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Introduction

By Simon Kuznets

This monograph is part of an inquiry into trends and prospects in capital formation and financing initiated by the National Bureau of Economic Research in 1950, with the financial assistance of the Life Insurance Association of America.[1] The inquiry examines long-term trends in capital formation and financing in the United States and is organized primarily around the principal capital-using sectors of the economy—agriculture, mining and manufacturing, the public utilities, residential real estate, and governments. The analysis for each sector summarizes the major trends in real capital formation since 1870 (or the earliest year for which data are available), in financing since 1900 (the earliest practicable date), and the factors determining these trends; and, so far as possible, it suggests the significance of these factors for the future. In addition to the five sector studies, the inquiry includes two others. One deals with trends in financing channeled through intermediate financial institutions and attempts to link the major types of institutions with the various groups of capital users. The second utilizes the results of all the other studies within a framework provided by countrywide estimates of national product and relevant components as well as of assets and debts.

Some of the findings have been presented, in part or in preliminary form, in a series of Occasional and Technical Papers.[2] This monograph, like the four preceding, presents the full results of a specific study, together with the supporting data.

The task the authors of this monograph set themselves appears

NOTE: I am indebted to the authors of the monograph and to Dr. Solomon Fabricant for valuable comments.

[1] Monographs already published are: *Capital Formation in Residential Real Estate: Trends and Prospects*, by Leo Grebler, David M. Blank, and Louis Winnick, 1956; *Capital in Agriculture: Its Formation and Financing since 1870*, by Alvin S. Tostlebe, 1957; *Financial Intermediaries in the American Economy since 1900*, by Raymond W. Goldsmith, 1958; and *Capital in Transportation, Communications, and Public Utilities: Its Formation and Financing*, by Melville J. Ulmer, 1960.

[2] Leo Grebler, *The Role of Federal Credit Aids in Residential Construction*, Occasional Paper 39 (1953); Daniel Creamer, *Capital and Output Trends in Manufacturing Industries, 1880–1948*, Occasional Paper 41 (1954); Raymond W. Goldsmith, *The Share of Financial Intermediaries in National Wealth and National Assets, 1900–1949*, Occasional Paper 42 (1954); Melville J. Ulmer, *Trends and Cycles in Capital Formation by United States Railroads, 1870–1950*, Occasional Paper 43 (1954); Alvin S. Tostlebe, *The Growth of Physical Capital in Agriculture, 1870–1950*, Occasional Paper 44 (1954); Israel Borenstein, *Capital and Output Trends in Mining Industries, 1870–1948*, Occasional Paper 45 (1954); David M. Blank, *The Volume of Residential Construction, 1889–1950*, Technical Paper 9 (1954); all published by the National Bureau of Economic Research.

simple. First, they undertook to compare trends in stock of capital and in output of mining and manufacturing—on the obvious assumption that capital is needed to produce output; and in the reasonable hope that observation of past trends in the relation between the two, via the capital-output ratio, would provide a basis for a better understanding of the factors that determine the demand for capital, in the past and therefore in the future. Second, they attempted to measure the changing contribution of various sources of financing—internal and external, equity and debt—in providing funds for capital formation in mining and manufacturing, again on the reasonable assumption that if past trends could be established, better understanding would be gained of the factors that determine choices among various sources of funds for needed additions to capital assets.

But in this field of capital formation and financing, as in other fields of economic research, tasks that seem simple and obvious when laid out often prove difficult and not at all obvious in execution. The reasons are not hard to find. The present study requires continuous, comparable data over long periods, with the measured quantities geared to clearly defined economic concepts—of capital, output, internal funds, external financing, etc.—and available for a variety of significant divisions within the wide mining and manufacturing aggregates. What one finds for most decades are data only at long intervals, with varying definitions and coverage; and for some important aspects, such as sources of financing relative to total uses, comprehensive, long-term data are not available, and reliance must be placed on samples (some of them small) of large corporations. By dint of laborious and patient effort, the authors secured usable records of stock of capital (at selected dates) back to 1880 or 1870 and of sources of financing back to 1900. But, as they themselves stress, these records leave much to be desired with respect to continuity, comparability, completeness, and detail.

As these incomplete data are examined, the initially simple task is further complicated by a variety of pertinent questions. Granted that capital is needed to produce output, should we take capital gross or net of accumulated depreciation, confine it to real assets or include financial assets; and if the latter, should all financial assets be included or should they be limited to some "working minimum"? Should the denominator of the capital-output ratio be gross value of output, or net value added (i.e., net of cost of materials and fuel), or net income originating (i.e., compensation of productive factors net of all payments to other industries)? On the financing side: Is the gross retention total for an industry aggregate a true measure of funds internal from the viewpoint of each firm, given the possibility of intraindustry, inter-

firm, borrowing and lending? Can gross retention be compared with capital formation alone, or must it always be related to total uses? Is it correct to interpret accumulated tax liabilities, which are treated as short-term debt, as short-term external financing provided to the enterprise by the government? The authors of this monograph, like all scholars in the field of economic research, were forced to revise and sharpen their initial concepts in the light of the variety of questions raised by the empirical data.

Finally, even if questions of the kind suggested are resolved—and the way they are answered will affect the cast of the findings, even if the available data are brought to bear upon the concepts thus revised and specified—the problem of establishing significant long-term trends still remains. For the interest here, as in the other monographs in the series, lies not in the year-to-year or short-term changes. The search is for persistent, underlying trends suggesting long-term factors that could be used in a more informed view of the present and, under reasonable assumptions, of the future. Even with continuous and comparable records stretching over long periods, it is not easy to segregate long trends from the complex of all changes, nor to secure characteristic measures of the former that would permit cogent analysis. When the data are discontinuous and do not cover a long period, and the short-term changes are varied in magnitude and impact, the task becomes difficult indeed. Significant long-term trends are particularly elusive for the financing flows; the financial data extend back only to 1900 and reflect the disturbances of two world wars, the Great Depression (itself partly a postwar maladjustment), and several years of "cold war."

The difficulties just noted—with respect to the quality and quantity of available data, the specification and revision of initially over-simplified concepts, the establishment of orderly patterns of change over time—are quite familiar to those who have ever tried to add to the stock of tested economic knowledge. They may not be so familiar to the wider body of readers for whom, it is hoped, this monograph will be of interest. But they go far to explain why, in this monograph as in others in the series, so much emphasis had to be placed on collating and organizing the relevant data to permit some clear pattern of past trends to emerge, and on establishing the broad movements. They also explain why, for some aspects of the subject, the results are uncertain, forcing the authors to present their conclusions in a hesitant and qualified fashion. And this concentration on securing an acceptable record of past trends means, in view of the limited resources at the disposal of the study, less emphasis on the explanatory framework; a greater emphasis would necessitate additional detail that would carry the study beyond feasible scope.

For these reasons, the present monograph, like the others, emphasizes empirical findings buttressed by detailed evidence. It does not reach out, as deeply as one might wish, into analysis of the underlying factors. This is stated not by way of apology, but as an indication of the priority given to establishing an acceptable record of what would, otherwise, be speculative analysis. On the contrary, we owe a heavy debt to the authors for having persisted in their efforts to wrest testable conclusions from recalcitrant data. It is altogether too tempting to evolve analytical hypotheses unrestrained by empirical evidence: the human imagination abhors the vacuum of ignorance and, for lack of facts, fills it with speculation. It is a more difficult, and often an exasperating, task to organize a vast and inchoate body of raw data in such a way that it may be brought to bear meaningfully upon a series of significant questions.

The following sections of this lengthy introduction present an attempt to summarize the findings in sufficient detail so that the reader can turn to the monograph proper adequately oriented. In pursuing this aim, we try to avoid technicalities and qualifications, courting the danger of oversimplification for the sake of a relatively clear, roughly true, picture. But the discussion goes beyond a summary of empirical findings. It tries to sketch out some explanatory hypotheses, and concludes with comments on the problem of using the findings for analyzing the prospects of capital formation and financing in this country.

Trends in Output and in Capital

In a democratic society, capital is needed to produce final goods, rather than accumulated by the state as a symbol of pride or a weapon of power. Hence, before considering trends in capital formation in the mining and manufacturing sector, we must take account of trends in the output of that sector.

Familiar though these output trends may be, three of their characteristics, observed over the past seven to eight decades, deserve note in the present connection.

