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Introduction

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This paper is one of a series originating in the inquiry into long-term trends in capital formation and financing in the United States. The project was initiated in mid-1950 at the suggestion of the Life Insurance Association of America and with its financial assistance.

Within the inquiry, Dr. Ulmer's study deals with trends in capital formation and financing in public utilities, one of the more important capital-using and demanding sectors of the nation's economy. Because of obvious differences among the several utilities in age, size, character of production and of market, the study proceeded by building up the long-term records, first for real capital formation and then for financing, for each major subsector — beginning with the steam railroads. The present paper is thus a summary of the first part of a much wider study.

The new estimates of capital expenditures by steam railroads since 1870, which Dr. Ulmer compiled, permit a telling analysis of the process of capital formation in a basic industry over a significant part of its life history; and the less continuous but illuminating estimates of sources and uses of funds are equally eloquent in describing the striking trends in the sources of financing. There is little that can or should be added here to the story unfolded in Dr. Ulmer's paper. But it may be of interest to relate the major findings for the steam railroads to similar findings for other sectors in the economy. Among these findings are (a) the long swings in gross and net capital formation; (b) the trend in the capital-output ratio; and (c) the shift in the sources of financing.

Dr. Ulmer's work shows that the long-term trend of capital formation in railroads was upward to about 1910 and downward thereafter. In addition, his record discloses shorter-term fluctuations closely conforming to cycles in general business and towering swings whose average duration is either seventeen or twenty years (see Charts 2, 4, and 7). Dr. Ulmer points out that identification of one of these swings may be questionable in the 1880's when a pronounced contraction in general business conditions is reflected in the five-year moving averages of railroad capital formation, but is much less significant in the nine-year moving averages. There are also difficulties in any precise dating of the peaks and troughs in such long swings. But such questions and obstacles need not deter us from recognizing that these swings exist as a distinct component of change; and one whose amplitude, at least in the case of capital formation by railroads, is striking to the point of dominating the record.

This finding is rendered all the more important by the evidence of swings of similar duration and, for some records, of not much narrower amplitude, in other major economic processes. They exist in residential construction, as Dr. Blank's Technical Paper[1] in the present series and several earlier studies in the field indicate. They appear in net capital exports or imports, i.e. the net changes in foreign claims. They exist in net immigration to this country, as various studies in the field and a forthcoming paper on the subject by the National Bureau of Economic Research will indicate. And while their amplitude is much narrower, they can be discerned in the rate of growth of so comprehensive a total as gross national product in constant prices.

On the basis of our preliminary studies a rough chronology of these long swings can be attempted. In this attempt, summarized below, we forego the effort to assign peaks and troughs to single years, since this might lend specious precision to the result. Instead, we refer to beginning or end of calendar decade (years from 09 to 01); early decade (years 2-3); mid-decade (years 4-6); and late decade (years 7-8). The table below is based partly upon evidence in other *Occasional*

[1] David M. Blank, *The Volume of Residential Construction, 1889-1950,* Technical Paper 10 (National Bureau of Economic Research, 1954).

Papers in the series and partly unpublished working memoranda in the study and is not carried beyond the 1930's, since the intervention of World War II and uncertainties about current year levels limit the value of any later dating.

Approximate Dates of Successive Troughs and Peaks in the Long Swings (based largely on nine-year moving averages; all series in 1929 prices)

	Trough	*Peak*	*Trough*	*Peak*	*Trough*	*Peak*	*Trough*
Capital formation, steam railroads	mid-1870's	end-1880's	end-1890's	late-1900's	late-1910's	mid-1920's	mid-1930's
Residential construction	late-1870's	end-1880's	end-1890's	end-1900's	late-1910's	mid-1920's	mid-1930's
Net immigration	late-1870's	mid-1880's	late-1890's	end-1900's	late-1910's	mid-1920's	early-1930's
Net capital imports	end-1870's	end-1880's	end-1890's	end-1900's	late-1910's		
Gross national product, total	early-1870's	early-1880's	early-1890's	mid-1900's	end-1900's	mid-1920's	mid-1930's

While timing relationships can be stated only with considerable qualifications, several are of sufficient interest as possible leads to merit note.

1. In general, the long swings in capital formation by railroads and in residential construction are synchronous, the single exception being the somewhat earlier trough in the latter in the 1870's.

2. There is also fair synchronism between the long swings in capital formation by railroads and in net immigration, although there is some tendency for the latter to lead the former in the 1880's, 1890's, and 1930's

3. In general, net changes in foreign claims fall into reasonable relation with those in capital formation by railroads and in residential construction, when the former are cast as net capital imports. The rationale for this lies in the fact that an expansion, i.e. an accelerated rate of domestic capital formation (by railroads or in residential construction), would attract more foreign capital and the opposite would occur when the rate of domestic capital formation slackens.

