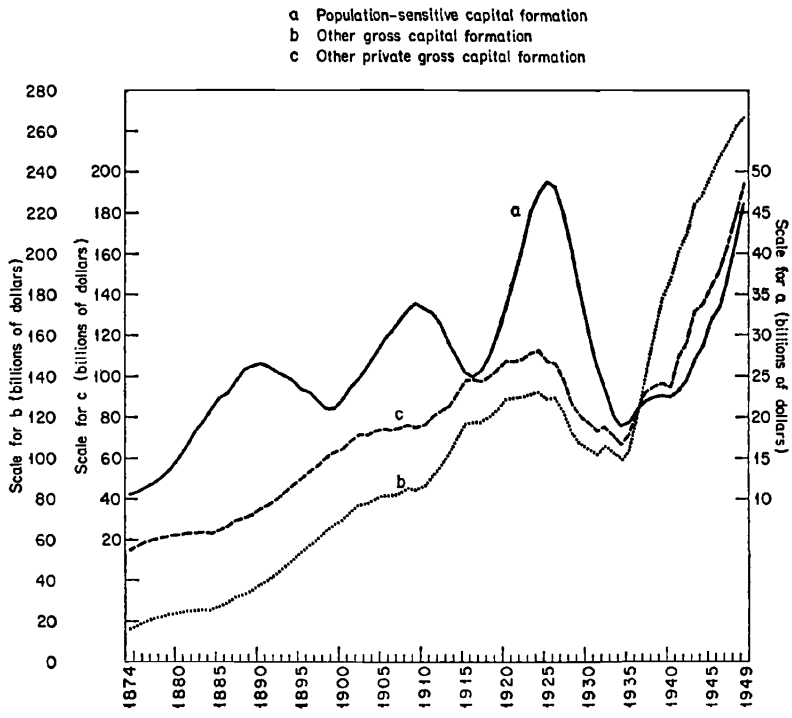
5. Association in time is not causation, and the association found is no proof that the swings in population growth and internal migration produce swings in residential and railroad construction. Indeed, it may well be that other factors produce at the same time swings in population growth and internal migration, as well as those in residential and railroad construction; and that if the former swings induced the latter

swings the lags would have been longer and the synchronism less conspicuous. The mechanism of connection is still to be explored.

We now turn to the other components of capital formation and ask how they move when the population-sensitive components display long swings of rather wide amplitude that are synchronous with the long swings in population growth and in internal migration. The answer to this question is provided in Chart 7, in which the successive ten-year totals of population-sensitive capital formation are plotted alongside ten-year totals of residual (that is, "other") capital formation, the latter including or excluding government. The residual is a miscellaneous category which, in line *b* comprises "other" construction including government, "other" producers' durable equipment including munitions, changes in inventories, and changes in claims against foreign

CHART 7

Population-Sensitive Capital Formation Compared with Other Gross Capital Formation and Other Private Gross Capital Formation, Decadal Levels in 1929 Prices, 1870–1954



countries. In line *c* government is excluded and we deal with "other" private capital formation alone, i.e., a sum of "other" private construction, "other" producers' durables exclusive of munitions, changes in inventories, and changes in foreign claims. In both cases there is a *semblance* of negative association until the 1920's, and positive association thereafter between long swings in population-sensitive capital formation and in "other" capital formation.

Table 62 provides a check on this impression. Here we record the standings, changes per year during successive phases, and differential changes between successive phases for total and other capital formation, during the phases of long swings in population-sensitive capital formation. To use the National Bureau terminology, we employ the dates of turning points in long swings in population-sensitive capital formation as a reference chronology for observing changes in total and private gross capital formation (columns 2 and 4) and other capital formation, inclusive and exclusive of government (columns 3 and 5). By comparing column 1 with columns 3 and 5, lines 16 to 19, we find that through the first four swings (trough to trough and peak to peak) the differential change in other capital formation moved inversely to the differential change in population-sensitive capital formation. This suggests that when population-sensitive capital formation was increasing more rapidly, other capital formation was increasing less rapidly, and vice versa. It suggests also that there were limits to total capital formation with the result that acceleration (or deceleration) in the population-sensitive components left so much less (or so much more) room for the growth of other capital formation. This restraining influence of a limit on total capital formation appears to have been removed in the 1920's, and synchronism has prevailed since then.[8]

[8] This is only one possible interpretation, for much depends upon the mechanism of response. In his comments on this chapter, Abramovitz argued an alternative interpretation, based largely upon a positive association between population-sensitive and other capital formation, with a long lag (not assumed here) of the population-sensitive components behind other capital formation, particularly at the peak. In other words, with other capital formation more closely keyed to the rate of change in output and income than are the population-sensitive components (which are more closely associated with population growth), the negative association observed before World War I may have arisen because the rate of growth of output reached its peaks and troughs long before population growth did, and because of the sluggish response of railroad construction and house building to deficits and surpluses in the supply of railroad facilities and houses.

At the present juncture, we cannot say which interpretation is the more likely. But the point to be stressed here is that, given the possibility of varying leads and lags among the variables in the response of one to the other (for instance, of resi-

TABLE 62

CHANGES IN POPULATION-SENSITIVE AND OTHER GROSS CAPITAL FORMATION DURING PHASES OF LONG SWINGS IN POPULATION-SENSITIVE CAPITAL FORMATION, 1870–1954
(billions of dollars, in 1929 prices)

		Gross Capital Formation				
		Population-Sensitive (1)	Total Including Military (2)	Other (2) − (1) (3)	Total Private (4)	Other Private (4) − (1) (5)
A. VOLUMES PER DECADE AT DATES OF TURNING POINTS IN COLUMN 1						
1. Trough, 1874		10.5	26.6	16.1	25.3	14.8
2. Peak, 1890		26.6	64.4	37.8	61.5	34.9
3. Trough, 1899		21.0	88.6	67.6	83.9	62.9
4. Peak, 1909		33.9	118.3	84.4	108.7	74.8
5. Trough, 1916		24.8	142.0	117.2	122.4	97.6
6. Peak, 1925		48.7	177.5	128.8	155.7	107.0
7. Trough, 1934		18.8	118.0	99.2	85.1	66.3
8. Peak, 1948		41.2	302.5	261.3	219.8	178.6
B. CHANGES PER YEAR DURING SUCCESSIVE PHASES						
9. Trough to peak	(line 1 to line 2)	+1.01	+2.36	+1.36	+2.26	+1.26
10. Peak to trough	(line 2 to line 3)	−0.62	+2.69	+3.31	+2.49	+3.11
11. Trough to peak	(line 3 to line 4)	+1.29	+2.97	+1.68	+2.48	+1.19
12. Peak to trough	(line 4 to line 5)	−1.30	+3.39	+4.69	+1.96	+3.26
13. Trough to peak	(line 5 to line 6)	+2.66	+3.94	+1.29	+3.70	+1.04
14. Peak to trough	(line 6 to line 7)	−3.32	−6.61	−3.29	−7.84	−4.52
15. Trough to peak	(line 7 to line 8)	+1.60	+13.18	+11.58	+9.62	+8.02
C. CHANGES BETWEEN SUCCESSIVE PHASES						
16. Trough to trough	(line 9 to line 10)	−1.63	+0.33	+1.95	+0.23	+1.85
17. Peak to peak	(line 10 to line 11)	+1.91	+0.28	−1.63	−0.01	−1.92
18. Trough to trough	(line 11 to line 12)	−2.59	+0.42	+3.01	−0.52	+2.07
19. Peak to peak	(line 12 to line 13)	+3.96	+0.55	−3.40	+1.74	−2.22
20. Trough to trough	(line 13 to line 14)	−5.98	−10.55	−4.58	−11.54	−5.56
21. Peak to peak	(line 14 to line 15)	+4.92	+19.79	+14.87	+17.46	+12.54