First, the rate of growth of output in the mining and manufacturing sector has been high—appreciably higher than that of the economy's total output as measured by national product. In 1880, the first year for which we have figures on capital in mining and manufacturing, the total value of output of the sector was $8.73 billion in 1929 prices (all figures for 1953, here and elsewhere in this summary, have been adjusted for comparability with those for prior years). By 1953, the value of product amounted to $173.66 billion, again in 1929 prices, an increase to almost twentyfold the 1880 level. Over the same period, gross

national product in 1929 prices rose from $18.0 billion to $185.0 billion, or to only about tenfold.[3] This comparison is affected, however, by the fact that the national product is gross only in that consumption of fixed capital is not deducted. Thus, it is a much "netter" total than value of product for manufacturing and mining, which includes costs of raw materials and other goods produced in other industries. A more direct comparison can be made if, instead of value of product, we use either net income originating or payments to factors in the sector—the net return to labor, capital, and enterprise in the sector. The contribution of mining and manufacturing to national income or aggregate payments (all are totals in current prices) was 15.4 per cent in 1880 and almost 30 per cent in 1944–1953. Thus, we are dealing here with a major sector of the country's industrial structure, one that grew over the last three-quarters of a century at a rate almost double that of national product.

Second, the rate of growth of mining and manufacturing output was subject not only to cyclical fluctuations, which do not concern us here, but also to long-term retardation. Between 1880 and 1900, total output grew from $8.73 billion to $23.16 billion (all figures here and below are in 1929 prices), or at the rate of 62.9 per cent per decade; from 1900 to the average of 1919 and 1929 (centered in 1924), it grew further to $61.40 billion, or at the rate of 50.1 per cent per decade; then it rose to $173.7 billion in 1953, or at the rate of 43.1 per cent per decade. The particular sequence of percentage rates of growth over successive long periods, and the extent of retardation revealed by them, depend partly upon our choice of the dates. These should relate to years not too far from secular levels and should distinguish intervals long enough so that the effects of the cycles and long swings that characterize rates of economic growth in this country can be canceled out. But, even without recourse to elaborate curve fitting, any justifiable selection of dates and periods would reveal a significant slowing down in the percentage rate of growth of mining and manufacturing output measured in constant prices.

Third, among the various industries within the sector, there were marked differences both in the rate of growth of output over the period as a whole and in the patterns of these secular rates of growth over time. Thus, while the output of the mining industries rose from $363 million in 1880 to $6,460 million in 1953, an increase to almost eighteenfold the 1880 level, the growth in coal output was from $225 million to $989 million, or to over fourfold; in metals, from $76 million

[3] See *Capital in the American Economy: Its Formation and Financing* (forthcoming), Appendix A, Table R-2 and Appendix C, unpublished extension of Table R-22.

to $731 million, or to almost tenfold; and in petroleum and natural gas, from $33 million to $3,939 million, or to well over a hundredfold. Likewise, value of product in total manufacturing rose from $8.36 billion in 1880 to $167.20 billion in 1953, a rise to twentyfold the 1880 level. But in the more slowly growing branches the rise was smaller. Thus, in leather and its manufactures, the rise was only from $0.93 billion to $1.98 billion, or to over twofold; and in forest products, from $1.54 billion to $4.27 billion, or to less than threefold. By contrast, in the more rapidly growing branches, the rates were far higher: the output of chemicals and allied substances increased from $0.29 billion to $11.52 billion, or to more than fortyfold; iron and steel products, from $0.46 billion to $13.83 billion (in 1948, comparable data for 1953 not being available), or to thirtyfold; and transportation equipment, from $0.051 billion to $17.76 billion, or to nearly three hundred fiftyfold. Even more extreme differences in rates of growth over the period would be found were we to deal with the *minor* industry branches within mining and manufacturing; we would find industries that have ceased growing and whose output had declined by 1953 to a vanishing point, and others that sprang up after 1880 and whose percentage rates of growth have been astronomically high.

With such large differences in rates of growth of output among the various industries within the sector, it would be surprising not to find also differences among them in the pattern of growth rates over time. To be sure, retardation in the rate of growth is a common feature: it is found both in the older industries and also in the young and emergent industries. In the older industries, exhaustion of domestic natural resources, the slowing down of the rate of technological change, and the competition of the newer industries all make for damping of the rates of growth. In the younger industries, the very high early rates of increase—a doubling or tripling in a few years—just cannot be sustained once the production base, from which the percentage increase is calculated, widens. But the formal similarity—the retardation commonly observed—is overshadowed by differences in the absolute level of the rates: a shift in the rate of growth from 20 to 19 per cent per decade in a large and already mature industry, and from 1,000 to 100 per cent per decade in a young and rapidly growing industry, are both instances of retardation; but, for many realistic purposes, particularly for estimating the effect on capital formation and capital-output ratios, they are worlds apart. And in some cases, exceptions emerge in the very pattern in which retardation occurs. Thus, from 1880 to 1900, the output of all textile materials (excluding carpets, knit goods, and clothing) rose by 36.9 per cent per decade; from 1900 to the average of 1919 and 1929 (centered in 1924), by 47.5 per cent per

decade; and from the latter point to 1948, by 17.7 per cent per decade. In this case, there was *acceleration* between the first and second interval followed by a sharp retardation in the third. By contrast, in the forest products group, the rate of growth per decade in the first interval was 46.7 per cent; in the second, there was a *decline* of more than 6 per cent per decade; and in the third, a rate of increase of 17.2 per cent per decade. Here, then, growth accelerated from the second to the third interval. Thus, even where retardation is the dominant pattern, different combinations of rates over the three intervals can be found.

Since growth of output is a major factor in the growth of capital, we would expect that the three features just observed—a high rate of growth, significantly in excess of that in the countrywide total; a distinct retardation in the rate of growth over time; and marked diversity among industries in the rate of growth over the period and in the time pattern of that rate—would be true also of the stock of capital used in the mining and manufacturing sector. And this is what we find. In 1880, the unduplicated total of capital assets in the sector, including fixed capital, inventories, and cash and receivables, was, in 1929 prices and for the coverage comparable with that in recent years, $5.55 billion; by 1948, it amounted to $82.68 billion—a rise to almost fifteenfold the earlier level. Over the same period, the total stock of all tangible wealth in this country, including land and international assets but excluding consumers' inventories and military goods, increased from $69.5 billion in 1880 to $429.5 billion in 1948, a rise to over sixfold.[4] But here, again, the comparison is affected in that capital assets for the mining and manufacturing sector include domestic financial claims, and the countrywide wealth totals do not. A more defensible comparison can be made between the growth of fixed capital (structures and equipment, including land) in the mining and manufacturing sector and in the country. If we use, as always, totals in 1929 prices and coverage comparable with that in 1919–1948, fixed capital in the sector (not adjusted for duplication between manufacturing and mining) can be set at $3.23 billion in 1880 and $42.85 billion in 1948, a rise in level to over thirteenfold. The roughly comparable figures for the country are $60.2 billion in 1880 and $350.7 billion in 1948,[5] a rise to less than sixfold. Thus, the share of the country's fixed capital accounted for by the sector rose from about 5.4 per cent in 1880 to over 12 per cent in 1948—a more than doubling of the share.

[4] See Raymond W. Goldsmith in "Income and Wealth of the United States," *Income and Wealth, Series II* (International Association for Research in Income and Wealth, Bowes and Bowes, Cambridge, England), Table II, p. 310.

[5] *Ibid.*, Tables I and II, pp. 306–307 and 310.

We find also, as in the case of output, a marked retardation in the rate of growth of capital. For total capital assets in the sector (adjusted to eliminate duplication between manufacturing and mining), the rise from 1880 to 1900 was as high as 92.7 per cent per decade; from 1900 to the average of 1919 and 1929 (centered in 1924), the rise was down to 61.0 per cent per decade; from 1924 to 1953, it was as low as 17.8 per cent per decade. The estimates of fixed capital including land (not adjusted to eliminate duplication) tell a similar story of marked slowing down in the rate of growth. The rate of rise from 1880 to 1900 was 92.5 per cent per decade; from 1900 to the average of 1919 and 1929, 59.4 per cent per decade; from 1924 to 1953, 12.3 per cent per decade. It will be noted that the rate of growth of capital in the early periods was appreciably higher than that of output, but lower in the later period. As a result, the retardation in the rate of growth of capital is much more marked. We shall return to this point below in dealing with the movement of the capital-output ratios.

Finally, just as in the case of output, there are wide interindustry differences in the rate of growth of capital over the period and in the pattern of growth over time. Thus, total capital assets in mining rose from $1.03 billion in 1880 to $8.87 billion in 1953, or to less than ninefold the 1880 level. Over the same period, capital in manufacturing (unadjusted for duplication between manufacturing and mining) rose from $4.52 billion to $98.6 billion, an increase to almost twenty-two-fold. Within mining, the value of capital (excluding land) in coal rose over the period from $147 million to $1,069 million, or to over sevenfold; in metal, from $174 million to $1,019 million, or to almost sixfold; but in petroleum and natural gas, from $68 million to $5,550 million, or to over eightyfold. Within manufacturing, the rise over the period ranges from that for leather and its products to that for transportation equipment. In the former, total capital rose from $298 million in 1880 to $819 million in 1953, or to less than three times the 1880 level; in the latter, the rise was from $18 million to $8,771 million, or to almost five hundredfold. And, while retardation in rates of growth of capital was widespread, the differences in absolute levels of the growth rates were persistently important.

