Inflation, Taxes, and the Composition of Business Investment

The composition of business fixed investment has shifted dramatically toward less durable assets over the past two decades. The investment share for short-lived equipment outlays has raced ahead, while the spending share of long-lived structures has plummeted (Chart 1). This shortened investment horizon has important repercussions for the nation's capital stock, impairing its productivity and reducing its growth as an increasing share of outlays is devoted to replacement. Among the roots of this changing distribution of capital spending are a system of business taxes and an inflationary environment that have discriminated against long-lived investment.

Tax policy and investment: channels of influence

Corporations purchase a new capital asset in anticipation of certain net earnings from the sale of the asset's output after deducting expected labor and materials costs, taxes, and wear and tear on the asset. Obviously, the expected profitability of a capital asset is greater the larger is the anticipated earnings stream and the lower the cost of purchasing the asset. The ratio of expected earnings to the replacement cost of corporate assets, or *rate of return* on assets, therefore, is a summary measure of the expected profitability of acquiring a new capital asset. Unfortunately, there are no data on the rate of return on new assets. The average rate of return estimated for this article includes the earnings of both old and new assets.[1] Information on the tax advantages of old and new investments is then combined with the average rate of return to estimate the rate of return on new assets.

The behavior of the average rate of return on corporate assets tended to parallel the movement of business activity in the twenty years following World War II (top panel, Chart 2). For the most part the rate of return rose during recovery periods and fell to relatively low values during each of the recessions. This pattern came to an abrupt halt in 1965, when the expansion pushed the rate of return to a postwar high. For the next ten years the rate of return fell continuously, reaching its lowest value in 1975, well below the earlier trough levels. An important part of this decline is due to the role of inflation in raising the effective corporate tax rate on capital income. Of course, the 1974-75 recession also depressed the rate of return. However, by 1978 the rate of capacity utilization in manufacturing had risen above the level for 1957-63 while the rate of return had hardly recovered.

Business decisions to invest are, of course, not based solely upon the rate of return on corporate assets. Rather the return is compared with the cost of raising capital in debt and equity markets, which is here called the *cost of capital.* The more the rate of return on corporate assets exceeds the cost of financing investments, the greater is the incentive for business to expand facilities.

The cost of capital rose sharply in the late forties and reached its highest values during the years 1949-53 (second panel, Chart 2). In part, these high values reflected the strong worldwide demand by business and consumers for capital. Businesses sought to bolster stocks of plant and equipment which had been ne-

[1] The measurement of the average rate of return and the cost of capital is discussed in Appendix I. These variables are refined versions of earlier measures discussed in Patrick J. Corcoran, "Inflation, Taxes, and Corporate Investment Incentives", this *Quarterly Review* (Autumn 1977), pages 1-10.

glected or destroyed during World War II. At the same time, households attempted to rebuild stocks of consumer goods which were far below levels commensurate with postwar income and wealth. As stocks of business capital and household durable goods were brought into balance, demand pressures subsided and the cost of capital gradually declined.

The cost of capital then exhibited a generally flat pattern in the sixties and seventies. Its relative peaks and troughs were influenced by many factors, including monetary policy. Following the peak in 1970, the cost of capital fell to very low levels in 1971-73. While the run-up of the cost of capital in 1974 was just over 1 percentage point, the 1974 peak was comparable to previous ones in the 1960's and 1970's. In 1978, the cost of capital equaled its value in 1974.

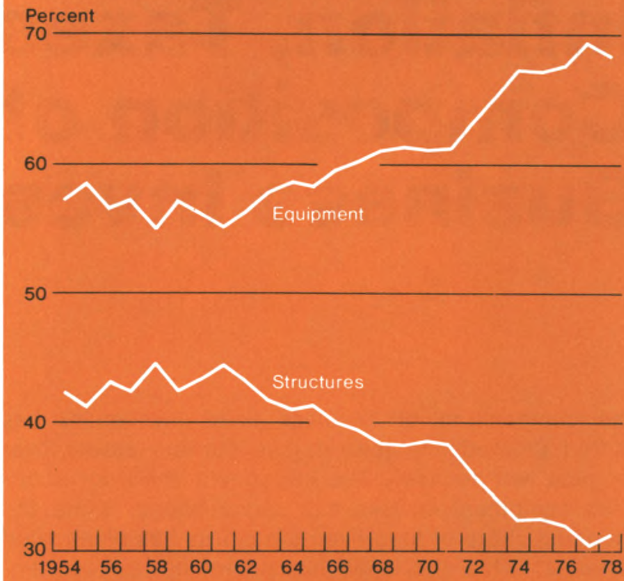
In order to measure incentives to invest, the cost of capital must be compared with the rate of return on new investments. The expected return on new assets can be above the average return on old assets for a number of reasons.[2] Under the tax laws, old and new assets are treated differently. Many statutory changes in the tax laws have applied only to new assets. This was true of the accelerated depreciation provisions introduced in 1954 and the investment tax credit initiated in 1962. Moreover, those tax write-offs that remain on old assets have been eroded away by inflation. The relative abundance of tax benefits on new assets elevates the rate of return available for new investments above the average rate of return measure.[3]