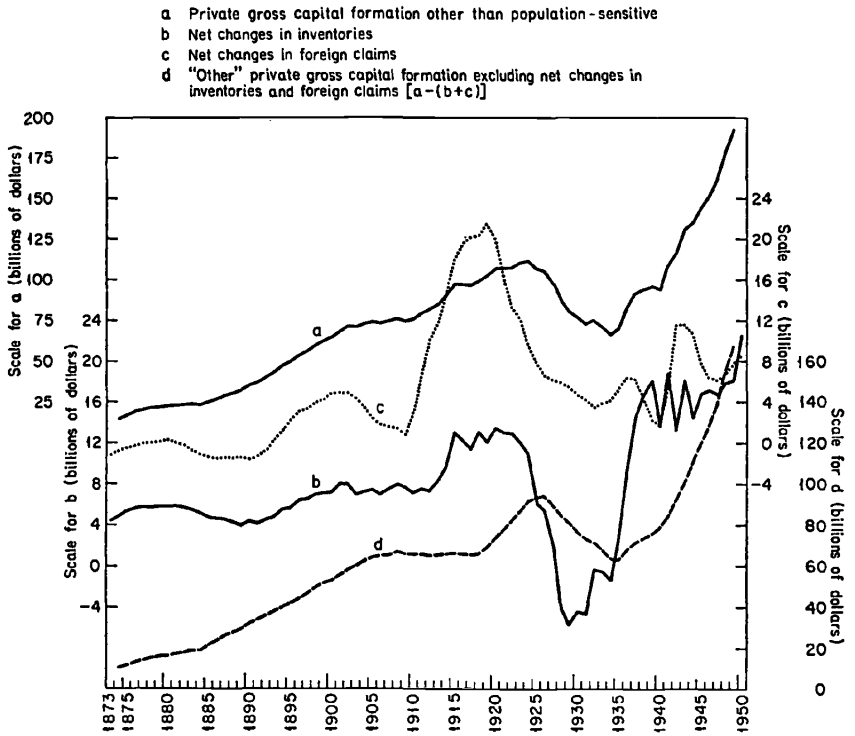
SOURCE, BY COLUMN

(1) See Table 61, col. 4.
(2) Ten-year moving totals, calculated from the annual series underlying Table R-29, centered on fifth year.
(4) Col. 2 minus ten-year moving totals of government construction and munitions, calculated from the annual series underlying Table R-30, or given in Table R-7.

To test the probability of the inverse correlation in long swings between population-sensitive and other capital formation, we first distinguish the major subcomponents of other capital formation and observe the characteristics of their long swings. In Chart 8 we have the

CHART 8

Decadal Levels of Components of Private Gross Capital Formation Other Than Population-Sensitive, 1929 Prices, 1869–1955



successive decade totals, in 1929 prices, for private gross capital formation excluding nonfarm residential construction and railroad capital expenditures; other private construction plus other private producers'

dential construction to population growth), an interpretation of the association in movements over time depends upon the lead and lag allowed. If time discrepancies in response are substantial, synchronism may in fact mean absence, rather than presence, of significant association. This problem is particularly acute with long-term changes, because the time variance of the leads and lags can be much wider than in the short-term fluctuations associated with business cycles.

TABLE 63

TIMING AND AMPLITUDE OF LONG SWINGS IN COMPONENTS OF GROSS CAPITAL FORMATION OTHER THAN POPULATION-SENSITIVE, 1869–1955
(billions of dollars, in 1929 prices)

		Gross Capital Formation Other Than Population-Sensitive				
		Total (1)	Private (2)	Private Construction and Producers' Durables (3)	Net Changes in Inventories (4)	Net Changes in Foreign Claims (5)
A. DATES OF TURNING POINTS						
1. First peak		1877	1876	1876	1881	1880
2. Trough		1884	1884	1884	1889	1890
3. Peak		1902	1902	1906 (1908)	1901	1901
4. Trough		1909	1909	1917	1912	1909
5. Peak		1924	1924	1926	1920	1919
6. Trough		1934	1934	1935	1929	1932 (1940)
7. Peak (for last year included in all series)		1948	1948	1948	1941	1942
B. VOLUMES PER DECADE AT DATES INDICATED						
8. Peak	(line 1)	21.4	18.7	13.3	5.87	0.22
9. Trough	(line 2)	25.4	23.1	19.1	3.97	−1.63
10. Peak	(line 3)	77.2	71.3	64.8 (66.7)	8.07	4.89
11. Trough	(line 4)	84.4	74.8	65.4	7.30	0.92

12. Peak	(line 5)	131.9	111.9	93.5	13.47	21.56
13. Trough	(line 6)	99.2	66.3	63.1	−5.74	3.54 (1.57)
14. Peak	(line 7)	261.3	178.6	154.2	18.72	11.52
C. CHANGES PER YEAR DURING SUCCESSIVE PHASES						
15. Peak to trough	(line 8 to line 9)	+0.57	+0.55	+0.72	−0.24	−0.18
16. Trough to peak	(line 9 to line 10)	+2.88	+2.68	+2.08 (+1.98)	+0.34	+0.59
17. Peak to trough	(line 10 to line 11)	+1.03	+0.50	+0.05 (−0.14)	−0.07	−0.50
18. Trough to peak	(line 11 to line 12)	+3.17	+2.47	+3.12	+0.77	+2.06
19. Peak to trough	(line 12 to line 13)	−3.27	−4.56	−3.38	−2.13	−1.39 (−0.95)
20. Trough to peak	(line 13 to line 14)	+11.58	+8.02	+7.01	+2.04	+0.80
D. CHANGES BETWEEN SUCCESSIVE PHASES						
21. Peak to peak	(line 15 to line 16)	+2.31	+2.13	+1.36 (+1.26)	+0.58	+0.77
22. Trough to trough	(line 16 to line 17)	−1.85	−2.18	−2.03 (−2.12)	−0.41	−1.09
23. Peak to peak	(line 17 to line 18)	+2.14	+1.97	+3.07	+0.84	+2.56
24. Trough to trough	(line 18 to line 19)	−6.44	−7.03	−6.50	−2.90	−3.45 (−3.01)
25. Peak to peak	(line 19 to line 20)	+14.85	+12.58	+10.39	+4.17	+2.19

SOURCE, BY COLUMN

(1) Calculated from the sources and by the procedure shown for Table 62, col. 3.

(2) Calculated from the sources and by the procedure shown for Table 62, col. 5.

(3) Series underlying col. 2 minus series underlying cols. 4 and 5.

(4) and (5) Based on ten-year moving totals calculated from the annual series underlying Table R-34, centered on fifth year.

durables; net changes in inventories; and net changes in claims against foreign countries.

On the whole, the dating of the long swings in these four totals is fairly similar. Of particular interest are the prominent swings in the net changes in claims against foreign countries, a series that is statistically independent of the others and has an adequate basis. The series on net changes in inventories is less significant, because before 1919 it was estimated largely as a function of changes in total commodity flow. All one can say about it is that if changes in inventories can reasonably be estimated as such a function, the timing of their long swings is fairly similar to that of the long swings in net changes in foreign claims and in other private capital formation. The series on other construction and producers' durables (line *d*), quantitatively a major component of total or of private capital formation, shows swings that are a bit different in timing from the others—reaching a peak late rather than early in the first decade of this century. But the similarity of long swings in the several totals—excluding government construction and munitions which we would not expect to follow the same pattern—is clear.