4. The number of long swings identified in gross national product is the same as in all the other series. But until the 1920's the timing is somewhat different from that in series relating to capital formation

components: there is a distinct tendency before 1910 for the timing points in gross national product to precede those in capital formation.

The interrelations of long swings in the various sectors of the economy obviously require further exploration, and the estimates for the other utilities in Dr. Ulmer's study and for other industrial sectors in the other monographs will contribute additional light. Pending such further exploration, we can say only that these swings are important for several economic processes, even before the wars of recent decades put their stamp upon them; that their presence in capital formation by railroads could probably be illuminated by the kind of analysis that has been brought to bear upon the long cycles in residential and other construction — particularly since such a large part of railroad capital formation is construction of road; that there seem to be rationally derivable relations between such swings in population growth, at least via immigration, in residential construction and in railroad construction; and that there are similarly reasonable economic relations between such swings in domestic capital formation and in net capital imports. The reasons for the disparity in timing between the swings in gross national product and in such important components of capital formation as residential construction and capital expenditures by railroads are still to be sought. But it is clear that we have here a type of movement the measurement and analysis of which are of the utmost importance to the study of trends in the growth of output and of capital.

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Dr. Ulmer's estimates show a striking decline in the capital-output ratio over the six decades covered. The highest level of this ratio is in the first year for which comparison can be made, 1880, when it stood at 16.4. By the end of the period, the ratio was at an average level of about 2½, even if we exclude the exceptional years of World War II when it dipped below 2.0 (in 1943 and 1944). A downward trend in this ratio was observed in other sectors also: in agriculture, from the beginning of the period covered, i.e. since the 1870's; and in manufacturing and mining, where a rise in the ratio to 1910-1919 was followed by a significant decline to the 1940's (see other papers in this series by Tostlebe, Creamer, and Borenstein).

But some distinctive features about the record for the railroads are worth noting. First, the period begins with capital-output ratios for the railroads far higher than those for other industries, although they are possibly matched by ratios in other public utilities. Second, perhaps because of this exceptionally high level of the ratios for the steam railroads at the beginning of the period, both the absolute and the proportional decline was much greater than for agriculture or for manufacturing. Both statements would be particularly true if we confine the comparison to reproducible fixed capital and exclude the value of land. Third, the pattern of the decline was different in the case of railroads. If we divide the whole time span into approximate halves and distinguish the period 1880 to 1915 (omitting World War I years) from that extending from 1915 to the second half of the 1940's (omitting World War II years), we find that both the absolute and the proportional decline in the ratio was significantly greater in the first than in the second period.

This pattern of movement can be shown by a simple calculation which uses Dr. Ulmer's estimates of capital and output in 1929 prices shown in the appendixes. As already noted the ratio in 1880 was over 16, and it averaged (arithmetic mean of annual ratios) well over 13 for the decade 1880-1889. For the decade 1905-1914 the ratio averaged about 4½. For the five years 1945-1949 it averaged about 2½. Thus the ratio declined from 1880 to 1915 by about 75 per cent; from 1915 to 1950 the decline was less than 50 per cent. This retardation in the decline of the ratio is clearly expressed by the function which Dr. Ulmer fits to the series in Chart 6.

The movement in agriculture, manufacturing, and mining was quite different: in the first period, before 1910-1919, the decline in the capital-output ratio in agriculture was relatively mild, while the ratio rose significantly in both manufacturing and mining; it was in the second period that the ratio in agriculture dropped precipitously and those in manufacturing and mining declined.

The reasons adduced by Dr. Ulmer to explain the full downward sweep of the capital-output ratios — overcapacity connected with indivisibility of original units, technological improvements not reflected in adjustments for price changes, the pressure of continuous efforts for more economical, more intensive utilization of equipment — are at

least partly relevant also to the explanation of the pattern of movement of the ratio over this period. From 1880 to 1910, total capital stock increased by between 80 to 90 per cent and barely doubled by 1913; output rose almost sevenfold from 1880 to 1910 and almost eightfold by 1913. But there was a rapid deceleration in the rate of addition to capital: from 1880 to 1895 the increase in the total stock was well over 50 per cent; from 1895 to 1910 less than 20 per cent. The slowing down and then virtual cessation of net additions to the track and plant meant a rapid reduction of at least one major factor serving to sustain the ratio -- existence of initial overcapacity created by building large units with an eye to their future *long-run* performance load.

The slowing down of the decline in the capital-output ratio in the second period can be traced to two aspects of growth of railroads since 1915. First, the extensive expansion of the railroad network was virtually at an end. Second, there was, barely a decade after the dividing date, a virtual standstill in the growth of output. From a pre-World War I output in 1929 dollars of somewhat over $4.5 billion, there was a rise to about $6.5 billion in mid-1920's and then a decline, with the latter level not exceeded until 1941. Thus a substantial part of the second period may have been characterized by under-utilization of capacity, due not to the building-ahead characteristic of the nineteenth century but to the leveling off and decline in the demand for services.