Trends in the Capital-Output Ratios—The Findings

In the capital-output ratio the numerator may be capital either including or excluding land and financial assets, net or gross of accumulated depreciation, in current valuation or translated to constant prices. The denominator may be gross value of output, or net value added, or net income originating, in current or constant prices,

and may cover output for a month, a year, or a decade. Finally, the ratio may be of the stock of capital at some point of time to the output during the period to which this point is relevant (*average* capital-output ratio); or it may be of the *change* in capital over some interval to the *change* in output over the same or another relevant interval (*marginal* or incremental capital-output ratio).

Our summary here will be largely in terms of the *average* capital-output ratio, relating either total or fixed capital, net of depreciation, to value of product, all in 1929 prices. This choice is due partly to the availability of detailed data, partly to analytical considerations. In general, movements of the ratio will reflect the similarities in or differences between the trends of output and of capital measured in constant prices. If these trends are similar, the capital-output ratio will show long-term constancy; if the trends in output and capital differ in some systematic way, there will be corresponding systematic movements in the capital-output ratios. If the ratios show long-term constancy, the finding is of obvious importance both analytically and in projecting capital formation as a simple function of projected output (projected output for a sector being, in turn, a function of projected national product). If the capital-output ratios for a sector show systematic long-term movements, the finding throws into relief both the analytical problem—how to explain these movements—and the problem of prognosis—how the factors advanced in the explanation bear upon future prospects of capital formation. In either case, the use of constant price data in calculating the ratio removes the distortion due to lags between changes in valuation of capital and prices of output.

1. In both manufacturing and mining, the ratio of capital to output based on values in 1929 prices rose markedly from 1880 through 1919 and then declined just as markedly. Thus, in manufacturing, the ratio of net total capital to gross value of product rose from 0.54 in 1880 to 1.02 in 1919 and then dropped to 0.61 in 1948 (and, still further, to 0.59 in 1953); ratio of capital to value added moved from 1.51 in 1880 to 2.55 in 1919 and down to 1.55 in 1948. In other words, whereas in 1880 it took 0.54 dollar of capital to produce one dollar of manufacturing output (or 1.51 dollars of capital to produce one dollar of manufacturing value added), in 1919 it took almost double that capital to produce a dollar of output or of value added. Then the situation changed, and by 1948 the capital needed to produce a dollar's worth of output or of value added dropped back to levels only slightly higher than those of 1880. In mining, the ratio of capital (excluding land) to value of output rose from 0.7 in 1870 to 2.3 in 1919 and then declined to 1.3 in 1948 (and 1953). These movements mean, as already indicated, that up through 1919, capital in both manufacturing and mining grew

at rates significantly higher than those of output, whereas after 1919 the reverse was the case.

2. These long-term rises and declines in the *average* capital-output ratios imply an even more conspicuous reversal in the levels of the *marginal* or incremental capital-output ratios. If the average capital-output ratio rises from time 1 to time 2, the marginal ratio over the interval must necessarily be *above* the higher of the two average ratios (i.e. above that for time 2); if the average capital-output ratio declines from time 1 to time 2, the marginal ratio over the interval must necessarily be *below* the lower of the two average ratios (i.e. below that for time 2).[6] Thus, when the average capital-output ratios are rising, the marginal ratios for each interval must be above the higher of the two terminal average ratios. Then, when the average capital-output ratio turns downward, the marginal ratios must drop below the lower of the two average ratios in each interval. The resulting violent movement of the marginal ratios can be illustrated by the estimate for total manufacturing. The average capital-output ratio was 0.54 in 1880, rose to 0.79 in 1900, and the mean of the two values for the period was 0.66. The marginal capital-output ratio for that interval was as high as 0.95. From 1900 to 1919, the average ratio rose again, from 0.79 to 1.02 (the mean thus being 0.905). Over that interval, the marginal ratio was as high as 1.24. Then, from 1919 to 1948, the average ratio dropped from 1.02 to 0.61 (the mean being 0.815, as compared with that of 0.905 for 1900–1919). But the marginal ratio for 1919–1948 was as low as 0.38, less than a third of the level of the marginal ratio for 1900–1919. With the detailed series available in the monograph, it is easy to calculate the marginal capital-output ratios for successive intervals and to show how widely they vary over time. The significance of these findings is that through 1919 it took much larger net additions to capital to produce a dollar of net additions to output than was the case after 1919.

[6] This can be shown by simple algebra. Assume that C_2/O_2 is larger than C_1/O_1, i.e. the average capital-output ratio at time 2 is larger than that at time 1. Then:

$$(C_2/O_2 : C_1/O_1) \text{ is larger than 1, and it follows that}$$
$$C_2O_1 \text{ is larger than } C_1O_2. \qquad (1)$$

The marginal capital-output ratio over the interval is:

$$(C_2-C_1)/(O_2-O_1)$$

It can be shown that under the condition stated above (viz. that C_2/O_2 is larger than C_1/O_1), this marginal ratio will be larger than C_2/O_2. Thus:

$$[(C_2-C_1)/(O_2-O_1)] : C_2/O_2 = (C_2O_2-C_1O_2)/(C_2O_2-C_2O_1) \qquad (2)$$

Since, as we know from expression (1) above, C_1O_2 is smaller than C_2O_1, it follows that the right-hand side of expression (2) must be larger than 1 and, hence, the marginal ratio larger than C_2/O_2.

The same reasoning will show that if the average capital-output ratio declines, i.e., if C_2/O_2 is smaller than C_1/O_1, the marginal ratio over the interval will be smaller than C_2/O_2.

3. The long-term rise of the average capital-output ratio through 1919 and the equally marked long-term decline thereafter were general, i.e., these movements characterized the distinguishable subgroups of capital as well as the different industrial branches within mining and manufacturing. For manufacturing, we can distinguish between fixed capital (plant and equipment) and working capital (inventories, cash, and receivables) for selected dates between 1890 and 1953. The ratio of fixed capital to output rises from 0.36 in 1890 to 0.47 in 1904, drops slightly to 0.43 in 1929, and then declines to 0.285 in 1948 (falling still further to 0.27 in 1953). The ratio of working capital to output rises from 0.36 in 1890 to 0.45 in 1929, and then declines to 0.32 in 1948 (and 1953). Thus, in both cases, we have the rise to the twenties and then the decline. Significantly, the drop in the ratio of working capital to output is not as great as the decline in the ratio of fixed capital to output. For mining, we can distinguish between plant (net value of structures and equipment) and working capital (defined as in manufacturing), for the full period, from 1870 to 1953. The ratio of plant to output rises from 0.61 in 1870 to a peak of 2.00 in 1919, and then drops to a trough of 0.84 in 1953. The ratio of working capital to output rises from 0.11 in 1870 to a peak of 0.57 in 1929, and then declines to 0.42 in 1953. Here again, both components show the rise and decline in the ratio to total output; but the ratio of working capital to output declines less, and the relative excess of its level in 1953 over that in the earliest year is greater. It follows that in both manufacturing and mining, at least since the twenties, the share of working capital in total capital increased, and the share of fixed capital decreased.

4. Even more important is the fact that this long-term rise and decline in the capital-output ratios is observed, with fair synchronism, in the great majority of the industrial branches within both manufacturing and mining. This can be demonstrated by calculating the proportion of the movement in the capital-output ratio for total manufacturing and mining due to such movement *within* each industry, i.e., eliminating the effects of changes in weights *among* the industries by holding industry weights constant. The calculation for manufacturing, for 1880–1919, using thirty-eight minor industries weighted by 1919 output, shows that as much as 83 per cent of the rise in the capital-output ratio for all manufacturing was due to the rise in the ratios *within* each industry, and only 17 per cent to interindustry shifts. A similar calculation for 1880–1909, using 1909 output weights, again shows that 85 per cent of the rise in the ratio for total manufacturing over the interval was due to the movement of the ratios *within* the minor industries, and only 15 per cent to shifts in industry weights. The results of a similar analysis for the phase of secular

decline of the ratio are even more striking. From 1919 to 1937, the capital-output ratio for all manufacturing declined by about a quarter. The effect of shifts *among* industries, using 1937 output weights, would have been to *raise* the ratio slightly; it follows that *all* of the decline in the ratio for total manufacturing was due to the decline in the minor industry ratios.