Table 63 presents the usual measures of the long swings for the four totals in Chart 8 and, in addition, for the widest total of "other" capital formation—gross, including government. It indicates the rather marked amplitude of the long swings, not only in the net change components (inventories and foreign claims), but also in the gross components in column 3. And it shows, particularly in parts A and D, that, given the rough similarity in dating of the long swings, there is a fair correlation among the long swings in the components of other capital formation. Long swings with approximately the same dating can be found in all of them.

In our final test of the probability of the inverse correlation in long swings between population-sensitive and "other" capital formation, we turn to Table 64. Here we use the dates of turning points of the long swings in population-sensitive capital formation as a reference chronology (as in Table 62) and measure standings and changes for the resulting reference phases in the total and the three components of other private capital formation (excluding the government component, because it may be affected by many other factors).

In lines 16 to 19, we would expect to find a series of +, −, +, −, an exact inversion of the sequence of differential changes between successive phases of population-sensitive capital formation (which runs

TABLE 64

CHANGES IN COMPONENTS OF PRIVATE GROSS CAPITAL FORMATION OTHER THAN POPULATION-SENSITIVE DURING PHASES OF LONG SWINGS IN POPULATION-SENSITIVE CAPITAL FORMATION, 1870–1954
(billions of dollars, in 1929 prices)

	Private Gross Capital Formation Other Than Population-Sensitive			
	Total (1)	Construction and Producers' Durables (2)	Net Changes in Inventories (3)	Net Changes in Foreign Claims (4)
A. VOLUMES PER DECADE AT DATES OF TURNING POINTS IN POPULATION-SENSITIVE CAPITAL FORMATION				
1. First trough, 1874	14.8	10.7	4.9	−0.8
2. Peak, 1890	34.9	32.2	4.3	−1.6
3. Trough, 1899	62.9	51.5	7.1	4.2
4. Peak, 1909	74.8	66.2	7.7	0.9
5. Trough, 1916	97.6	65.8	12.2	19.6
6. Peak, 1925	107.0	92.9	6.2	8.0
7. Trough, 1934	66.3	63.5	−1.4	4.1
8. Peak, 1948	178.6	154.2	17.7	6.6
B. CHANGES PER YEAR DURING SUCCESSIVE PHASES				
9. Trough to peak (line 1 to line 2)	+1.26	+1.34	−0.04	−0.05
10. Peak to trough (line 2 to line 3)	+3.11	+2.14	+0.31	+0.64
11. Trough to peak (line 3 to line 4)	+1.19	+1.47	+0.06	−0.33
12. Peak to trough (line 4 to line 5)	+3.26	−0.06	+0.64	+2.67
13. Trough to peak (line 5 to line 6)	+1.04	+3.01	−0.67	−1.29
14. Peak to trough (line 6 to line 7)	−4.52	−3.27	−0.84	−0.43
15. Trough to peak (line 7 to line 8)	+8.02	+6.48	+1.36	+0.18
C. CHANGES BETWEEN SUCCESSIVE PHASES				
16. Trough to trough (line 9 to line 10)	+1.85	+0.80	+0.35	+0.69
17. Peak to peak (line 10 to line 11)	−1.92	−0.67	−0.25	−0.97
18. Trough to trough (line 11 to line 12)	+2.07	−1.53	+0.58	+3.00
19. Peak to peak (line 12 to line 13)	−2.22	+3.07	−1.31	−3.96
20. Trough to trough (line 13 to line 14)	−5.56	−6.28	−0.17	+0.86
21. Peak to peak (line 14 to line 15)	+12.54	+9.75	+2.20	+0.61

Because of rounding, detail will not necessarily add to total.

For dates of turning points, see Table 61, col. 4. For source, see notes to Table 63, cols. 2, 3, 4, and 5, respectively.

−, +, −, +). We do find such complete negative association for net changes in inventories and net changes in claims against foreign countries (columns 3 and 4). Before the 1920's, upswings in population-sensitive capital formation were accompanied by downswings in inventory accumulation and in capital exports (upswings in capital imports); and, conversely, downswings in population-sensitive capital formation were accompanied by upswings in inventory accumulation and in capital exports (downswings in capital imports). Of these associations the most interesting is that with capital imports. When population-sensitive capital formation was in the up-phase of the long swing—presumably in response to an upswing in immigration, native population growth, and internal migration—capital imports were also in the up-phase of the long swing; and the same association persisted in the downswing.

The results for other private construction and producers' durables are not so clear (lines 16 to 19, column 2). There are only two agreements out of the four expected, and the case of negative association is not proved as it stands. But one qualification of this finding must be taken into consideration. Nonfarm residential construction and capital expenditures by railroads are not the only components of capital formation that can be regarded as directly and positively affected by additions to population and by internal migration. There are a variety of others—construction of stores, local transportation facilities, service establishments, and so on—which, being directly geared to the provision of services to ultimate consumers, could be expected to reflect the long swings in the additions to population and in the extent of migration to new areas. All these population-sensitive components of capital formation are included in the category labeled "other" private construction and producers' durables (column 2 of Table 64). This, therefore, is a mixed category, and may include substantial components whose long swings are positively, rather than negatively, associated with the long swings in population growth. If we could draw a finer line of distinction, and remove more of the population-sensitive components, column 2 might show the same sequence of signs in lines 16 through 19 as columns 3 and 4 show, indicating negative association with the measures for additions to population.

We conclude this section with the tentative findings that the long swings in additions to population and in internal migration are synchronous with long swings in population-sensitive components of capital formation (nonfarm residential construction and capital expendi-

tures by railroads, which can be segregated in our estimates, and probably in several other components which cannot be segregated); until the 1920's these long swings in population growth and in population-sensitive capital formation are coterminous with *opposite* swings in "other" private capital formation (total, net changes in inventories, net changes in foreign claims, and possibly the "other" construction and producers' durables components). But the association between the long swings in population-sensitive and other capital formation shifted from negative to positive, beginning with the 1920's. This suggests that whatever factors tended to prevent synchronous acceleration in the population-sensitive and the other components of capital formation before the 1920's ceased to be operative after World War I.

Population Movements and Additions to Product

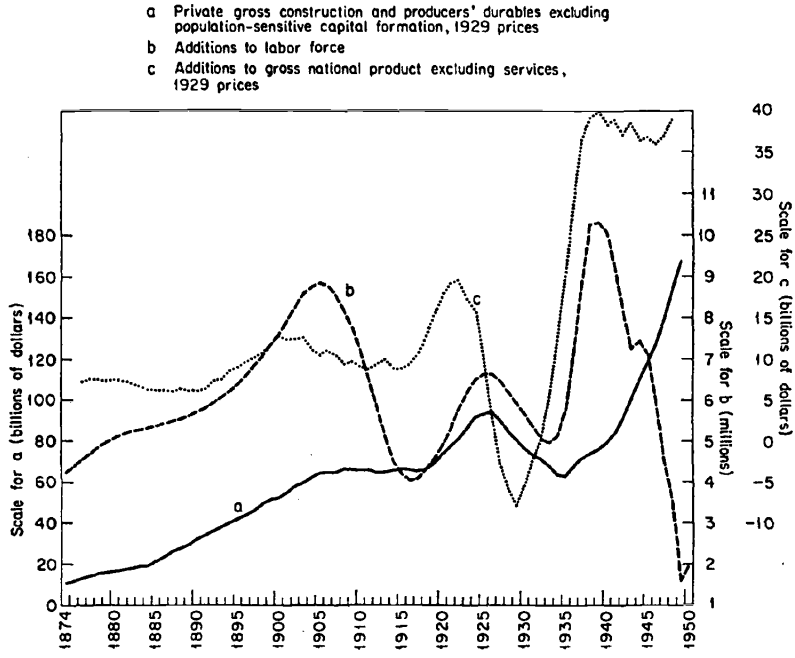
In the preceding discussion of the possible effects of long swings in population growth and internal migration on demand for certain population-sensitive components of capital formation, we found, in addition to the expected positive association, a negative association with long swings in "other" capital formation before the 1920's. The question naturally arises whether these associations have affected total output.