Empirical measures of these tax benefits are based upon a new study of tax policy. Estimates of tax service lives and tax credit rates were computed for several different classes of investment.[4] These data measure the tax advantages of new investments and also make it possible to remove the tax benefits of old capital from the average rate of return.[5] This study uses these tax variables, together with the rate of return net of the tax benefits on old capital investments, to measure incentives to invest and to explain shifts in business investment toward less durable asset categories.

The investment classes for which the tax variables were computed fall under the broad headings of equipment and structures. The equipment categories are (1) transportation equipment, (2) office, computing, and accounting machinery, and (3) production machinery. Transportation equipment, the shortest lived component, consists largely of autos and trucks but also includes ships, railroad equipment, aircraft, and tractors. The second category includes business outlays on furniture and fixtures as well as office and computing equipment. Production machinery, the most durable equipment category, includes all remaining equipment outlays. The broad structures heading includes categories for industrial, commercial, public utilities, and other.[6]

Chart 1

As a share of total business investment, equipment spending has surged while structures spending has plummeted.



Source: United States Department of Commerce.

2 In theory, differential tax benefits on old and new assets might be "capitalized" in the prices of the assets in a manner that would equalize the rate of return on old and new assets. However, prices of used capital goods are generally unavailable. As a consequence, existing capital-stock estimates value old capital goods using new capital goods prices. Since older capital goods provide smaller tax advantages than new ones, the procedure implicitly overvalues the capital stock and depresses the average rate of return.

3 In addition to the effects of taxes, the rate of return on new and old investments can differ for other reasons. For example, changes in technology or in relative prices can render old capital goods economically obsolete or inefficient.

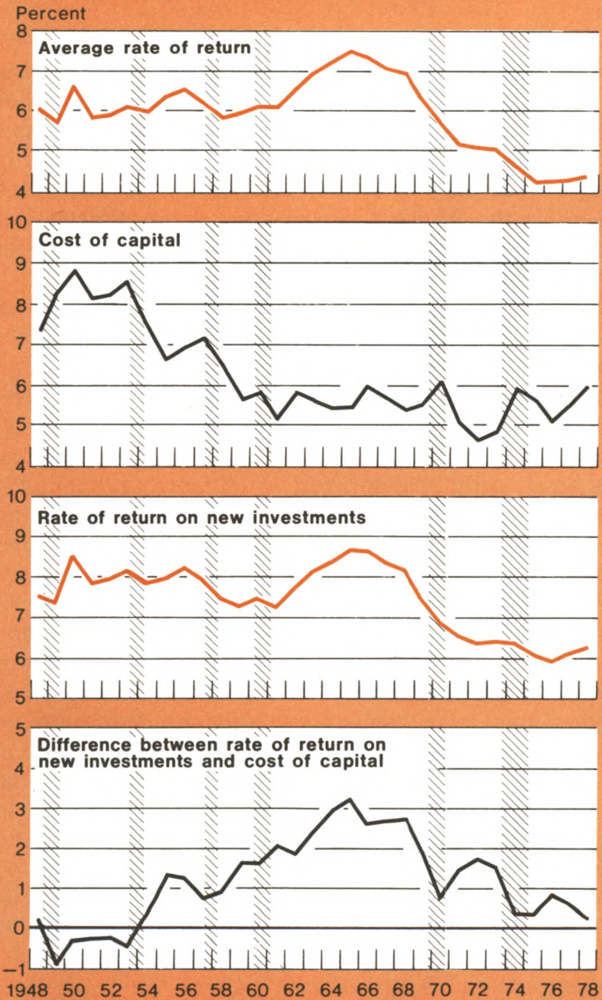
4 These estimates are the results of unpublished work by P.J. Corcoran and L. Sahling.

