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# ECONOMIC COMMENTARY

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# Shifts in the Composition of Fixed Investment in the 1970s

by Roger H. Hinderliter

In recent years, a relatively low rate of growth of real business investment has troubled U.S. economic performance. Since the last trough in economic activity in 1975, real investment has grown at an average rate of about 6.5 percent a year, compared with about 8 percent a year for the average of five previous business expansions. Although real GNP growth also was somewhat slower than in past expansions, some slippage in the share of output devoted to increasing and replacing productive facilities occurred over the past five years. Moreover, increases in employment (about 4 percent a year since 1975) have been stronger than past experience, suggesting a movement toward more labor-intensive operations in the business community.

Viewed from the perspective of the economy as a whole, slow investment has been widely associated with the problem of declining productivity growth. Correspondingly, recent investment performance is related to developments reaching back to the mid-1960s. Concern over investment heightened as declining productivity growth continued during the 1970s and intensified as the decade drew to a close. Raising the level of investment to improve productivity has become a major objective of economic policy. The Humphrey-Hawkins Act (Full Employment and Balanced Growth Act of 1978) directs that an Investment Policy Report,

outlining the investment problem and discussing some of the aspects important to its solution, be included each year in the *Economic Report of the President*.<sup>1</sup>

Slow investment growth is but one troublesome feature of recent investment behavior. Another is the shift in the composition of investment that has accompanied slower growth. The allocation of total investment in the economy between short-lived and long-lived capital facilities (between machinery and structures) has been weighted more heavily toward short-lived capital since the mid-1960s, and this change also seems to have accelerated in the late-1970s. The allocation of investment between short-lived and long-lived capital facilities is important because the mix of different capital goods materially affects the productive capital processes acquired from a given level of investment. A capital process may be viewed as the combination of short-lived and long-lived facilities that generates output. For example, two lathes per 100 square feet of factory space can produce 20 units of output per hour.<sup>2</sup> Many combinations are available (three or

1. See *Economic Report of the President* (GPO, January 1980), pp. 136-47.

2. The distinction in this hypothetical example is not fully adequate. Machinery and factory space are built to precise specifications embodying available technology, and these specifications (for example, the cutting spread of a particular lathe) serve further to distinguish among capital facilities. In empirical economic analysis, it is usually not possible to capture very precise differences. Investment is measured by dollars spent, and quantities (capital facilities) can be measured only by constant dollar equivalents.

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The opinions stated herein are those of the author and not necessarily those of the Federal Reserve Bank of Cleveland or of the Board of Governors of the Federal Reserve System.

Table 1 Estimates of Investment Composition in the 1970s<sup>a</sup>

Period of estimate	Unadjusted sample		Adjusted sample	
	Average composition	Relative dispersion	Average composition	Relative dispersion
1970-73	3.9	1.12	3.3	0.72
1974-75	4.9	1.36	3.6	0.72
1976-79	5.6	1.16	4.2	0.55

a. Data are drawn from a sample of firms in machinery and equipment industries (SIC 35, 36, 37) headquartered in the Fourth District. The sample is a 40 percent random drawing from an industrial data base maintained for research. Real investment was obtained by deflating current dollar, machinery, and structures outlays by the appropriate price deflator from national income estimates. The unadjusted sample includes 19 firms whose total 1979 constant dollar investment outlays range from \$0.8 million to \$116.8 million. The adjusted sample excludes five firms that exhibited extreme variability in the composition of investment. Investment composition is measured by the ratio of constant dollar machinery and equipment outlays (excluding rentals) to constant dollar outlays for structures (excluding construction in progress). Average composition is the geometric mean of the individual ratios for the period indicated. Relative dispersion is measured by the coefficient of variation (standard deviation divided by the arithmetic mean) of the individual ratios.

SOURCE: Securities and Exchange Commission, *Form 10-K*, Annual Report Pursuant to Section 13 or 15(d) of The Securities Exchange Act of 1934, Schedule V, Property, Plant, and Equipment.

Price data are from the Department of Commerce, National Income and Product Accounts, *Survey of Current Business* (various issues).

four lathes could be placed within 100 square feet of space), but not all processes are equally efficient. Processes are changed through investment, but the over-utilization of one type of capital relative to another (for example, crowding too many lathes into a given space) is likely to result in less productive processes; incremental capacity would be lower than if the same level of investment were allocated differently.

Though recognized in studies of the productivity problem and in the Investment Policy Report, compositional changes within the level of investment have been examined less closely than investment growth. In particular, little attention has been focused on the allocation practices of individual firms, where the investment decision is made. Ultimately, changes in investment composition in the economy as a whole rest on capital-budgeting decisions of firms. For the firm, the composition of investment, like the level of investment, is an economic decision that reflects the influence of current economic conditions as well as longer-term

effects, such as technological change. This *Economic Commentary* examines the composition of investment, independent of the level of investment, during the 1970s. Data are drawn from a small sample of machinery and equipment firms in the Fourth Federal Reserve District (see table 1, footnote a). Investment composition for a "typical firm" is estimated for the periods 1970-73 and 1976-79 and separately for the recession years of 1974-75.