A first, rather tentative, answer to this question is suggested by the comparisons in Chart 9. Line *a* relates to private construction and producers' durables, excluding the population-sensitive components. This is a measure of gross additions to durable capital stock within the country, excluding stock serving primarily needs for housing and railroad transportation (its inclusion would not change the picture materially). We might have included also changes in inventories but, in view of the rough basis of the estimates before 1919, it seemed best to omit that component.

Line *b* measures decadal additions to the labor force. It would have been desirable to limit the series to additions to the labor force not engaged in nonfarm residential construction or in producing construction materials, but that was impossible with the existing data. Another desirable exclusion would have been the labor force engaged in provision of services not embodied in commodities. We can only hope that the long swings in the labor force excluding those engaged in construction, production of construction materials, and provision of serv-

CHART 9

Decadal Levels of Private Gross Construction and Producers' Durables Excluding Population-Sensitive Capital Formation, and Decadal Additions to Labor Force, Compared with Decadal Additions to Gross National Product Excluding Services, 1870–1955



ices are not unlike the swings in the total labor force portrayed in Chart 9.

The two lines just described, which represent additions to factors of production, are compared with additions to gross national product excluding services (line *c*). Services are excluded because two major components are the net yield of residential housing, and government services (and we wish to exclude the latter from the analysis). The comparison is thus quite crude, and yet the results merit consideration.

There is fair consilience between the combined movements of "other" private durable capital formation and additions to the labor force, on the one hand, and additions to what might be called gross commodity product, on the other. There is a downswing in capital formation from the mid-1870's to the early 1880's, and in additions

to the labor force from the late 1870's to the late 1880's; and there is a similar downswing in additions to gross commodity product from the late 1870's to the late 1880's. There is an upswing in capital formation from the early 1880's to about the middle of the first decade of the twentieth century, and an upswing in additions to the labor force from the late 1880's also to the middle of the first decade of this century; and an upswing in additions to commodity product from the late 1880's to about 1900. There follows a downswing in capital formation from about the middle of the first decade of this century to about 1917, and a marked downswing in additions to the labor force from about 1905 to about 1916; and a similar downswing in additions to gross commodity product from about 1900 to about 1915. Beyond World War I the similarity continues—provided we combine the movements of capital formation and additions to labor force.

The association just described is measured in Table 65 which records the standings, the changes per year during successive phases, and the differential changes between successive phases, for all the series during the phases of the long swings in additions to gross national product excluding services. Lines 16 to 21 are particularly instructive. If the changes in capital formation and labor are weighted equally (the latter should be given greater weight, but the labor force totals used here are more comprehensive than they should be for our purposes), the sum of the differential changes in columns 2 and 3 agrees in sign with those in column 1 in five out of six cases. The implication is that long swings in additions to gross national product, excluding services, are associated with long swings in private gross durable capital formation, excluding the population-sensitive components, and with long swings in additions to the labor force.

It should be remembered that long swings in additions to population were associated, at least until the 1920's, with opposite swings in capital formation other than population-sensitive. If this other capital formation contributed to swings in additions to commodity product (national, excluding services), there should have been, at least until the 1920's, a negative association between long swings in population growth and in additions to commodity product. This is confirmed, if only partly, in column 4 of Table 65, where we measure changes in additions to total population during phases of long swings in additions to commodity product. During the first two phases (lines 16 and 17), the differential change in long swings of population growth (column 4)

TABLE 65

CHANGES IN PRIVATE GROSS CONSTRUCTION AND PRODUCERS' DURABLES EXCLUDING POPULATION-SENSITIVE CAPITAL FORMATION, AND IN ADDITIONS TO LABOR FORCE COMPARED WITH CHANGES IN ADDITIONS TO GROSS NATIONAL PRODUCT EXCLUDING SERVICES DURING PHASES OF LONG SWINGS IN THE LATTER, 1870–1955

(dollars in billions, in 1929 prices; numbers in millions)

	Additions to GNP Excluding Services (1)	Private Gross Construction and Producers' Durables Excluding Population-Sensitive Capital Formation (2)	Additions to Labor Force (3)	Additions to Population (4)
A. VOLUMES PER DECADE AT DATES OF TURNING POINTS IN COLUMN 1				
1. First peak, 1880	7.46	15.8	5.07	11.5
2. Trough, 1890	6.09	32.2	5.68	12.8
3. Peak, 1900	12.85	52.6	7.61	13.6
4. Trough, 1915	8.88	66.4	4.19	14.9
5. Peak, 1922	19.60	81.6	5.78	15.7
6. Trough, 1929	−7.73	80.7	5.94	12.7
7. Peak, 1939	39.91	75.6	10.29	11.7
8. Trough[a] 1946	36.01	127.7	6.01	20.7

B. CHANGES PER YEAR DURING SUCCESSIVE PHASES					
9. Peak to trough	(line 1 to line 2)	−0.14	+1.64	+0.06	+0.13
10. Trough to peak	(line 2 to line 3)	+0.68	+2.04	+0.19	+0.08
11. Peak to trough	(line 3 to line 4)	−0.26	+0.92	−0.23	+0.09
12. Trough to peak	(line 4 to line 5)	+1.53	+2.17	+0.23	+0.11
13. Peak to trough	(line 5 to line 6)	−3.90	−0.13	+0.02	−0.43
14. Trough to peak	(line 6 to line 7)	+4.76	−0.51	+0.44	−0.10
15. Peak to trough	(line 7 to line 8)	−0.56	+7.44	−0.61	+1.29
C. CHANGES BETWEEN SUCCESSIVE PHASES					
16. Peak to peak	(line 9 to line 10)	+0.81	+0.40	+0.13	−0.05
17. Trough to trough	(line 10 to line 11)	−0.94	−1.12	−0.42	+0.01
18. Peak to peak	(line 11 to line 12)	+1.80	+1.25	+0.46	+0.02
19. Trough to trough	(line 12 to line 13)	−5.44	−2.30	−0.20	−0.54
20. Peak to peak	(line 13 to line 14)	+8.67	−0.38	+0.41	+0.33
21. Trough to trough	(line 14 to line 15)	−5.32	+7.95	−1.05	+1.39

[a] Last year included in all series.

SOURCE, BY COLUMN

(1) Changes between five-year moving averages ten years apart, centered on the fifth year. The averages are calculated from the annual estimates underlying the series in Tables R-26 and R-28.

(2) See Table 64, notes to col. 2.

(3) Changes between five-year moving averages ten years apart, centered in the middle of the decade. The averages are calculated from the annual estimates underlying the series in Table R-39.