The results of an analogous calculation for mining suggest similar conclusions. The capital-output ratio for total mining rose from 0.72 in 1870 to 2.30 in 1919, or by 1.58. Over this same interval, with the industry ratios held at their 1890 levels, the changing weights of the industries within mining would have produced a rise of 0.66 in the ratio. This shows that the movement of the ratios *within* the industries accounted for about six-tenths of the rise in the ratio for total mining. In the declining phase, the ratio for total mining dropped from 2.30 in 1919 to 1.34 in 1948. The shift in weights among industries would have made for a *rise* in the ratio for total mining. Hence, all of the decline in the capital-output ratio for mining after 1919 was due to the decline of the ratios *within* the industries.

5. For manufacturing, both theoretical expectation and empirical observation indicate that the capital-output ratios are higher for the larger than for the smaller plants and firms. From 1880 onward, large plants and firms became increasingly important. This must have been a factor contributing to the observed rise in the capital-output ratio for total manufacturing. However, we have no data by which to measure the effect of this factor, nor can we assume that the growth of large plants and firms was independent of the whole complex of forces (some of which will be suggested below) that made for the secular rise in the capital-output ratio. But large plants and firms continued to increase in importance after 1919. This means that the decline in the capital-output ratio for total manufacturing since 1919 occurred *despite* the rise in the indicated trend toward larger firms. Indeed, data for 1937–1947 indicate that the fixed capital-output ratios of large firms declined more than did the ratios of small firms.

Trends in the Capital-Output Ratios—Some Hypotheses

The findings above reveal that, at least for manufacturing and mining, a secular rise in the capital-output ratio, extending from the 1870's and 1880's through 1919 or 1929, and a secular decline thereafter, were generally observed throughout the sector, and could hardly have been either a statistical or historical accident. While it is not possible to provide a tested and thorough explanation of these trends, tentative analysis should be illuminating, particularly for the use of these findings as bases for assaying future prospects.

In such a tentative explanation, a secular *decline* in capital-output ratios may be easily ascribed to the pressure for reducing costs and maximizing profits. A high capital-output ratio may contribute to higher costs in several ways. First, and most obvious, are the interest charges—overt or imputed—on the capital thus tied up. If the capital-output ratio is 2 instead of 1, two dollars of capital investment are tied up in producing one dollar of output (i.e., gross recovery). If the interest rate is, say, 6 per cent, the cost to be recovered out of the proceeds of output—in whatever form such recovery appears (interest on equity may appear as a component of total net profits)—is 12 cents instead of 6 cents. Second, to the extent that capital is consumable and depreciable, which is true of plant and equipment, a higher capital-output ratio means either a higher ratio of depreciation charges to cost of output, or a longer life over which depreciation, i.e., recovery of capital assets, is spread. In the former case, there is a larger cost element in current output; in the latter case, the enterprise is exposed for a longer period to risks of obsolescence, loss of markets, and any other economic danger implicit in a slow recovery of investment. Third, there is a limit to the size of capital that any single firm can secure—if only because of the necessary balance between equity and debt. If, then, the maximum capital of an enterprise is set at X, a lower capital-output ratio would mean that much more output and sales volume. Since profits are, at least in part, a function of sales volume, a lower capital-output ratio would mean a higher rate of profit for total capital—and an even higher rate on the equity share of it.

These arguments could be expounded further, but it is hardly necessary to labor this obvious point. The economic incentive to minimize the stock of capital tied up per unit of output is clear and strong—just as is the incentive to minimize the inputs of other costly factors of production. But there is this significant difference in the case under consideration: capital *stock* rather than flow is involved; for this stock (unlike the stock of labor services), the firm carries the risk and responsibility. Thus, one could assume that, *unless* other factors intervened, economic incentives would bring about a persistent reduction and consequently, a secular decline in the capital-output ratios.

The other factors are numerous: technological and related social inventions, whose application requires tangible capital goods of large size and long life, and changes and innovations in financing, which may require a higher ratio of financial assets to output. The technological innovations are perhaps most important and, certainly, most conspicuous. If a small machine costing $100,000 can, because of

a new invention, be replaced by one costing $1 million, with somewhat larger capacity but much longer life and much lower cost per unit of product, the replacement will be made. However, unless output can be immediately increased tenfold (which is rarely the case), the capital-output ratio will rise, and may remain at a higher level for a long time. Much of modern technical change inherently involves larger volumes of power, more costly construction materials, and more elaborate functions (mechanical or chemical). Thus, it requires plant and machinery of ever increasing size, and the rise in the volume of capital thus tied up exceeds, for a long period, the possible rise in the volume of output. Furthermore, there are always changes in the capacity for organizing large plants and large firms—partly necessitated by, partly inherent in, the changing technology of production proper—which call for an ever increasing scale of operation. Insofar as it is feasible to have larger plants and firms—to the extent that the limit upon the maximum amount of capital that can be tied up in a single firm is lifted—a higher capital-output ratio can be tolerated, and the pressure for reducing the ratio for any of the reasons suggested above is lessened. Also, new forms of credit and new types of financial institutions may facilitate growth in the size of firms and the volume of capital, for they may permit easier mobilization of equity funds and a higher ratio of debt (particularly long-term) to equity.

As compared with these technological, and closely related organizational, innovations that make for higher capital-output ratios, those that contribute to the building up of financial assets seem less important. As plants and firms grow in size, and as the division of labor increases among them in various industries, conditions may develop under which the producing units must, in order to facilitate output and sales, extend short-term credit to the buyers of their products. As a result of such practices, receivables may grow more rapidly than output. Likewise, a need may develop for cash balances. With the economic size of such firms increasing, and the cost of cash to them declining, cash balances may rise not only absolutely but also proportionately to output. Thus, it is likely that, during some periods of an industry's growth, its financial assets may grow at a greater rate than the volume of its output. In a rapidly expanding industry, an expansion of short-term credit to buyers may facilitate the high rate of growth of the market for its products. At the same time, the rate of growth of its cash balances may be high as a by-product of the rapidly increasing volume of its net profits and total turnover.

Thus, the life span of an industry, as reflected in the secular movement of its capital-output ratio, may be envisaged as the result of

continuous competition between technological and other innovations, many of which serve to raise the ratio, and economic incentives which, again through technical changes and managerial improvements, just as continuously operate to depress the ratio. In general, in the earlier phases of a modern industry's vigorous growth, the ratio-raising factors seem to preponderate. It is in these phases that capital-demanding technological innovations come thick and fast; that the optimum scale of plant and firm increases rapidly; that, with the rapid growth of the market, as evidenced by high percentage rates of growth of the industry's output, the main pressure upon enterprises is for rapid expansion of capacity and volume of output—under relatively favorable price-cost relations in a growing market. Then, as the industry reaches large size and comparative maturity, accompanied by a much higher ratio of capital to output than that characterizing it in its early decades, the pressure for economy in the use of capital increases. The very slowing down in the rate of growth of output that typically ensues permits greater concentration upon a host of refinements in the use of capital, with resulting economies for which there is great scope within the already existing network of plant and equipment. Thus, after a certain phase in the life of an industry is reached, the ratio-depressing factors are likely to begin to outweigh the ratio-raising forces, and a secular decline in the capital-output ratio begins.

Several comments supplementing this rather sketchy picture of an industry's life cycle of capital-output ratios can be made.

1. The first relates to the role of undercapacity utilization of fixed capital in the early phases of an industry's growth and to the effects of an increasing ratio of capital replacement (consumption) to total capital in the later phases. Both conditions accentuate the secular movement of the capital-output ratios. In the early phases of an industry's growth, the construction of new capacity, because of indivisibilities and prospective long life of the plant and equipment, may result in additions geared to the longer future. Suppose the optimum scale is a plant whose full capacity is 10 million units per year. Further suppose that the market will not warrant full capacity output for several years to come. Nevertheless, it may pay to build such a full-capacity plant rather than a less economical plant capable, at full utilization, of producing only 1 million units per year. In the early phases of an industry's growth, when rapid and large increases in the market are expected, such large additions to capacity that are bound to be temporarily underutilized may be fully warranted by economic calculation. *If* such additions to what is temporarily overcapacity constitute an increasing fraction of total capital, the result would be not only relatively high but *rising* capital-output ratios; such additions

would raise the ratios over and above the technological and related changes that would warrant higher capital-output ratios under the assumption of full utilization of capacity. Then, as the industry matures and the percentage rate of its growth declines, the economic justification for such future-oriented additions to capacity is weakened, and the effects of such additions on high and rising capital-output ratios slacken.