5 The theoretical approach employed here owes much to John H. Ciccolo, "Tobin's q and Tax Incentives", paper to be presented at the Southern Economic Association meeting, November 1979.

6 Structures outlays by religious, educational, and hospital institutions were not examined.

Chart 2

Determinants of Investment Spending



Shaded areas represent periods of recession, as defined by the National Bureau of Economic Research.

Present value of tax-depreciation streams

The present value of the tax deductions available on a new investment is a way of adding up the worth of these deductions over time. Since today's value of one dollar of income several years in the future is smaller than the worth of one dollar to be paid immediately, an important element of present value is the extent to which future income should be "discounted" relative to current income. In addition, the statutory provisions governing allowable tax service lives, the choice of the depreciation method, and the corporate tax rate are all important in determining the shape and level of tax deductions, and hence their present value.

What discount rate should be used in capitalizing the tax write-offs on new capital outlays? Financial theory suggests that the appropriate rate depends upon the properties of the income stream generated by business tax depreciation. This income stream is dollar denominated, similar to the interest payments accruing to a corporate bond. Moreover, just as with a corporate fixed-income security, there is a chance that the maximum nominal tax benefit will not be realized. In the case of a bond, this event corresponds to default. In the case of tax write-offs, it occurs when the firm's revenues are so low that it is unable to utilize fully all its depreciation deductions.

The risk that a firm is unable to utilize tax write-offs fully is greater than the default risk on its fixed-income securities. The difference between these risks, however, has been reduced by a well-developed leasing market for capital goods. The leasing market helps to minimize the possibility that a firm may be unable to use tax write-offs fully. By leasing capital goods rather than purchasing them outright, a firm can effectively exchange tax-depreciation deductions for lower lease payments.

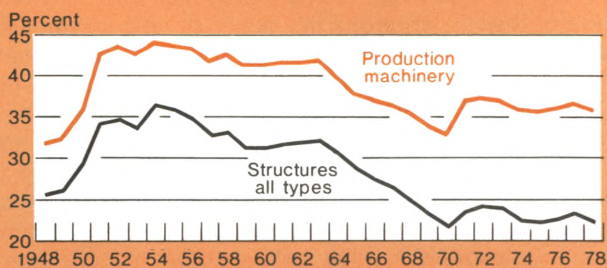
The income streams from tax write-offs and corporate bonds are thus similar in risk properties and their dollar-denominated character. In this article, the Aaa corporate bond rate is used as the discount rate in capitalizing tax-depreciation streams. The present value of the tax write-offs per dollar of new investment has been declining since the early fifties (top panel, Chart 3). The reason for this has been the rise in interest rates which mirrors the ratcheting-up of inflation. The secular rise in the bond rate from about 3 percent in 1954 to close to 9 percent in 1975 has exerted a sharp downward influence on the present value of business tax write-offs. Moreover, the depressing impact on the present value for assets with longer service lives is greater than those with shorter lives (bottom panel, Chart 3). This is because the longer the waiting period for a tax write-off, the more the write-off is "discounted" under the present value calculations.

In addition to the effects of inflation on the value of depreciation, statutory tax changes have affected the present value series. Since the midfifties, these factors have generally acted to slow the decline of present values and sometimes to dampen increases in the spread between the present value of write-offs for production machinery and structures. The introduction of accelerated methods of depreciation beginning in 1954 helped stem the downward drift in present values by allowing businesses to switch to faster methods of writing off their capital outlays. Switching from straight-line to accelerated methods also tends to be more favorable to structures than to production machinery or other equipment assets with shorter tax service lives. However, in practice, accelerated methods have actually been used more extensively for equipment-type assets than structures. In 1970, 82 percent of equipment was being depreciated using accelerated methods; the figure for structures was only about 60 percent. The more limited switching to accelerated methods for structures tends to offset the larger relative advantage which accrues to structures from a given amount of switching. Thus, the net impact of accelerated depreciation on the composition of investment was rather small.