(4) See Table 59, notes to col. 3.

bears a sign opposite to that for additions to commodity product (column 1). The correlation would be more significantly negative if column 1 were based on additions to commodity product per capita.

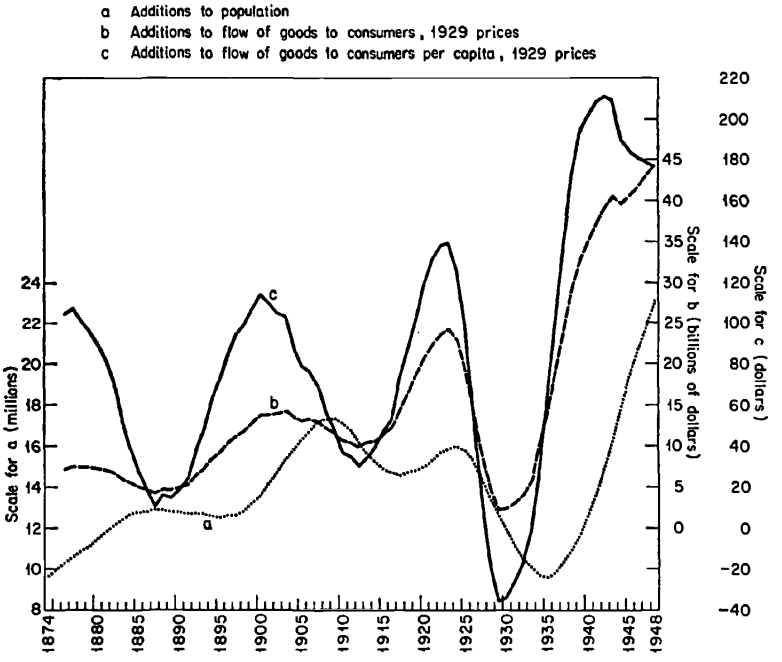
The associations indicated in Chart 9 and Table 65 suggest a mechanism by which long swings in population growth produced, at least before the 1920's, opposite swings in additions to product. The acceleration or retardation in growth of population numbers, by producing similar swings in population-sensitive capital formation, resulted in opposite swings in all other capital formation. At the same time, those swings in population growth, even if largely dominated by immigration, did not result immediately in similar swings in additions to the labor force. The reasons may be that there were other movements in labor force participation by the population already resident in the country, and also that—insofar as swings in population growth were produced by up-and-down movements in the rate of natural increase—additions to the labor force would come much later. Hence the inverted swings in other than population-sensitive capital formation, not offset by any positive swings in additions to the labor force, tended to produce swings in additions to product that were, until the 1920's, negatively associated with swings in population growth.

Another facet of this association is portrayed graphically in Chart 10. Here we have decadal additions to total population compared with decadal additions to flow of goods to consumers, total and per capita. All three measures are calculated in identical fashion—as changes between five-year moving averages, ten years apart, and centered in the middle of each decade interval.

Total flow of goods to consumers includes services not embodied in new commodities but does not include capital formation. In these two respects it differs from the gross commodity product changes plotted in Chart 9. But because flow of goods to consumers is such a large fraction of gross national product, and because the movement of services in the short run was estimated for the earlier years as a function of commodity movement, the movement of additions to total flow of goods to consumers in Chart 10 is more or less like that of additions to total commodity product in Chart 9. The similarity indicates that the factors suggested earlier as determinants of the long swings in additions to total commodity product also determine the long swings in additions to flow of goods to consumers. It is these factors that produce a semblance of negative association between long swings in population

CHART 10

Decadal Additions to Population Compared with Decadal Additions to Flow of Goods to Consumers, 1869–1955



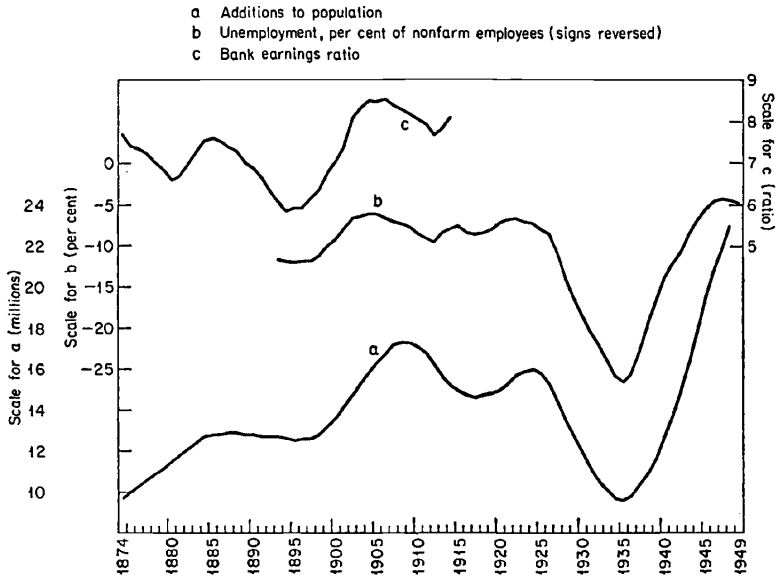
growth and those in additions to total flow of goods to consumers, until the period of World War I.

As a result, the long swings in additions to flow of consumer goods *per capita* are inverted to those in additions to population in the years before World War I—and quite prominent. Yet they suggest one explanation of the swings in additions to population, if we allow for a long lag that would, in a sense, turn negative into positive association. It must be remembered that an important component of additions to population was immigration. Immigration, particularly in its timing, could be assumed to be responsive to the pull—that is, largely to conditions in this country rather than in the country of origin. This assumption of responsiveness to the pull is clearly indicated by the fact that *net* additions were affected not only by gross inflow but also by emigration, which clearly reflected conditions in this country. It is indicated also by the fact that the long swings in emigration from va-

rious countries of origin were fairly similar.[9] One could, then, argue that a sizable reduction in additions to per capita flow of goods to consumers (with some lag), all other conditions being equal, would represent a discouragement to immigration, while a sizable rise in additions to per capita flow of goods to consumers would represent an encouragement. This is not to contend that additions to per capita

CHART 11

Decadal Additions to Population Compared with Decadal Levels of Unemployment and Bank Earnings Ratio, 1870–1955



flow of goods to consumers were necessarily a major element in producing swings in immigration, and thus in additions to population (as well as in internal migration and natural increase), but they may have contributed to them. The importance of additions to per capita flow of goods to consumers in the present connection lies in the fact that, at least before World War I, they can be identified as after-effects of long swings in population growth.

That the swings in additions to per capita flow of goods to consumers do not tell the whole story is suggested by Chart 11. We tried, in this

[9] On these points see further evidence in Kuznets, "Long Swings in the Growth of Population."

chart, to compare the long swings in population growth with some measures of the state of the economy that would indicate changes in degree of engagement of resources and profitability—conditions of pull that would affect not only net immigration but also internal migration and the rate of natural increase. We found only two relevant measures for the long period to be covered, although a further search might unearth more. One is an index of unemployment taken as a percentage of nonfarm employees. Even pieced out in various ways, this index could be carried back only to the early 1890's. The other index is the profit earning record of national banks (the ratio of profits to total capital accounts). The indexes, shown as lines *b* and *c* in Chart 11, are decadal averages centered on the fifth year.