As the rate of growth of capital diminishes, another factor comes into play that may contribute to a secular decline in the capital-output ratio. Given a constant life period of depreciable capital, a high rate of growth of gross fixed capital formation means a low ratio of current capital consumption to total stock of fixed capital; conversely, a low rate of growth of gross fixed capital formation means a high ratio of current capital consumption to the total stock of fixed capital. Assume a life span of, say, twenty years, straight line depreciation, and a million units of gross fixed capital formation in the first year. Assume that no growth takes place during the following twenty years, i.e., annual gross fixed capital formation is exactly a million units per year. Then in the twenty-first year, capital consumption will equal current gross fixed capital formation and will be a tenth of the total net stock of accumulated fixed capital. If any growth in annual volume of gross fixed capital formation is assumed, capital consumption in the twenty-first year will be smaller than gross capital formation in that year and will be below a tenth of the total accumulated stock of fixed capital. Hence, with constant life, a slowing down in the rate of growth of gross capital formation means a rising ratio of capital consumption to total fixed capital (whether gross or net of depreciation). An additional relevant consideration is that, with the growth of an industry to maturity, a slowing down in the rate of growth of capital formation is often accompanied by a decline in the share of long-lived construction in total fixed capital and a rise in the share of shorter-lived equipment. The resulting reduction in the weighted average life of depreciable capital contributes further to an increase in the ratio of capital consumption to fixed or total capital.

Capital replacement, under conditions of modern technology, raises the productive capacity of capital, even when the calculation is in constant prices, since the adjustment for price changes does not correct for growth in the productive power of the dollar spent on plant and machinery. Hence, the same stock of capital in constant prices will be capable of turning out a larger volume of output if a larger proportion of that stock is replaced during the year. Assume that replacement means an increase of 100 per cent in productive power, not an unrealistic figure if the life span involved is as long as twenty years; and

that fixed capital remains the same both in years 1 and 2 and years 51 and 52. However, in year 2, capital consumption (replacement) is 5 per cent of fixed capital, and in year 52 it is 10 per cent. The increase in the productive power of the capital of the same volume (as measured by us in the numerator of the capital-output ratio) is, therefore, 5 per cent from year 1 to year 2 and 10 per cent from year 51 to year 52. If output in both intervals rises by the same percentage, say, 5 per cent, and if the capital is geared to capacity use, the average fixed capital-output ratio will remain the same in years 1 and 2, but will decline from year 51 to year 52.

The relevance of these comments to the model of secular movements of capital-output ratios is obvious. This is evidenced by our earlier finding that the rate of growth of capital, particularly fixed capital, declined in both mining and manufacturing. The overcapacity additions in the early phases of an industry's life span, and the secular rise in the ratio of capital consumption (replacement) to total and fixed capital may accentuate the secular movement of the capital-output ratios, both the rise in the upward phase of the secular swing and the decline in the downward phase.

2. The preceding discussion clearly suggests that the extent to which the secular capital-output ratios can rise during the upward phase and fall in the downward phase is fairly narrowly limited. To begin with, there is a limit to the impact of technological changes in enlarging the scale of operations and increasing the intensity of capital as measured by the ratio of capital to output. An industry is a circumscribed framework of operations. After the major technological innovations have been made in it, much less room remains for additional *economical* major inventions and improvements. Furthermore, no single industry can long grow at constant percentage rates of increase of output. Eventually, the rate of growth must retard. Retardation reduces the raising effects of advance overcapacity construction on the level of the capital-output ratio. Thus, even without capital-saving innovations, there would be an upper limit to the capital-output ratio. And the level of such a limit is all the lower because, as the capital-output ratio rises, the room and incentive for capital-saving innovations increases; and as growth of capital slackens, the effect of the rising ratio of replacement to stock of capital begins to come into play.

If, in any given industry (or complex of industries), there is an upper limit, a ceiling, to the secular rise of the capital-output ratio there must likewise be a lower limit, a floor, to the decline. To begin with, the economic incentive for capital-saving innovations and improvements slackens as the capital-output ratio declines. Furthermore, there are always technological and other changes that make for a higher

capital-output ratio even in the mature industries with slowly growing output; changes may originate in the technology of other sectors. (Witness the effect of innovations in packing and quick-freezing on some of the oldest and most mature food industries.) It is, thus, unlikely that the secular decline of the ratios, even of the fixed capital-output ratio, will reach fractions close to the impossible zero level. With reference to the total capital-output ratios, the same point is strengthened by consideration of the working capital components, whose ratios to output need not decline as much as those of durable and depreciable capital.

3. The model sketched out so far implies a positive correlation between the rate of growth of an industry's output and its capital-output ratio. In the earlier phases of an industry's life, when the rate of growth of its output is high, its capital tends to grow at an even higher rate, and the capital-output ratio rises. In the later phases, the percentage rate of growth of output is much lower, capital grows at an even lower rate, and the capital-output ratio declines.

Of course, the association is rough, rather than continuous: the percentage rate of growth of an industry's output retards even in the early decades when the capital-output ratio is still rising. Here, I comment upon this association not because of its importance for the analysis of secular changes in the capital-output ratios of the type summarized in the preceding section, but because of its much greater relevance to the analysis of shorter, though still secular, movements—specifically, the long swings of about twenty years, which have been noted in so many series relating to output and other aspects of the economy of this country. There is reason to argue that such shorter-term accelerations and decelerations in the rate of growth of output would tend to be accompanied by even greater rises and declines in the rate of additions to capital and, hence, by alternations in the capital-output ratios. The estimates of capital in manufacturing suggest the existence of these twenty-year swings in the rate of its growth, but the data are not sufficiently continuous to permit an analysis of them in comparison with the long swings in the rate of growth of output.

4. Finally, one may note that the implications of the model for the fixed capital-output ratio differ from those for the ratio of working capital to output. A great part of our discussion applied to the ratio of fixed capital to output. Some implications relevant to the ratio of inventories to output may be drawn. Thus, one could expect that high and rising ratios of fixed capital to output in the earlier phases of an industry's growth would, all other conditions being equal, make for high and rising ratios of inventories to output (relatively larger sup-

plies of raw materials, goods in process, etc.). Likewise, the greater economy in the use of capital in the later phases of the growth of an industry might make for declining inventory-output ratios. But the effect of indivisibilities and the requirements of large-scale operation do not apply to inventories with the same force as they do to fixed capital; nor does the argument relating to the effect of a rising ratio of capital replacement to stock of capital apply to inventories. It is quite likely, therefore, that both the rise of the inventory-output ratio in the upward phase (if there be a rise at all) and the decline of this ratio in the downward phase are milder than the secular movement of the fixed capital-output ratio. Data for manufacturing, available from 1919 on, do tend to suggest that the decline of the inventory-output ratio up to 1948 was much less than that of the fixed capital-output ratio.

Few of the arguments adduced above apply to the ratios of financial assets (cash and receivables) to output. To be sure, there would always be an incentive to minimize both the absolute volume of funds tied up in these assets and the volume per dollar of output. Technological and related organizational changes can make for larger scale operation, enormously larger units of long-lived capital equipment, and rising fixed capital-output ratios. Just so, changes in the business and credit structure of industries can make for larger volumes of cash and receivables, absolutely and even in relation to output. In a purely formal way, the model of the secular movement of the financial assets-output ratio may, like that of the fixed or the total capital-output ratio, appear to be a combination of factors, some of which press for a higher ratio of capital to output, and others, for a lower ratio. But the relative strength and timing of the ratio-raising and -depressing factors that act on the financial assets-output ratio need not be the same as those that act on the fixed capital-output ratio. One may argue, in particular, that the very increase in the size of firms, which accompanies the coming of an industry to maturity, facilitates, and sometimes necessitates, increases in cash holdings and in short-term credit extensions through receivables (in many cases, the big firms have assumed a sort of banking and financial function to meet their own needs and those of their customers). Thus, in the downward phase of the life-cycle of capital-output ratios, the ratio of financial assets to output need not decline as drastically as does the ratio of fixed capital to output.

The brief discussion above can hardly be considered an adequate explanation of the findings concerning the secular movements of the capital-output ratio in mining and manufacturing. An adequate explanation would require more statistical and other documentation that would draw heavily upon the historical records of the major

branches within the sector.[7] Such an undertaking is beyond the scope of the present monograph. But the hypotheses suggested do bear directly upon the major findings. Moreover, they carry some validity in that the major arguments are closely associated with the generally observed characteristics of industrial growth in dynamic economies, such as that of this country. After all, the retardation in the growth of output has been found in several studies of industrial growth in this country, and much of the structure of the hypotheses above is anchored in the broad differences between the early and the later phases of the life-cycle of an industry's growth.

The discussion above suggests, then, that the mining and manufacturing sector of the United States grew most rapidly from the 1870's to the 1920's. During this time, its share in national income rose from about 16 to 25 per cent; and, in this typical period of early and rapid growth, the capital-output ratio-raising technological and social changes tended to preponderate. High capital-output ratios were reached by the twenties. Since then the share of the sector in national income has risen by only five to six points, the rates of growth of output have been much lower than in the decades preceding 1919, and the capital-saving, capital-output ratio-reducing factors have tended to preponderate.