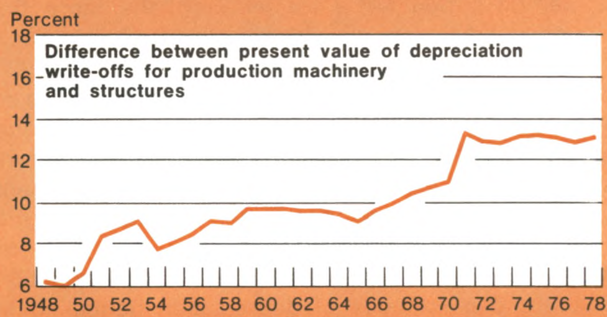
In addition to the adoption of accelerated depreciation methods, changes in the corporate tax rate have also exerted an influence on the present value of write-offs for different investments. In the years 1950-52 the corporate tax rate rose dramatically, raising both the present value of tax-depreciation streams and the difference between such values for long-lived and short-lived assets (bottom panel, Chart 3). In 1964 and 1965 the rate of taxation for large corporations was lowered, reducing the values for both long- and short-lived assets.

Chart 3

Rising interest rates have reduced the present value of tax-depreciation write-offs more for structures than equipment . . .



. . . encouraging less durable investments.



The net influence of higher interest rates and various statutory tax changes between 1954 and 1970 was to reduce the present value of tax-depreciation streams for all categories. The decline in the present value of tax write-offs was larger, the more durable or longer lived the investment category. Thus, the differences in the present value of tax write-offs between less durable and more durable categories exhibited increases between 1954 and 1970.

The value of tax depreciation for production machinery jumped sharply in 1971 at the onset of the Treasury's asset depreciation range (ADR) system. The ADR system provides a range of tax service lives for investments eligible for the investment tax credit. The range is generally 20 percent above and below the so-called guideline lives which were introduced in 1962. In addition to permitting the use of shorter tax lives, the ADR system also involves some additional features which allow faster write-offs of depreciation outlays than were previously possible. To obtain the benefits of ADR, a taxpaying firm must formally "elect" the ADR system and fulfill reporting and other requirements. According to a Treasury study, about 60 percent of new investments eligible for the investment tax credit is made by firms electing ADR.[7]

The value of tax write-offs for structures also rose in 1971 in response to ADR (top panel, Chart 3). Investments covered under ADR and eligible for the investment tax credit include not only equipment assets but also structures (see next section). Since structures investments have more limited eligibility for the tax credit, the present value of tax depreciation for structures rises by about half of the increase in the depreciation value of production machinery. While the present value of the tax write-offs increases for all asset categories, the gain is greatest for production machinery.

The rise in the present value of depreciation charges for transportation equipment is about the same size as the structures increases. The possibilities for higher present values under ADR are limited for the short-lived transportation equipment, because in 1970 it already had the highest present values among the investment categories. In addition, the option to shorten tax lives further tended not to be exercised because

[7] See Thomas Vasquez, "The Effects of the Asset Depreciation Range System on Depreciation Practices" (Office of Tax Analysis, Department of the Treasury, May 1974).

the investment tax credit gives only partial credit for tax lives at the short end of the spectrum (see next section). To a limited degree, these factors also dampened the 1971 increase in the present value for office, accounting, and computing machinery.

The investment tax credit

The investment tax credit has encouraged the use of less durable or shorter lived capital goods, primarily because equipment assets have generally received higher tax credits.[8] As initially introduced in 1962, the credit was available for outlays on most types of "tangible personal property" and certain limited types of "real property" which were used directly in manufacturing, production, or transportation. In a very rough sense, "tangible personal property" applies to equipment outlays and "real property" refers to structures outlays.[9]

In addition to excluding certain types of capital expenditures, the full benefits of the tax credit were limited to assets with a tax service life of at least eight years. Assets with a tax life of six to eight years obtained a two-thirds credit; those with a life of four to six years, one-third credit; and those with a life less than four years, no credit. It is primarily these different levels of partial credit that explain the differences in the tax credit rates for the various equipment categories (top panel, Chart 4).