In both series, the long swings reflecting general economic conditions, while similar to those in population additions, precede them by significant periods varying from two to five years. The indexes have turning points that, in consequence, are fairly close in timing to those in additions to per capita flow of goods to consumers in Chart 10. They add to the impression that there may be some validity in assuming that the lag in response of population movements to changes in economic conditions in the United States contributed in some measure to the inverted long swings in additions to product per capita, which set the stage for the next long swing in population growth.

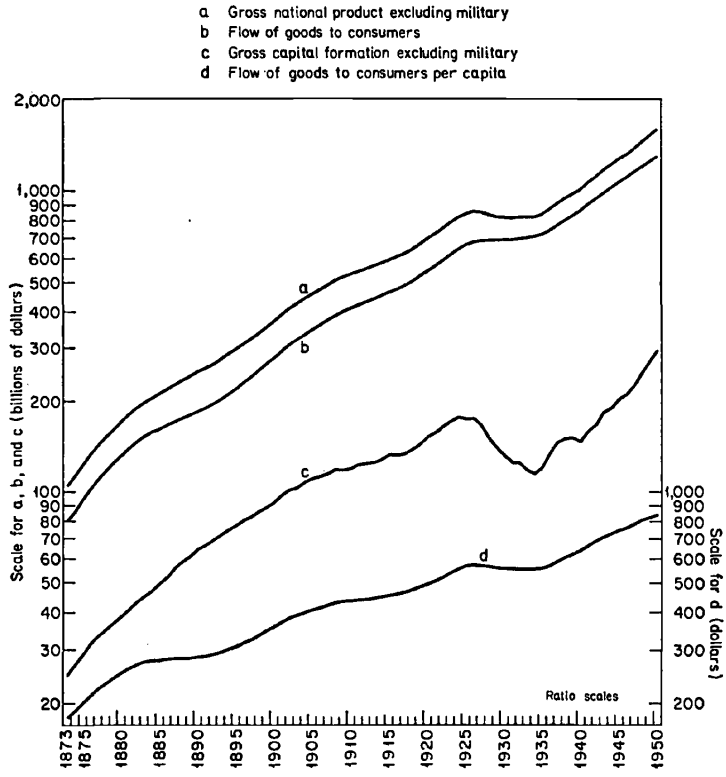
If there was such a self-perpetuating mechanism of long swings before World War I, it disappeared thereafter. The reasons for the change are not far to seek. To begin with, immigration was greatly restricted. Second, the two world wars made for a change in timing that brought about a coincidence of the long swings in residential construction and in other components of capital formation. Finally, the productive capacity of the country after World War I was such that the earlier limits that prevented synchronous upswings in population-sensitive capital formation and in other capital formation ceased to operate. This is clearly indicated by the shift from debtor to creditor position in the international capital markets, by the ease with which expansions were attained after World War I without running into the capacity bottlenecks that were a common feature of the cyclical expansions in this country before that war, and by the tremendous reserve capacity revealed during World War II in contrast with our experience in World War I.

The Countrywide Aggregates

We conclude the discussion of long swings in the output flows by observing those in the countrywide aggregates. Chart 12 presents decadal averages of gross national product excluding military, flow of goods to consumers, total and per capita, and gross capital formation excluding military. The inclusion of military output would alter the picture only slightly, affecting the standing from about 1913 through 1922 and from about 1937 through 1950, but without changing the timing of the long swings observed.

CHART 12

Decadal Levels of Gross National Product, Flow of Goods to Consumers, Gross Capital Formation, and Flow of Goods to Consumers Per Capita, 1929 Prices, 1869–1955



Because the totals in Chart 12 have a pronounced long-term upward rise, they have been plotted on a ratio scale to reveal more sharply the long swings in rate of growth. The long swings in gross national product, in flow of goods to consumers, and in flow of consumer goods per capita are quite clear. In gross capital formation, however, the movement up to World War I reveals no marked long swings. Apparently the difference in timing between the long swings of population-sensitive components and of other capital formation, which prevailed until World War I, resulted in so much cancellation that the comprehensive capital formation totals fail to reveal distinct long swings.

In lines 1 to 5 of Table 66 we attempt to date the turning points of long swings in the major countrywide aggregates. As in all other cases discussed so far, the dating is based on a close inspection of the charts of decadal averages and on calculation, if necessary, of successive changes. The dating follows the rule of regarding a phase as terminated only when the beginning of a new phase is clearly indicated. The results are naturally subject to error, but they suffice to outline the broad timing of the swings.

The long swings in gross national product, including or excluding military, and in flow of goods to consumers, total or per capita, were quite similar in timing. There was an upswing from 1873 (the earliest year that can be covered in the procedure followed here) to the early 1880's; a downswing to about 1893 (somewhat earlier in flow of consumer goods per capita); another upswing to 1908 (although the peak came earlier in flow of consumer goods per capita); a downswing to 1915 or 1916 (with flow of consumer goods per capita again reaching a trough earlier); an upswing to the middle of the 1920's; a marked downswing to the early or mid-1930's; and then a sharp rise to 1950, the most recent year covered by our averages.

The long swings in gross capital formation are discernible beginning with the peak in the 1920's, and from that date on they follow closely those for gross national product and flow of goods to consumers. Since, as stated above, it is extremely difficult to discern the long swings in total capital formation before World War I, the dates in line 5, columns 3 to 5, are quite problematical.

The dates of turning points in long swings in the various components of gross capital formation, discussed in the preceding sections, are also entered in Table 66. Three general impressions are suggested by these entries, in comparison with those for long swings in gross national

TABLE 66

DATES OF TURNING POINTS IN LONG SWINGS OF GROSS NATIONAL PRODUCT AND ITS COMPONENTS, 1869–1955
(based on decadal levels in 1929 prices)

	Trough (1)	Peak (2)	Trough (3)	Peak (4)	Trough (5)	Peak (6)	Trough (7)	Peak (8)
1. Gross national product	1873	1882	1893	1908	1916	1926	1934	1950
2. Gross national product, excluding military	1873	1882	1893	1908	1916	1926	1934	1950
3. Flow of goods to consumers	1873	1882	1893	1908	1915	1926	1932	1950
4. Flow of goods to consumers, per capita	1873	1882	1889	1904	1912	1926	1934	1950
5. Gross capital formation			1884	1902	1909 (1916)	1924	1934	1950
6. Nonfarm residential construction	1874	1890	1899	1909	1916	1925	1934	1948 [a]
7. Gross capital expenditures by railroads	1875	1889	1899	1909	1918	1925	1935	1948 [a]
8. Private construction & producers' durables excluding nonfarm residential construction and capital expenditures by railroads		1876	1884	1906 (1908)	1917	1926	1935	1948 [a]
9. Net changes in inventories		1881	1889	1901	1912	1920	1929	1941
10. Net changes in foreign claims		1880	1890	1901	1909	1919	1932 (1940)	1942

[a] Last year for which series are available for lines 6, 7, and 8.

SOURCE, BY LINE

1 to 5. Decadal totals were calculated from the annual series underlying the five-year averages in Tables R-26, R-29, and R-40, and from the annual series in Table R-7.

6 and 7. See Table 61, cols. 2 and 3, respectively.

8 to 10. See Table 63, cols. 3, 4, and 5, respectively.

product and flow of goods to consumers, which can be used as a reference chronology. First, the timing of the long swings among the various components of capital formation is different, particularly before the 1920's, and for some components (net changes in inventories and in foreign claims) there are differences even in recent decades. Second, before World War I, the long swings in many components of capital formation were neither positively nor negatively correlated with swings in gross national product and in flow of goods to consumers, but were in between—their peaks and troughs falling within the phases of the reference chronology. Third, the partly inverted relation between long swings in the population-sensitive and in other components of capital formation accounts for the mild character of long swings in total gross capital formation before World War I (and during the latter, if we include military production). It explains also the difficulty of discerning clearly marked turning points.