The tentative observations just made point to the promise of more detailed comparisons than are possible here. It would certainly be most interesting to juxtapose the movements of the capital stock and output, during the distinctive periods described in railroads, other utilities, and other major industrial sectors of the economy. For it should shed a great deal of light on the responses of these various sectors to the stimulus of growing and slackening demand for their services and to the shift from initial construction and extensive expansion to a period of more intensive use of capital resources. It is quite probable that differences in the organizational structure of these sectors — at one extreme the large-scale utilities and at the other small-scale agriculture — produced differences in the response, particularly in the area of capital formation. It is also possible that some important similarities will emerge, as is already suggested by the prevalence of downward trends in the capital-output ratios.

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In considering the trends in financing, Dr. Ulmer had to take into account not only gross and net capital formation represented by fixed capital but all other assets — inventories, cash, receivables, securities, etc. He was also compelled to operate with balance sheet data from which, at least for the earlier periods, distortions caused by revaluations could not be removed. But fixed capital is by far the largest group of assets used by the railroads; and the weaknesses of the data for the earlier decades, while qualifying the results, are hardly of the kind to cast serious doubt upon the validity of the major conclusion.

The latter can be stated simply. Between 1880 and World War I the overwhelming part of all of the additions to assets was financed out of sales of capital stock and bonds — with only insignificant shares provided by additions to surplus, depreciation reserves, and short-term credit. During the recent three decades (from 1920 to the end of the 1950's) the contribution of external financing through securities dwindled to insignificance, and the major sources of financing were additions to surplus and to depreciation reserves.

This conclusion as to the almost complete shift from "external" to "internal" financing is subject to many qualifications pointed out by Dr. Ulmer in the text. Could the adjustments have been made, they might have somewhat lessened the dominance of new security issues as sources in the earlier period and of additions to surplus and depreciation charges in the later. But there is little doubt that this major shift from external to internal financing occurred and that its magnitude was striking.

Indeed, given the trends in the accumulation of real fixed capital and in the volume of output of the railroads, external financing of gross additions to its real durable assets could hardly have continued dominant after World War I — except for financing by government under conditions resembling outright subvention or salvage credit extension. In any calculation of the financing of *net* additions to real capital, the reduction of such net additions to relatively small magnitudes as the growth of capital slackened to almost a standstill would render a *proportional* distribution among possible sources most erratic. If we assume that in the absence of substantial net capital growth a proper

analysis of sources of funds can be made only for gross additions to assets, it is inevitable that in an industry whose secular net growth of capital has almost reached the saturation point, external financing of the free market type cannot be a dominant source of funds. And if it has been a dominant source earlier in the history of the industry, the shift is, in a way, an inevitable corollary of the change in real capital formation.

While we may expect parallel results in other industries, i.e. a similar association between relative importance of external financing and substantial growth in net stock of durable capital during the earlier phases of an industry's extensive expansion, and a similar decline in the importance of external financing as the rate of net additions to stock of durable capital slackens, this shift may well have been exaggerated in the case of railroads. The exaggeration is due not only to some of the unavoidable defects in Dr. Ulmer's estimates: the upward valuation of physical property on the asset side and of securities on the liability side serves to raise the ratio of securities in total additions to assets and so does the assumption that Dr. Ulmer had to make concerning absence of additions to depreciation reserves between 1880 and 1907. A more significant exaggeration is contributed by the distinctive position of railroads and some specific features of their practices. As Dr. Ulmer observes, the railroads were, until quite recently, reluctant to set their depreciation rates at levels more consistent with the economic obsolescence of their plant. And because of their organization and size, railroads had access to long-term security markets that was denied, or much more limited, to other industries whose technology permitted them to operate efficiently in smaller units. Their very role as public utilities made it possible for them to command funds on the long-term security markets that many other capital-using industries could not. Their relatively easy command over sources of external financing, as well as depreciation practices underestimating their long-term economic vulnerability, make the railroads an exceptional case — exceptional in that the shift from long-term external to internal financing would be much more marked in them than in many other sectors in the economy.

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The brief comments above are largely tentative reactions to the rich and intriguing record that Dr. Ulmer sets forth in some detail in the paper. They are intended to suggest part of the wider framework within which Dr. Ulmer's findings may eventually be placed and to which they will, in turn, contribute. But such a framework can be effectively constructed only after the results of Dr. Ulmer's other analyses, as well as of the studies by other members of our group, are completed; and it may well be that the suggestions above overlook more important aspects or suggest conclusions that would not be supported by the results of further analysis.

Meanwhile, one can only urge the reader to turn to Dr. Ulmer's paper and observe the striking features of the long-term record of capital formation and financing for an important and distinctive sector of this country's economy.

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