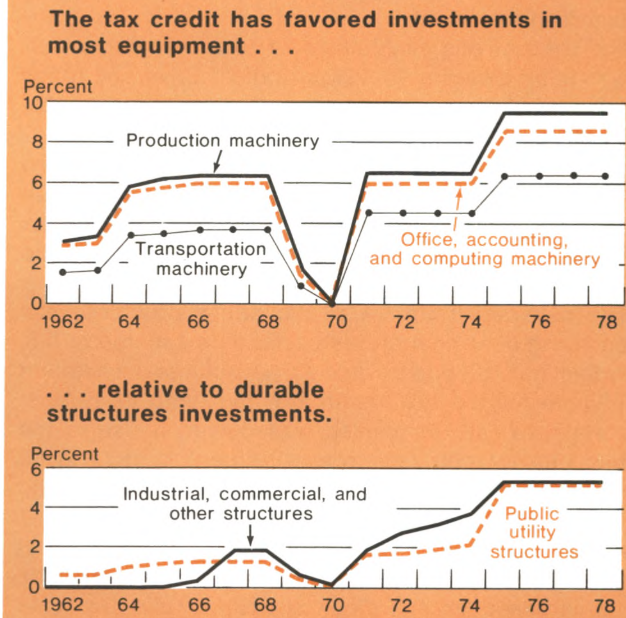
In 1962 the rate of credit on fully eligible investments was set at 7 percent but any credit taken had to be deducted from the depreciation base of the asset. The latter provision, known as the Long Amendment, was repealed in 1964. As a result, there was a sharp jump in tax credit rates. In April 1969 the tax credit was suspended. The credit was reinstated in 1971, and the rate was raised from 7 to 10 percent in 1975. Although the 1975 increase was intended initially as a temporary measure, it subsequently became permanent. When the credit was reinstated in 1971, the ranges for full and partial credit were all reduced by one year relative to those pertaining in the 1962-69 period. The full benefits of the tax credit now apply to eligible investments with a tax service life of seven years (formerly eight years). Two-thirds credit was available to assets with tax service lives in the five- to seven-year range (previously six to eight years); investments with a life of three to five years received one-third credit. As a result, the average tax credit

[8] In principle, shorter lived investment can also be encouraged by an increase in the level of a credit which is uniform across asset categories. This kind of effect is not very important, however. See Appendix II.

[9] The inadequacy of this correspondence as a guide in calculating effective tax credit rates is discussed below.

Chart 4

Effective Tax Credit Rates



rate for transportation equipment was higher in the seventies than in 1968 and 1967.

It is a common notion that the tax credit has been largely unavailable to investment in structures. However, a look at the data for recent years shows this assumption to be in error. In 1974, for example, the cost of new investments eligible for the investment tax credit is estimated to be about $120.9 billion (Table 1). By comparison, equipment outlays amounted to about $96.2 billion. Suppose every dollar of investment in equipment is eligible for the tax credit.[10] Then the

[10] In fact, this is not the case since some equipment outlays are charged to current expense and hence are not eligible for the tax credit. Little information is available on the amount of this current expensing, however. Assuming that all nonresidential equipment outlays were eligible for the tax credit causes the estimates of eligible structures investments and the tax credit rates calculated for the structures categories to be underestimated. For example, if 5 percent of equipment outlays were current expensed, estimated eligible structures outlays would rise to $29.7 billion from $24.7 billion (Table 1). This would raise the estimated tax credit rates for the structures categories to 6.2 percent for public utility structures and 6.3 percent for other categories of structures outlays from 5.2 percent and 5.3 percent, respectively. On the other hand, there is also a small amount of residential investment that qualifies for the credit so that the estimated tax credit rates for structures (Chart 4) are probably not so conservative as the comparison suggests.

excess of eligible total outlays over equipment expenditures would represent outlays on new structures which were eligible for the investment tax credit. Eligible structures spending thus amounted to $24.7 billion in 1974 and represented about half of total structures investment.

The ratio of eligible outlays to total structures outlays may be called a "coverage ratio". Coverage ratios can be computed in a number of different years for total structures investment and for structures investment by public utilities. They also may be computed for investment in structures by other than public utilities in a residual fashion. To obtain the effective tax credit rate (bottom panel, Chart 4), the coverage ratio is multiplied by the statutory tax credit rate.

The coverage ratio for public utility structures has been rising over time and is currently estimated at 0.5, meaning half of public utilities' structures investment is eligible for the tax credit. The big jump in 1975 in the effective rate of utilities was due to a rise in the public utility credit rate from 4 percent in 1974 to 10 percent in 1975. For structures outlays outside public utilities, the coverage ratio was very small until 1967 when it rose to about 0.25. It currently stands at about 0.5, the same level as the public utilities category. The rapid increase in the other structures effective rate between 1971 and 1975 reflected the doubling of the coverage ratio and the jump in the statutory credit rate from 7 to 10 percent in 1975.