Using the dates of long swings in gross national product as a reference chronology, we can measure the amplitude of the long swings in all major countrywide totals (Table 67). In addition to providing the usual measures of standings at troughs and peaks, the rate of change per year during the up-and-down phases, and the differential change from one phase to the next, we attempt here to measure relative amplitude. The base is the average volume of the specific series during the swing for which the differential change is measured. To simplify calculations, the average volume is derived from the standings in part A; and, in calculating the ratio of the differential change over the long swing to the average volume, we first convert the differential change to a per decade rather than a per year basis.

Several findings, some already indicated, are clearly suggested by Table 67.

1. Gross national product, including and excluding military, and flow of goods to consumers, total and per capita, reflect the long swings as dated, without exception. This is not true of gross capital formation, including or excluding military. It shows a rise in rate of growth from 1873–1882 to 1882–1893, instead of a decline as expected by the reference chronology; and for totals including military the decline in line 18 is too mild to be significant.

2. When converted to percentages of the base, the differential change in decadal rates of growth during the long swings varies, even in the conforming series (gross national product and flow of goods to consumers, total and per capita) from −4 per cent to 52 per cent. However,

TABLE 67

CHANGES IN MAJOR COUNTRYWIDE AGGREGATES DURING PHASES OF LONG SWINGS IN GROSS NATIONAL PRODUCT, 1869–1955
(in billions of dollars, except per capita in dollars; in 1929 prices)

	Gross National Product (1)	Gross National Product Excluding Military (2)	Flow of Goods to Consumers (3)	Flow of Goods to Consumers, Per Capita (4)	Gross Capital Formation (5)	Gross Capital Formation Excluding Military (6)
A. VOLUMES PER DECADE AT DATES OF TURNING POINTS IN COLUMN 1						
1. First trough, 1873	105.0	105.0	80.3	179	24.7	24.7
2. Peak, 1882	188.9	188.9	145.6	267	43.3	43.3
3. Trough, 1893	273.7	273.7	201.8	294	71.8	71.8
4. Peak, 1908	506.6	506.6	388.4	430	118.3	118.3
5. Trough, 1916	615.2	605.8	473.2	459	142.0	132.6
6. Peak, 1926	857.3	855.8	680.0	574	177.3	175.7
7. Trough, 1934	824.7	820.5	706.7	553	118.0	113.8
8. Peak, 1950	1,617.1	1,584.4	1,287.2	835	329.8	297.2
B. CHANGES PER YEAR DURING SUCCESSIVE PHASES						
9. Trough to peak (line 1 to line 2)	+9.32	+9.32	+7.26	+9.8	+2.07	+2.07
10. Peak to trough (line 2 to line 3)	+7.71	+7.71	+5.11	+2.5	+2.59	+2.59
11. Trough to peak (line 3 to line 4)	+15.53	+15.53	+12.44	+9.1	+3.10	+3.10
12. Peak to trough (line 4 to line 5)	+13.58	+12.40	+10.60	+3.6	+2.96	+1.79
13. Trough to peak (line 5 to line 6)	+24.21	+25.00	+20.68	+11.5	+3.53	+4.31
14. Peak to trough (line 6 to line 7)	−4.08	−4.41	+3.34	−2.6	−7.41	−7.74
15. Trough to peak (line 7 to line 8)	+49.53	+47.74	+36.28	+17.6	+13.24	+11.46

C. CHANGES BETWEEN SUCCESSIVE PHASES						
16. Trough to trough (line 9 to line 10)	−1.61	−1.61	−2.15	−7.3	+0.52	+0.52
17. Peak to peak (line 10 to line 11)	+7.82	+7.82	+7.33	+6.6	+0.51	+0.51
18. Trough to trough (line 11 to line 12)	−1.95	−3.13	−1.84	−5.5	−0.14	−1.31
19. Peak to peak (line 12 to line 13)	+10.63	+12.60	+10.08	+7.9	+0.57	+2.52
20. Trough to trough (line 13 to line 14)	−28.29	−29.41	−17.34	−14.1	−10.94	−12.05
21. Peak to peak (line 14 to line 15)	+53.61	+52.15	+32.94	+20.2	+20.65	+19.20
D. VOLUMES PER DECADE DURING LONG SWINGS [a]						
22. Average, lines 1 to 3	189.1	189.1	143.3	252	45.8	45.8
23. Average, lines 2 to 4	310.7	310.7	234.4	321	76.3	76.3
24. Average, lines 3 to 5	475.5	473.2	363.0	403	112.6	110.2
25. Average, lines 4 to 6	648.6	643.5	503.7	480	144.9	139.8
26. Average, lines 5 to 7	788.6	784.5	635.0	540	153.6	149.4
27. Average, lines 6 to 8	1,031.0	1,020.3	845.2	629	185.8	175.1
E. CHANGES BETWEEN SUCCESSIVE PHASES (MULTIPLIED BY 10) AS PER CENTS OF AVERAGE VOLUMES						
28. Line 16 ÷ line 22	−9	−9	−15	−29	+11	+11
29. Line 17 ÷ line 23	+25	+25	+31	+21	+7	+7
30. Line 18 ÷ line 24	−4	−7	−5	−14	−1	−12
31. Line 19 ÷ line 25	+16	+20	+20	+16	+4	+18
32. Line 20 ÷ line 26	−36	−37	−27	−26	−71	−81
33. Line 21 ÷ line 27	+52	+51	+39	+32	+111	+110

[a] Calculated by averaging the terminal standings (trough or peak—each weighted 1) and the middle turning point (peak or trough—weighted 2).

SOURCE: Same as in notes to Table 66, lines 1 to 5.

because the secular trend in these series is upward, the negative changes tend to be smaller than the positive. The average of the two changes (disregarding signs), taken as a fair representation of the amplitude of each long swing, varies from 10 to 44 per cent of the base for the gross national product series, and from about 12 to 33 per cent for the flow of goods to consumers series.

3. The relative amplitude of the long swings tends to widen—a result largely of the long sharp depression of the 1930's and of the recovery thereafter.

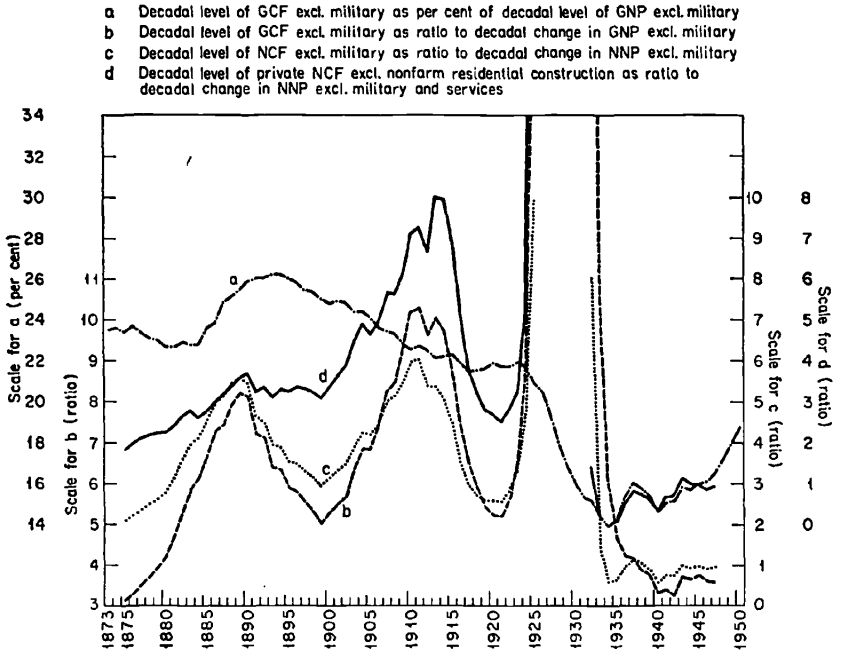
4. If we were to take the differential change over the long swings as a percentage not of the absolute volume of the series, but of the average change per decade during the swing, the relative amplitude would be much wider; and the trend toward widening the relative amplitude would be much sharper. To put it differently, the long swings affect the cumulative volumes of gross national product and its components in the manner indicated in part E of Table 67; but they affect the rate of change in those volumes in much more violent fashion.