The consideration of these capital-output ratio-raising and -depressing factors led to some suggestions concerning secular trends in the structure of capital assets and to some implications concerning the trends in financing. We turn now to a direct consideration of this aspect of capital formation in mining and manufacturing.

[7] Thus, no explicit consideration was given to the relative prices of other factors of production—raw materials and labor—regarding which various speculative hypotheses could be advanced. For example, it could be argued that an industry in the early period of its growth has to draw labor for its rapidly growing working force away from other industries. Such labor is more expensive relative to prevailing rates. This higher cost, combined with the limited experience of the working force in what is, essentially, a new process, provides further stimulus for the use of capital. Consequently, the capital-output ratios must rise. Likewise, any difficulties in obtaining an adequate supply of raw materials to feed a rapidly expanding industry would exert pressure for greater economies in the use of materials. Such economies might be attained by a more elaborate, and more capital-demanding, way of utilizing the materials. But these are, necessarily, speculations. Equally speculative are considerations relating to possible changes, in the course of an industry's growth, in the functions that it will retain, and those that it may transfer to others, e.g., the transfer of the manufacture of power from the manufacturing industry to central power stations. Clearly, the purpose of the brief discussion in the text is not to provide a complete and tested theory of industrial growth that could be used to derive the pattern of movement of the observed capital-output ratios; rather, the purpose is to suggest particular factors that seem most likely to account for the actual trends in the capital-output ratios as they have been revealed by the empirical investigation on which this monograph reports.

Trends in Financing—External and Internal

The data on financing of capital formation in mining and manufacturing are far less adequate than those on long-term changes in the stock of capital. To begin with, the former extend back only to 1900. Second, they relate to corporations alone. However, the exclusion of unincorporated firms is not too damaging a limitation since, even in the decade before World War I, corporations accounted for over 80 per cent of total output and, probably, for an even greater share of capital.[8] Third, even for corporations, estimates relating to the total include, for the full period since 1900, only gross retention (depreciation and depletion charges plus net retained profits) and new security issues; for other forms of financing, particularly short-term, we have to rely on samples of large corporations with a coverage that becomes distressingly thin as we go back in time. Finally, the structure of financing is subject to rapid and violent fluctuations, associated with business cycles, wars, and changes in tax policy. As a result, long-term trends in financing are more difficult to establish and are subject to greater error than are those in capital in constant prices or even in capital-output ratios. The findings summarized below should, therefore, be taken with great caution—particularly in their possible use as bases for analyzing future prospects.

1. Gross internal financing (gross retention)—depreciation and depletion charges plus undistributed net profits—in manufacturing and mining represents a much greater proportion of total new financing than do external funds. For all corporations, gross internal financing during 1900–1953 totaled $180 billion, over five times as much as the total net amount of new security issues ($33.6 billion) of these companies over the same period. For a sample of large corporations (of varying coverage during successive periods), the share of internal financing in total financing (including here both long- and short-term external financing) was 70.4 per cent in 1900–1910, and 71.6 per cent in 1915–1953.[9] And the relatively small share of external financing was, in large measure, offset by the outflow of funds resulting from the acquisition of financial assets, so that the *net* balance of external financing, in most periods, was even smaller.

2. Although it is not realistic to identify specific sources of funds with specific uses, it may be significant that internal funds have been an increasing percentage of expenditure on plant and equipment. For all corporations, the ratio was 0.87 in 1900–1914, 1.08 in 1919–1929, and 1.10 in 1946–1953. In other words, gross additions to fixed capital

[8] Raymond W. Goldsmith, *A Study of Saving in the United States*, Vol. I, Princeton University Press, 1955, Table P-11, line 1b, p. 889.

[9] Using dollar volumes, shown in Table 44, cumulated over the period.

could be financed to an increasing extent out of the internal funds of corporations.

3. The two components of gross internal funds (gross retention)—depreciation and depletion charges, and undistributed profits—are available separately. The ratio of the former to plant and equipment expenditures was 0.42 in 1900–1914, 0.79 in 1919–1929, and 0.58 in 1946–1953; the ratio of the latter to the same expenditures was 0.45, 0.29, and 0.52, respectively. Thus, both depreciation charges and retained net profits, particularly the former, are responsible for the rise in the ratio of internal funds to plant and equipment expenditures. It should be noted that these gross retention components are unadjusted for the effects of changes in inventory valuation and for differences between depreciation charges based on cost and those based on replacement values. However, in the analysis of financing flows, such unadjusted totals in current prices are perhaps the most useful.

4. While there was a rise in the ratio of internal funds to expenditures on plant and equipment, no such rise appears in the ratio of internal funds to total capital expenditures or uses (sources). This cannot be shown in the data for all corporations, for which new security issues are the only external financing source that can be estimated back to 1900. Even so, if we take the share of gross internal funds in a total that combines them with new security issues, it moves from 0.74 in 1900–1914, to 0.75 in 1919–1929, and to 0.83 in 1946–1953 (Table 40, below)—a rise to be sure, but quite moderate. But when we use the sample of large corporations (Table 44, below), in which all external financing is included, we find that the share of internal funds in total financing is 70 per cent in 1900–1910, 89 per cent in 1919–1927, and 67 per cent in 1946–1953. If any inference can be drawn, it is that there was no significant long-term trend, either upward or downward, in the share of internal funds in total sources (uses) of funds.

5. The combination of an upward trend in the ratio of internal funds to both plant and equipment expenditures and to the sum of internal funds plus new security issues, on the one hand, with the absence of such secular rise in the share of internal funds in total uses (sources), on the other, leads to one obvious inference. The share of short-term external financing in total financing must have increased, and so must have the share of short-term assets in total assets. The first conclusion can be checked directly in the evidence provided by the sample of large corporations. The share of short-term external in total financing was only 2.4 per cent in 1900–1911; it was negative during the twenties; and as high as 20 per cent in 1946–1953. A large contribution to this rise is made by income tax accruals, which are treated here as short-term financing provided to corporations by the government. If

these accruals were to be considered a kind of short-term income retention and included in internal funds, the ratio of internal to total financing would show a slightly upward trend over the period. But, even so, the trend would involve a rise of just a few percentage points over a period longer than half a century, and its significance would be greatly reduced by lack of continuity over time. It should be noted that the increase in tax accruals was accompanied by a rise in holdings of government securities.

We may now sketch an explanation of the findings just summarized. The first of these is that gross internal funds constitute a large proportion of total financing—in the long run, well above two-thirds. In any attempt to explain this pattern, one naturally turns to the capital-output ratio, as well as to the general argument that any growing sector of the economy that uses a great deal of capital will, in order to avail itself of the favorable opportunities provided by an expanding market, consistently retain and reinvest some fraction of net earnings. What are the proximate quantitative determinants involved? We know that in manufacturing the ratio of total capital, net of depreciation reserves, to value added was, at most, 2.6. Assume that with capital gross of depreciation reserves, the ratio was 3.0; that about six-tenths of the capital is durable and depreciable capital, of which seven-tenths is plant, with an average annual depreciation rate of 2 per cent, and the balance is equipment, with an average annual depreciation rate of 8 per cent. This means that the combined depreciation charges would amount to 3.8 per cent of the depreciable part of capital, 2.28 per cent of total capital, or 6.84 per cent of annual net value added (i.e., 2.28 per cent multiplied by the capital-value added ratio of 3.0). Assume next that value added grows at the rate of 5 per cent per year, and that the marginal ratio of gross capital to value added is, like the average, 3.0. The gross additions to capital must, therefore, be 15 per cent of value added (i.e., 5 per cent multiplied by the capital-value added ratio), and depreciation charges, equal to 6.84 per cent of value added, would contribute about 46 per cent of the total funds needed to finance gross capital additions. Assume further that total net profits, after interest and taxes, are 10 per cent of value added, and that a third of total net profits is retained. Then, retained profits would provide funds equivalent to 3 per cent of value added, or another fifth of the funds needed to finance gross capital additions. In this illustration, then, internal funds account for about 66 per cent, or two-thirds, of the total financing needed.