Rate of return on new investments

The effective tax credit rates and present values of tax-depreciation streams are used to calculate the rate of return on new investments. In order to assess the incentives to invest in new capital goods, the remaining tax advantages from old capital must be removed from the average rate of return. Then the tax benefits arising from new capital outlays are added in. The result is the rate of return on new investments (third panel, Chart 2).[11]

In the two decades after World War II, the rate of return on new investments hovered around 8 percent. It stayed below this mark during the years 1958-61 and was driven above it during the boom years of the midsixties. In the late sixties and seventies the rate of return on new investments plunged downward. By 1978 it stood nearly 2 percentage points below the average level recorded for the years 1948-68.

The difference between the rate of return on new investments and the cost of capital is a measure of the incentives to invest in new plant and equipment (bottom panel, Chart 2). Incentives to invest were growing prior to 1965 as the cost of capital was falling in the fifties and the rate of return on new investments surged in the early 1960's. Since the midsixties, incentives to invest have been shrinking and have mirrored the decline in the rate of return on new investments. An important reason for these declining incentives has been the increase in the effective tax rate on capital income brought about by inflation.

In order to measure incentives to invest for the various asset categories, the spread between the new rate of return and the cost of capital can be separated into three elements.[12] The first two elements are the benefits from the depreciation and the tax credit for each asset category. The third element is the spread between the average rate of return excluding tax benefits from old capital and the cost of capital. The latter

Table 1

Comparison of Investments Eligible for Tax Credit with Total Equipment Outlays, 1974

Item		Billions of dollars
(1)	New investments eligible for tax credit	120.9
(2)	Total equipment investment	96.2
(3)	Eligible structures investment: (1) minus (2)	24.7
(4)	Total structures investment*	49.3
		Percent
(5)	Percentage of structures investment eligible for tax credit: [(3)/(4)]×100	50.1

* Excludes investments by religious, educational, hospital, and institutional organizations.

Source: Department of Commerce and unpublished work by P.J. Corcoran and L. Sahling.

11 The present value of the remaining write-offs on old capital is calculated in the same way as the present value streams for new assets. The per dollar present value of these tax write-offs must be converted into an *income* adjustment to be added to or subtracted from the average rate of return. The income per dollar of investment stemming from the depreciation write-offs is obtained by multiplying the present value of such write-offs by the cost of capital.

12 The "rate of return on new investments" (denoted r^N) is equal to the average rate of return (denoted r) minus the permanent income stemming from the write-offs on old investments (cTo) plus that stemming from the investment tax credit (cITC) and write-offs on new investments (cDEPR). Symbolically,

$$r^N = r - cTo + cITC + cDEPR$$

where c represents the cost of capital. The symbol To is the per dollar present value of remaining tax depreciation on old assets, DEPR the present value of the tax write-offs on new investment, and ITC the effective tax credit rate. Thus the spread between r^N and the cost of capital c is:

$$\begin{aligned} \text{spread} &= r^N - c \\ &= [r - cTo - c] + cITC + cDEPR \end{aligned}$$

The first term above is the difference between the net rate of return (r−cTo) and the cost of capital.

Table 2

Changes in Investment Shares, 1961-78*

Selected categories; in percent

Investment categories	Higher interest rates and tax depreciation: Reduction in present value of depreciation†	Higher interest rates and tax depreciation: Change in shares	Investment tax credit: Effective rate 1974-78	Investment tax credit: Change in shares	Asset depreciation range: Change in shares	1964-65 tax cut: Change in shares	Total share changes
Transportation	−3.45	+1.32	6.4	−0.34	−0.07	−0.18	0.73
Office	−4.59	+0.13	8.6	+0.23	0.04	−0.10	0.30
Production	−5.22	+0.64	9.5	+1.88	0.24	−0.31	2.45
Commercial structures	−8.03	−1.14	5.3	−0.06	0.05	−0.04	−1.19
Other structures	−8.03	−0.52	5.3	−0.28	−0.02	0.07	−0.75
Public utility structures	−8.03	−0.02	5.2	−0.60	0.00	0.24	−0.38
Industrial structures	−8.03	−1.27	5.3	+0.06	0.05	0.10	−1.06

* Column totals for share changes do not necessarily add to zero because structures investment by religious, educational, and hospital institutions is excluded.