One final inference should be stressed. If the long swings in gross capital formation differ in timing from those characterizing gross national product, it follows that the ratio of gross capital formation to gross national product—the gross national savings fraction—must display long swings of its own. Indeed, the same result would follow even if the swings in the numerator (gross capital formation) and the denominator (gross national product) of the fraction were identical in timing but differed in relative (proportional) amplitude.

Chart 13 shows four measures of the relation between capital formation and national product (both excluding military because, as before, we wished to eliminate it from the analysis). In line *a* we have the proportion of gross capital formation to gross national product—both in terms of ten-year moving averages and in constant prices. This ratio describes three peak-to-peak swings, on the assumption that the initial year in the series is a peak. The dates of these swings are quite different from those in gross national product recorded in Table 66. There is a peak in the mid-1870's at about the time of the trough in gross national product; there is a trough in the early 1880's, when there is a peak in gross national product; and there is a marked peak in the early 1890's, when there is a trough in national product. It is only starting with World War I that the swings in the ratio of gross capital formation to gross national product begin to coincide with those in gross national product.

CHART 13

Decadal Level of Gross Capital Formation as Per Cent of Gross National Product, and Marginal Capital-Output Ratios, Based on Volumes in 1929 Prices, 1869–1955



The other lines in Chart 13 can be described as marginal capital-output ratios. Two of them (lines *b* and *c*) represent the ratio of capital formation (gross or net), in the form of a ten-year moving average, to the increment in national product (gross or net), over essentially the same ten-year period. In these ratios both capital formation and national product exclude military. Furthermore, the increment in national product is derived from quinquennial averages in order to reduce short-term variations. Thus, the first entry in line *b* (or *c*) of the chart is the ratio of the decennial average of gross (or net) capital formation for 1871–1880, centered in the fifth year (1875), to the difference between two quinquennial averages of gross (or net) national product, one centered in 1871 and the other in 1881. There is a slight discrepancy in timing: the increment in national product should be centered at the middle of 1876, whereas capital formation for the pe-

riod is centered at the end of 1875. But the discrepancy would not affect the long swings in the ratios materially. Line *d* portrays perhaps the most interesting marginal capital-output ratio: the ratio of private net capital formation excluding nonfarm residential construction to the increment in net national product excluding services (the method of relating capital formation to additions to product is the same as that followed for lines *b* and *c*). All the underlying volumes are in constant prices.

In some periods capital formation is positive and the decadal change in product is negative, in which case the marginal capital-output ratio is infinitely large (as happened during the severe depression of the 1930's). In some periods net capital formation is negative, and the change in net national product is positive, in which case the marginal capital-output ratio is negative. Both contingencies could be eliminated by the use of longer periods for both numerator and denominator. But this would have resulted in a substantial damping of the long swings in the marginal capital-output ratios, and we are interested in their magnitudes unreduced by such damping.

It is clear from Chart 13 that the swings in the marginal capital-output ratios are extremely wide, even when the periods in which the ratios drop below zero or become infinitely large are omitted. Table 68, which records the standings and approximate dates of the turning points of the series in Chart 13, confirms this impression, but the calculations are impeded by the occurrence of infinitely large values.

There is some similarity between the long swings in the capital formation proportion (line *a*) and in the marginal capital-output ratios (lines *b*, *c*, and *d*). However, the latter are affected not only by the former, but also by the varying rate of growth of national product itself. Three long swings and the beginning of a fourth are conspicuous; but the dissimilarity in timing between the swings in the marginal capital-output ratios and those in the proportion of capital formation to national product is also quite marked.

With this general indication of the wide amplitude of the long swings, the evidence in Chart 13 and Table 68 leads to one important inference. The long-term trend in the gross capital formation proportion is somewhat downward, as can be seen if we calculate the average ratio for each swing by the procedure followed for the entries in panel D of Table 67. But the long swings in the standings are obviously an important qualification of this long-term trend, and must be considered in any interpretation of the past as a basis for the

TABLE 68

DATES OF TURNING POINTS AND STANDINGS IN LONG SWINGS OF GROSS CAPITAL FORMATION AS PER CENT OF GROSS NATIONAL PRODUCT, AND OF MARGINAL CAPITAL-OUTPUT RATIOS, 1869–1955

	GCF [a] as % of GNP [a] (1)	Ratio of GCF [a] to Additions to GNP [a] (2)	Ratio of NCF [a] to Additions to NNP [a] (3)	Ratio of Private NCF, Excluding Nonfarm Residential Construction, to Additions to NNP [a] Excluding Services (4)
A. DATES OF TURNING POINTS				
1. First peak	1876			
2. Trough	1884	1875	1875	1875
3. Peak	1894	1889	1889	1890
4. Trough		1899	1899	1899
5. Peak		1911	1911	1913
6. Trough	1917	1921	1921	1921
7. Peak	1923	———	Late 1920's	———
8. Trough	1934	1942	1934	1934
9. Peak	1950	1947 (1945) [b]	1947 (1943) [b]	1947 (1943) [b]
B. STANDINGS AT DATES INDICATED, BASED ON DECADAL LEVELS				
10. First peak (line 1)	23.7			
11. Trough (line 2)	22.8	3.12	2.07	1.83
12. Peak (line 3)	26.2	8.20	5.57	3.68
13. Trough (line 4)		5.02	2.95	3.08
14. Peak (line 5)		10.27	6.01	8.01
15. Trough (line 6)	21.5	5.21	2.56	2.52
16. Peak (line 7)	21.9	∞	∞	∞
17. Trough (line 8)	13.9	3.27	0.60	∞
18. Peak (line 9)	18.8	3.59 (3.74)	0.97 (1.02)	0.93 (1.12)

Percentages and ratios are based on values in 1929 prices.
GCF = gross capital formation; GNP = gross national product.
NCF = net capital formation; NNP = net national product.
[a] Excluding military.
[b] 1947 is the latest year available for all series in cols. 2 to 4. The peak appears to fall somewhat earlier, as indicated by the entries in parentheses.
SOURCE: See text for derivation of entries.

future. This is more conspicuously true of the marginal capital-output ratios, especially that in line *d*, which climbs during the first half of the period, from 1875 to 1913, and then declines sharply during the second half. One must conclude that the long-term trend in the relation between additions to capital and additions to output is not persistent, and that any extrapolation into the future must take account of the variability of the marginal capital-output ratios, not only within the span of shorter business cycles, but also over the decades that mark the long swings.