### Composition of Fixed Investment

A firm's capital stock comprises many different types of productive facilities. Some facilities have relatively long service lives, while others are capable of economically producing output over a shorter time span. Structures (new plant) generally produce over longer periods than machinery, although this division is only a proxy for actual service lives of capital facilities. Some machinery may be productive for a long period, and some structures may be less durable than structures in general and longer-lived machines.

A capital process available to a firm combines short-lived and long-lived capital facilities. As an illustration, let

$$(1) \quad K = K_J + 2K_S,$$

where  $K$  represents a productive capital "unit," and  $K_J$  and  $K_S$  are the long-lived and short-lived components, respectively. Here, short-lived and long-lived components combine in the ratio of two-to-one to form one productive capital unit.

Investment changes the capital stock. Investment is the acquisition of new capital units to replace those that are economically worn out (replacement) and also to add to the existing stock (expansion). Because the service lives of the short-lived and long-lived components in a capital unit differ, the composition of replacement investment will be different from the capital unit being replaced, even if the compositional ratio of the unit is unchanged. If, for example, short-lived capital facilities wear out steadily over five years and long-lived facilities have service lives of ten years, replacement of the capital unit in the example above would require annual investment in the ratio of  $4K_S/1K_J$ . The composition of investment for expansion reflects current values of the factors that determine the makeup of capital units. If these conditions are constant, expansion in the ratio  $2K_S/1K_J$  is consistent with the illustration. The composition of fixed investment is determined by weighting the ratios of replacement and expansion. If, for any level of fixed investment, replacement and expansion each are 50 percent of the total, the composition of fixed investment in the example here would be  $3K_S/1K_J$ .

A variety of forces lead to changes in the composition of fixed investment. Over the longer term, technological progress plays an important role in determining the service lives of capital facilities. Improved technology increases the rate of replacement and, if it affects service lives of the short-lived and long-lived facilities disproportionately, will alter the composition of investment for both replacement and expansion. Government

policies such as those dealing with pollution abatement contain incentives for reallocating investment, as do provisions of the tax code. The investment tax credit, until 1978, excluded structures. Although the exclusion may have been less binding in practice than the code would suggest, the tax credit still favored a shift in investment toward short-lived facilities. Economic conditions, as reflected in relative prices (or rates of return) on capital, uncertainty, and business expectations, also feed back into a firm's investment decision, affecting both the level and composition of total investment.

### Investment Composition in the 1970s

Investment decisions are not likely to generate a smooth flow of short-lived and long-lived facilities into the capital stock. Investment is "lumpy," in that, for example, a factory is added or replaced at one time rather than adjusted gradually by the 100-square-foot piece. Thus, investment composition will vary, and, in a single firm or even a sample of similar firms for a single year, measured composition can deviate from the characteristic combination of facilities. For a sample of firms over several years, however, the lumpiness of investment should be largely smoothed, and a representative estimate of investment composition can be derived.

Estimates of investment composition (machinery/structures in constant dollars) are presented in table 1. The estimates are calculated from a sample of 19 Fourth District firms that are producers of machinery and equipment. Restricting the sample to firms in capital-goods industries holds constant, in a simple way, the capital intensity of manufacturing operations. Because firm size (the level of investment) does not obviously influence composition, no size restrictions were imposed. Large manufacturers do not necessarily employ different capital processes, only more capital than small manufacturers. For some firms in the sample, investment in structures appeared especially lumpy, which contributed very low compositional ratios in "factory building years" and very high ratios in other years. Separate estimates (the

adjusted sample) were computed excluding these firms.

The outstanding feature of the estimates in table 1 is the clear shift in investment composition toward short-lived capital facilities during the 1970s. Measured by the geometric mean of the individual ratios, composition in 1976-79 included 5.6 units (1972 dollars) of machinery for each unit of structures. This was more than 40 percent higher than the compositional ratio of 3.9 that was characteristic of the 1970-73 period. Relative dispersion among ratios was about the same in the two periods, suggesting a true shift in the distribution of ratios rather than simply greater dissimilarities among firms in the post-recession period.

A similar but somewhat less pronounced shift is indicated by the estimates from the adjusted sample. When firms that experience the highest variability of investment composition are excluded, the compositional ratio in 1976-79 is nearly 30 percent higher than in 1970-73. Relative dispersion among the ratios in the adjusted sample is lower in 1976-79.

The recession years of 1974-75 do not appear out of line with a shift in investment composition during the decade, despite economic conditions that might be expected to disrupt investment patterns. The greater relative dispersion during the recession may reflect the effect of more varied business expectations at this time, but the variability seems confined to the firms excluded from the adjusted sample.