The specific figures used in the illustration above are not important, even if there be a rough and ready realism about them. What *is* important is the demonstration of the connection between the

capital-output ratios and the structure of financing in its distribution between internal and external funds. A difference between the average and marginal capital-output ratios, which means movement over time in the average, will affect the share of internal funds, because the marginal ratio bears directly upon the volume of *total* financing, and the average ratio determines (given the depreciation rate) the contribution of depreciation charges to *internal* financing. Given a functional relation between output, volume of total net profits, and volume of expected profit retention, the average and the marginal capital-output ratios will also determine the share of total financing that would be contributed by undistributed net profits. It follows that much of the previous discussion concerning the levels of, and trends in, capital-output ratios bears upon the levels of, and trends in, the share of internal funds in total financing. With the inclusion of a few additional variables (such as length of life and other elements in setting depreciation charges, and the ratio of retained profits to output), a single model could be devised for the analysis of secular movements in both the capital-output ratios and the share of internal funds in total financing.[10]

This point bears directly upon the second major finding presented above, the long-term rise in the ratio of internal funds to expenditures on plant and equipment. We have argued above that a retardation in the rate of growth of fixed capital formation means a rise in the ratio of capital consumption to current gross fixed capital formation (plant and equipment expenditures). Capital consumption is measured by current depreciation charges. We know that the rate of growth of capital and, hence, of capital formation, in the mining and manufacturing sector has declined. We should, therefore, expect that the ratio to plant and equipment expenditures of internal funds contributed by depreciation charges would rise, and this is what we find. However, the rise in the ratio is relatively modest, partly because the underlying data are available only since 1900 (and the rate of growth of capital formation had largely slowed by then), partly because we use deprecia-

[10] The model is complete, but only on the severely limiting assumption that external funds are always available to fill the gap left by internal financing. If they are not, or are in excess of the demand for external capital funds as determined by the model sketched out in the text, the system will not be in equilibrium. As a result, the cost of capital funds will change, with consequent changes in all the variables of the system; finally, the entire level of economic activity will change—with effects on the distribution between external and internal financing not accounted for by the model. The model could, perhaps, be completed by making savings other than those internal to an industry a function of total output and making part of such savings available to an industry as external funds, i.e., as a function of the industry's share in countrywide output. But the purpose of the model is to indicate the relation between capital-output ratios and shares of internal funds in total financing. No claim is made that such relation fully determines the actual trends in the share of internal funds in total financing.

tion charges based on original-cost valuation, and partly because we deal with a disturbed period over which long-term trends are difficult to establish.

Furthermore, it may be argued that, to a substantial extent, retained net profits are a function of output, i.e., of the volume of sales. Hence, if the marginal fixed capital-output ratio declines, the share that retained net profits would contribute to the financing of plant and equipment expenditures should rise—all other conditions being equal. Because the average fixed capital-output ratio declined from the twenties onward, the marginal fixed capital-output ratios since then should be much lower than they were from 1900 to about 1920. In turn, this should have made for a secular rise in the ratio of retained profits to plant and equipment expenditures. Here again, long-term movements in factors affecting the stock of capital and its ratio to output are connected with the findings relating to the upward trend in the ratio of a component of internal funds (this time, retained profits) to a major category in the uses of funds (plant and equipment expenditures).

Given a long-term rise in the ratio of internal funds to expenditures on plant and equipment, a rise in the ratio of such funds to net new issues is probable. For one would expect the trend in the latter to be geared to the trend in expenditures on new plant and equipment—even though one should not push too far the association between specific uses and sources of funds.

The last of the findings summarized above—absence of a rise in the share of internal funds in total financing—appears to be due to forces outside those considered in connection with the capital-output ratios, namely (as already indicated), to a rise in the share of short-term external financing. Hence, the explanation can be more easily sought in a direct examination of the trends in the structure of external financing.

Trends in the Structure of External Financing

1. Within total external financing, the share of short-term funds was much higher in the post-World War II period than during the earlier periods back to 1900, excluding the World War I and World War II years. In the sample of large corporations, the share of short-term in total external financing was 8 per cent in 1900–1910, over 65 per cent during the World War I period (1915–1919), negative in the twenties and early thirties, almost 90 per cent during the World War II period (1939–1946), and 61 per cent during 1946–1953 (Table 44, below). For all manufacturing corporations, the share of short-term in total external financing in 1946–1953 amounted to 57 per cent. Though the

trend is disturbed by major fluctuations during depressions and wars, there is some semblance of a rise in the share of short-term in total external financing.

2. The substantial proportions of short-term financing during 1915–1919, 1939–1946, and 1946–1953 were, in large part, due to increased accruals for income tax purposes. The increase in the latter accounted for between 33 and 54 per cent of total short-term financing, as shown by the sample of large corporations. Yet, if we deduct these increases from both numerator and denominator, the share of short-term financing in external financing is still almost 50 per cent during 1915–1919, almost 85 per cent during 1939–1946, and almost 44 per cent during 1946–1953. Thus, the upward trend in the share of short-term in total external financing still remains, if we compare the post-World War II period with either the twenties or 1900–1910.

3. There was some rise in the ratio of debt to operating assets (total assets minus investment in government and corporate securities). In manufacturing, the ratio of interest-bearing debt to total capital invested in operating assets (in book values) rose from over 14 per cent in 1890 to 18 per cent in 1952. The ratio of total debt to total assets increased from 23 per cent in 1929 to 36 per cent in 1952. Similar tendencies are revealed by the data for mining.

4. This rise in the ratio of debt to assets was due partly to the rise in the relative importance of short-term external financing, with such financing all taking the form of debt obligations partly to the rise, within long-term external financing, of debt obligations relative to equity issues. For all manufacturing and mining corporations, the share of new bond issues in total new security issues was 46 per cent during 1900–1914, 20 per cent during 1919–1929, and 62 per cent during 1946–1953 (Table 51, below). The ratio of total bonded debt to current value of operating assets of all manufacturing corporations fluctuated, but it was 3.7 per cent in 1900, 4.5 per cent in 1919, and 6.3 per cent in 1952 (Table 54, below). Again, granting the marked variation in the shares over time, there is some semblance of an upward trend in the relative weight of debt obligations within long-term external financing—although the sharp rise occurred largely in the post-World War II years.

The paragraphs above summarize the major findings on the long-term changes in the structure of external financing. There are many other changes, e.g., the increased share, in recent years, of privately placed long-term financing compared with that chaneled through public security markets. But the summary will suffice for the present purposes, the more detailed findings being available to the interested reader in the chapters that follow.

Among the factors that may have made for these trends in the structure of external financing, two somewhat different groups may be distinguished. One lies in the realm of government policy, which is, in turn, affected by the changing internal problems of our society and the vicissitudes of war and other changes in international relations. The increased weight of income taxes, and the resulting rise in the share of income tax accruals in short-term financing of business corporations is a clear illustration. Obviously, we deal here with a factor that is beyond the control, the decision power, of the private sector. Also among the extraneous factors, which business enterprises adjust to but do not determine, is the effect of corporation taxes on the relative attractiveness of bonds or other long-term debt obligations as compared with equity issues. The interest payments on debt can be treated as costs and deducted for tax purposes, but the dividend payments on equity issues cannot be so treated. Finally, one must not overlook the government policy, during World War II and some of the postwar years, of keeping long-term interest rates low to provide an adequate market for government obligations. As a consequence, bonds and other interest-bearing debt were more attractively priced than new stock issues. Thus, it would not be difficult to explain, in terms of government policy, the high levels, in recent decades, of the share of short-term in total external financing, of the share of debt obligations in that total, or of the share of bonds in total new security issues.

Yet, it would be an oversimplification to limit our consideration to government policy, induced by war and other necessities. There are factors within the private sector that might have contributed to the same trends. In discussing the secular movement of the capital-output ratios through the life span of an industry's growth, we have noted that, in the downward phase of this movement, the decline in the ratio of working capital to output need not be as great as the decline in the ratio of fixed capital to output; indeed, the estimates strongly suggest this conclusion. It follows that during this downward phase, which begins in the mining and manufacturing sector in the twenties, the average ratio of working to total capital is bound to rise, and the marginal ratio even more so. Working capital represents short-term assets, so that a rise in its share means a rise in the share of short-term in total assets. While no specific assignment of short-term funds (which are external funds by definition, because we classify gross retention with long-term funds) to short-term assets is fully warranted, it stands to reason that, all other conditions being equal, a rise in the share of short-term in total assets would be accompanied by a rise in the share of short-term in total financing. The latter would also mean a rise in

the share of short-term financing in total external financing, so long as the share of the latter in total financing is constant or does not materially rise. Finally, such a rise in the share of short-term in total external financing will, in turn, serve to raise the ratio of debt to external financing and, probably, of debt to operating assets.

Another factor lies in the relation between debt and assets for corporations classified by volume of assets. In general, cross-section analysis for 1937 and 1948 reveals that the ratio of debt to assets is lower for the large corporations and higher for the small corporations. But this relationship holds only for the range of assets from less than $50 thousand to the asset class of $5 million to $10 million. The ratio of long-term debt to assets rises, if anything, with the size of the corporation, from the $1 million class upward—particularly in the data for 1948. This latter positive relationship between corporation size and the ratio of long-term debt to assets can be easily explained in terms of the greater economic stability and credit-worthiness of the larger units. It may have contributed also, if in a minor way, to the slight upward trend, which we found among manufacturing and mining corporations, in the ratio of long-term debt both to equity issues and to assets.