The dependent variable in each investment equation is gross investment outlays in 1972 dollars (I) divided by the stock of capital (K). The shifts in the estimated equations can be denoted $\Delta I/_K$. To translate these shifts into percentage changes in gross outlays, the shifts must be divided by representative values of the ratio $I/_K$. Thus, $\Delta I/_K \div I/_K = \Delta I/_I$. The $I/_K$ ratios were set equal to 4 percent (a steady growth rate) plus the depreciation rate appropriate for each category of investment. The base years used for calculating changes in composition were 1965 for higher interest rates, 1961 for the tax credit, 1970 for ADR, and 1963 for the tax cut.

† Present value reductions are expressed as a percentage of gross investment outlays.

element can be measured for nonfinancial corporate assets only in the aggregate. These three elements form the basis for statistical equations that explain the composition of business investment and quantify the role of tax policy (Appendix II). The influences examined are tax depreciation and interest rates, the investment tax credit, ADR, and the 1964-65 corporate income tax cut.

Higher interest rates and tax depreciation

The impact of higher interest rates on the composition of investment is important. In the calculation shown (Table 2), higher interest rates operate through reducing the present value of tax depreciation on new investments. The present value of tax write-offs in 1978 is calculated using the 1965 and 1978 interest rate levels. The reduction in the present value of the tax depreciation attributed to the rise in interest rates is larger for longer lived assets, and this shifts the composition of investment toward shorter lived capital goods. The equipment categories grow, while the structures categories decline. The increase in the share of equipment is slightly more than 2 percentage points over the period studied.

The investment tax credit

The effective tax credit rates for 1974-78 differ for each kind of capital good (Table 2). Those assets such as production machinery and office and computing equipment with the highest effective tax credit rates post larger increases in outlays and rising shares in total investment. Further, investment in shorter lived equipment is more responsive to a given change in the tax credit than the structures investments, and this enhances the shares of the equipment categories by a modest amount.[13] The rise in the share of equipment is a bit less than 2 percentage points.

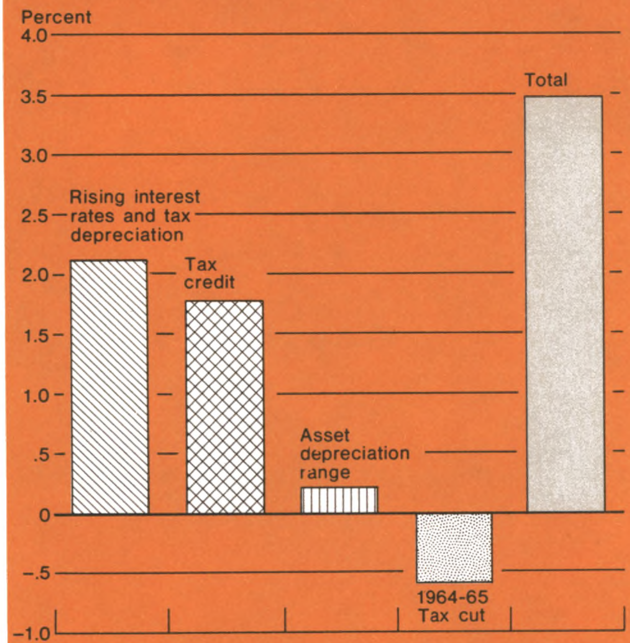
ADR system and the 1964-65 tax cut

The impacts of the asset depreciation range system and the 1964-65 tax cut on the composition of business investment are small and work in opposite directions. The ADR system has its strongest stimulative impact on production and office machinery. For short-lived

[13] This can be seen by looking at the estimated tax credit coefficients (Appendix II). These coefficients are generally consistent with the view, expressed in footnote 8, that increases in the average tax credit rate shorten the durability of capital.

Chart 5

Effect of Inflation and Taxes on the Share of Equipment Investment in Total Capital Spending, 1961-78



transportation equipment, the impact is smaller because of limitations on the investment tax credit for short-lived equipment. For structures, the impact is also smaller since only about one half of structures investment falls under ADR. Thus, the main impact of ADR is to enhance the share of production machinery and to reduce the share of transportation equipment (Table 2). The share of total equipment outlays edged up by about 0.2 percentage point.

The 1964-65 corporate tax cut from 52 percent to 48 percent is the only measure examined that increases the durability of capital. Since the present value of tax write-offs is larger for short-lived investments, a cut in the tax rate reduces tax benefits most for short-lived investments. This induces a mild substitution toward longer lived structures (Table 2). The share of equipment falls by about 0.6 percentage point.