What caused the shift in the composition of investment? Factors such as technology and government regulation no doubt were important, especially if the origins of changes are traced back to the 1960s. Computer technology is an obvious technological force in the period that is likely to increase machinery relative to structures. Pollution regulations appeared in the late 1960s, probably with similar effect. While these developments would exert continuing influence on investment composition, and help explain why a firm's machinery/structures ratio would be higher in the 1970s than earlier, it is less clear that they would account for sharp changes during the 1970s. Economic conditions in the

1970s, however, were volatile. The economy experienced the worst business recession since the 1930s. Recurring energy price shocks after 1973 added to economic uncertainty. Inflation was a persistent problem throughout the 1970s, and in the latter part of the decade inflationary pressures intensified.

Inflation stems from many sources and is not represented by proportional increases in all individual prices. Some prices rise faster than others, and relative prices as well as the price level change in an inflationary environment. Even if the overall rate of inflation were correctly anticipated by firms, changes in relative prices could influence investment and its composition through adjustments in a firm's demand for factors of production. Indeed, the composition of investment could change regardless of what happens to the level of investment.

Suppose a firm's demand for capital (and the level of investment) is unaffected by relative price changes associated with inflation. A direct incentive to reallocate investment could still arise if the relative price of machinery versus structures changes. Judging only from price indexes (implicit deflators) of capital goods, the price of structures rose faster than the price of machinery in the 1970s. This was true, however, throughout the decade, and the relative price change in favor of machinery was greater in 1970-73 than in 1976-79. To the firm, of course, the important consideration in an investment decision is the increase in costs from acquisitions of capital facilities. This is measured by the rental price of capital, which is a broader concept than a price such as the implicit deflator. The rental price includes, in addition to the price index, the effects of taxes, depreciation, interest rates, and the firm's financial structure. Although rental prices may have moved similarly to price indexes in the 1970s, this is uncertain. The impairment of depreciation allowances by inflation may have been greater for structures than machinery, especially in 1976-79.

Of course, relative price effects alter the demand for capital compared with other factors of production and change the level of investment. On balance, relative factor price

movements in the late-1970s probably depressed the level of investment (retarded investment growth) and induced firms to hire more labor.<sup>3</sup> In addition, energy price shocks after 1973 were incentives for firms to conserve on the use of energy. Even if the relative price of machinery versus structures were unchanged, a firm substituting labor for capital and conserving on energy would probably shift its investment composition toward the machinery component. Incoming workers would require, in the absence of expanding investment, a larger proportion of investment going to machinery. Rapidly increasing energy prices could well have contributed to the observed compositional changes by shortening service lives of less-energy-efficient machinery in the existing capital stock and thus increasing the rate of machinery replacement relative to structures.

Additional problems arise if inflationary pressures are not uniform over time. If variability in the rate of inflation results in a smaller likelihood that inflation will be correctly anticipated, a firm's uncertainty about future prices rises. This uncertainty may be transitory, in the sense that any errors in anticipating the rate of inflation will, over time, net out to zero. If so, no long-run influence on the level or composition of real investment would be associated with misinterpreting inflationary pressures. A short-run effect could exist, and, if the variability of inflation increases with the rate of inflation, as some studies show, expectational errors may be reinforcing during periods of high inflation rates.<sup>4</sup>

The rate of inflation in 1976-79 was, on simple measures, more variable as well as higher than in the early 1970s. Greater uncertainty about prices in the post-recession period followed increases in uncertainty already generated by the recession, which were causing firms to re-examine many aspects of the way they conducted business. As uncertainty increases, binding commitments become a less desirable business policy. For a firm's investment decision, structures represent a more binding commitment than machinery. The shift in the composition of investment in the 1970s thus may have been in part a reaction, though perhaps temporary, to the uncertain economic conditions of the time.

## Conclusions

A pronounced shift in investment toward short-lived machinery occurred during the 1970s. Although the sample of firms examined was small and restricted to three industry groupings (and therefore not representative of the economy as a whole), this evidence is consistent with broader tendencies noted elsewhere.<sup>5</sup> The shift was not associated with growing dissimilarities among firms, nor does it seem to have been the result of sudden changes in technology or other long-run determinants of investment composition. It could well have been part of the inflationary environment and uncertain economic conditions of the decade. Apart from the level of investment, the shift in composition suggests that capital processes were formed that contributed to relatively slow expansion of potential output. It is possible, for example, that much of the investment effort in the late-1970s was directed at improving energy efficiency rather than capacity or labor productivity. Longer-term implications are difficult to identify and depend to a high degree on whether the economic conditions of the 1970s continue into the 1980s.

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3. This is consistent with the macro evidence on investment and employment growth cited above. Once again, depreciation is an important channel through which the rental price of (total) capital is increased during inflation, as are corporate tax rates and the firm's financial structure. For a technical analysis of these effects on capital, see M. Feldstein, J. Green, and E. Sheshinski, "Inflation and Taxes in a Growing Economy with Debt and Equity Finance," *Journal of Political Economy* (April 1978, part 2), pp. S53-70.

4. See Edward Foster, "The Variability of Inflation," *Review of Economics and Statistics* (August 1978), pp. 345-50.

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5. See Burton G. Malkiel, "Productivity—the Problem Behind the Headlines," *Harvard Business Review* (May/June 1979), pp. 82-3.