Finally, we should note that the complexes of factors, suggested above, in both government policy and the private sector, affect not only the structure of external financing, but also the division between internal and external financing. Thus, the economic conditions that prevailed immediately after World War II, characterized, on the one hand, by active consumer demand and rising prices, and on the other, by government policy with respect to taxes and debt management, influenced the earning position of corporations and their outlook for the future. These economic conditions influenced the extent to which corporations could earn both depreciation charges and retained net profits, their capacity and willingness to provide internal funds for reinvestment, and their choice, in seeking external funds, between debt and equity funds and between short- and long-term debt.

Bearing upon Future Prospects

What is the bearing of the empirical findings and explanatory hypotheses discussed above upon prospects for capital formation and financing in the mining and manufacturing sector over the next two to three decades? The period is designedly set at this duration, because both our analysis of the past record and our interest in future prospects emphasize secular movements—not the transient changes associated with business cycles and other short-term alarums and diversions.

Furthermore, over a short period, changes in the rate of secular movement are too small to be either clearly discernible or of much importance for practical policy. For example, if the secular level of the stock of capital in the sector in 1958 is X, and the secular rate of change suggested by past experience is, say, 4 per cent per year, the projections for 1959 and 1960 will be $1.04X$ and $1.082X$, respectively. If the projection is in substantial error in that the actual secular rate of change declines to, say, 3.5 per cent (a truly large decline in a single year), the difference between the projection and the actual rate will be only between $1.04X$ and $1.035X$, and between $1.082X$ and $1.071X$—hardly significant for practical purposes. It is only in a long extension from the starting point in time that projected and actual secular trends can diverge significantly, and we are interested in these long-term extensions so that the slowly made changes in institutional patterns and policies can at least be considered. The period ahead must be long enough to permit the emergence of significant possible differences in secular movements.

When such long-term prospects are considered, two aspects of the findings and analysis above become directly relevant. The first is that, whatever patterns of order we find in the past trends in capital formation and financing in the sector (and it is only such orderly patterns that can be projected), the empirical coefficients involved were quite variable over the decades. For example, the ratio of capital to output in manufacturing declined from 1.02 in 1919 to 0.61 in 1948, and to 0.59 in 1953. In view of such past movements, there is no immediate reason to assume that, over the next two decades (to the late seventies) the ratio could not continue to rise to, say, 0.8, or decline to 0.5. If, then, we project output of the manufacturing sector as a function of some projected gross national product, the annual rate of capital formation required by such future output may vary within a wide range indeed. In other words, there is no empirically observed *constancy* of the capital-output ratio that would justify simple statistical extrapolations using fixed coefficients. And this comment applies even more strongly to trends in financing—discontinuous, as they have been over time, and distorted, as they have been in the past, by wars and major depressions.

Second, the factors suggested, even in this brief and tentative explanation of past trends, have been diverse and, while identifiable, not easily measurable. Most important, our knowledge of the characteristics of these factors, particularly their persistence over time and susceptibility to change, is deficient. For example, we can identify many of the technological and other capital-demanding innovations that made for a secular rise in the capital-output ratio in the sector,

as well as many of those capital-economizing changes that made for a decline. But, considering the long, and still unexplored, sequence of causal connection running from scientific discoveries to inventions to technological innovations to the use of capital, how can we translate the patterns of the past record into a basis for prognosis of the future? Clearly, we do not know enough of what makes for scientific discovery, invention, and innovation to derive from this line of analysis firm bases for projecting capital demand into the future. Likewise, we can clearly recognize the forces that made for the changed role of government in our economy during the recent decades. Thus, we can indeed understand some of the government policies that had a direct effect on the structure of financing in the sector. But, given the connection between government policy and the state of international relations—with the latter likely to loom large in the future of this country over the next two to three decades—how can we project into the future the changing and complex patterns of past relations?

These comments obviously do not mean that the statistical estimation and economic analysis embodied in this monograph are futile exercises in scholarly ingenuity for the gratification of antiquarian whimsy. To begin with, the indication of the variability over time of the empirical coefficients and of the variety of factors impinging upon trends in capital formation and financing should have at least the negative value of discouraging oversimplified extrapolations. It may be debated whether wrong projections are worse than none, but it can hardly be denied that too much faith in simple extrapolations of constant coefficients may lead to distressing policy results. Such faith is far worse than skepticism, which should lead, if projections are needed, to experimentation with a wide range of values and assumed changes. Insofar as the monograph, through its findings and analysis, contributes to such healthy skepticism, it will have performed a useful service.

But there is also a substantial positive result. The very task of establishing long-term trends in capital formation, in their relation to output, for the different minor industries within the sector, serves to provide a series of starting points, otherwise nonexistent, for any projection into the future. Also, whatever points of light have been shed on the connection between technological changes, changes in size of firms, changes in industry mix, and changes in the relation between gross capital formation and consumption, are so many guideposts for any contemplated projection that would try to translate some reasonable assumptions concerning movements of population and per capita, or per worker, productivity into a structure of manufacturing and mining output and, thence, into prospective demand for capital in the

sector. Likewise, whatever the estimates have shown concerning trends in the structure of financing, and the analysis concerning the factors at play, are indispensable to a projection that must *assume* some plausible complex of domestic and international conditions and then translate these assumptions into inferences concerning prospects of financing.

In short, the empirical findings and the analytical discussion in the monograph provide raw materials for an evaluation of prospects of capital formation and financing in the sector. Such an evaluation can be sensibly undertaken only as part of an explicit projection of the prospects for the economy as a whole. But the findings and discussion are no more than raw materials, for two reasons. First, we deal here with just one sector of the economy, though an important one, and it is not meaningful to project its future without making a whole host of assumptions relating to the economy as a whole. Second, in making these assumptions for the country, as well as the more specific ones relating to the sector proper, we have a choice between two alternatives. One is to formulate the assumptions quite restrictively by saying "if conditions remain much the same as in the past." In such a case, we can extrapolate past trends, provided we are successful in establishing them, but the projections are likely to be puerile, since the future is rarely a replica of the past. The second is to formulate the assumptions quite permissively, by allowing for major changes in future conditions. However, we must be able to specify these changes, gauge their magnitude relative to the past changes upon which we established trends and, thus, estimate their probable effect. But this requires an elaborate specification and analysis of the assumptions on which the projection relies—both those for the economy as a whole and those specific to the given sector or sectors. This is an entirely new study, in which the empirical findings of the type provided by this and other monographs are combined with such specification and analysis of future changes in underlying conditions as are deemed probable.

The broader aspects of this topic can be, and are, discussed more effectively in the summary monograph. But it can be suggested here that, among the complexes of general conditions that would have to be taken into account in any projection into the future, three stand out clearly: the changed position of the country in the world, which imposes upon it a set of obligations of a continuity and magnitude unparalleled in the past—a task not merely of assuring external security, but also of providing economic leadership in the free and uncommitted part of the world; the accelerated pace of technological change and, evidently, a new power revolution; and what is, apparently, a major acceleration in the rate of growth of our population, at least

in comparison with the decades immediately preceding World War II. These groups of changes are hardly coordinate; there are some parallels to them in the past; and they are not offered here as a fully thought out selection. They are cited here to illustrate the kind of general changes, concerning which assumptions are needed to provide the framework for projections not only for the economy, but also for any major sector in it. In addition, there are, of course, the more specific assumptions, such as those relating to the possible effects of automation on capital demand in manufacturing, the impact of a continuing high level of income taxes and inflationary pressures on the structure of financing in the sector, and the possible trends and changes in credit and financial institutions and policies.

All of this is to say that the present monograph, like all the others, has necessarily concentrated on only one part, and that the *prior* part, of the job of interpreting the past as a basis for understanding the future—i.e., finding the order in the past, and some rationale for that order. Without such an understanding of the past, no intelligent view of present problems or of future prospects is possible. But there is another part, in which reasonable alternative specifications of future changes are set down and combined with the past order to yield some tentative insights. However, such specification is definitely beyond the scope of this group of monographs.

In such a translation of past order into future prospects, and in any understanding of the present, it is extremely important—indeed indispensable—to be quite sure what the order was, and to know how secure the bases are for statements concerning past trends. One would need to have at hand all the detail the authors of this monograph have accumulated and organized with such skill and effort, all the analytical links suggested, and, most important, all the qualifications, when the apparent long-term movements are too insecure to be given much weight. The present monograph adds richly to our store of tested information, reveals movements in the capital-output ratios and in the financing flows that have barely, if ever, been hinted at before, and is a storehouse of organized information in an important field. One can only hope that it will be used widely in the many studies that are concerned with the relation between capital and output and between uses and sources of capital funds.