Conclusions and summary

In recent years, the crosscurrents of accelerating inflation and business taxation have reduced the durability of the nation's capital stock. With the run-up in inflation, the value of tax write-offs for long-lived capital investments in structures has fallen much more sharply than that for short-lived equipment. Accordingly, businesses have attempted to improve profitability by altering the mix of their investments away from long-lived structures and toward shorter lived equipment. The switching from structures to equipment has gained additional momentum from the wider availability of the investment tax credit to equipment. Only about half of new structures outlays are eligible for the credit.

Taxes and inflation have not been the only factors responsible for raising the share of equipment outlays. The "computer revolution" has raised the share of office and computing machinery, while the rise in outlays related to pollution abatement has been concentrated in production machinery. Nevertheless, accelerating inflation operating through rising interest rates has caused an estimated 2 percent of total business investment to be switched from structures to equipment. The tax credit has brought about an additional 2 percent reallocation of total business investment in favor of equipment spending (Chart 5). Altogether, the upsurge in inflation over the past decade and tax policy changes increase the share of equipment outlays in total investment by 3.5 percentage points. This increase amounts to one quarter of the 14 percentage point run-up in the equipment share between 1961 and 1978 (Chart 1). The change in investment composition cushions the impact of inflation and taxes on business profits. However, the cost to the nation is lessened productivity growth and reduced business output.

The influence of inflation and the business tax structure in reducing the durability of business capital and output is only one facet of a larger problem. Inflation operating through the tax system has eroded incentives to invest and has thus reduced the level of capital spending. One way of resolving these problems is to modify the tax system to eliminate some of its burdensome effects on business investment. More fundamentally, these difficulties can be overcome through strong policy actions that reduce the rate of inflation.

Patrick J. Corcoran

Appendix I: Measurement of the Rate of Return and the Cost of Capital

The rate of return is measured as the ratio of long-run expected earnings to the replacement cost of nonfinancial corporate assets.[1] These earnings—denoted total capital income (TCI)—include income accruing to both debt holders and equity holders. The income to debt holders is equal to the net interest payments[2] of nonfinancial corporations (NI) less the reduction in the real value of debt holders' securities arising from the expected increase in the general price level. Thus

$$TCI = P + NI - \pi D$$

where D is the market value of debt holders' securities, π is the expected increase in the general price level,[3] and P represents the income to equity holders. The loss to debt holders arising from expected inflation represents a corresponding gain to equity holders. In other words, shareholders' income P already includes an amount $+\pi D$, so that total capital income is unchanged.

Most measures of income to equity holders look at actual corporate profits rather than a more appropriate long-run expected income concept. As a result, they tend to be overly volatile in response to transitory developments. While no solution to this problem is completely satisfactory, an attractive approach is to use the idea that corporate dividend payouts are tied to a longer run concept of sustainable shareholder income. Comparing the actual annual values of shareholder income[4] and dividends shows that, on average, dividends are about half of shareholder income. In turn, this suggests that sustainable shareholder income, P, could be measured as:

$$P = 2\,DIV \text{ and}$$
$$TCI = 2\,DIV + NI - \pi D$$

where DIV denotes corporate dividend payouts.

The cost of capital (c) is defined as the ratio of long-run total capital income to the market value of firms' debt (D) and equity (S) securities.

Thus,

$$c = \frac{TCI}{V} = \frac{2DIV + NI - \pi D}{S + D}$$
$$= 2\left(\frac{S}{S+D}\right)\left(\frac{DIV}{S}\right) + \frac{D}{S+D}\left(\frac{NI}{D} - \pi\right)$$

The terms DIV/S and $(NI/D - \pi)$ represent, respectively, the dividend-price ratio and the inflation adjusted return on nonfinancial corporate debt. Thus, the weight on the dividend-price ratio is $2\,S/(S+D)$ and that on the inflation adjusted return on debt is $D/(S+D)$. The market value on nonfinancial corporate debt and equity claims is calculated following a procedure used by the Council of Economic Advisers.[5]

[1] The replacement cost of corporate assets includes Commerce Department estimates of the stock of plant and equipment and inventories plus some short-term financial assets. For the measurement and setup of these balance-sheet variables, see *Annual Report of the Council of Economic Advisers* (January 1977), Table 1, page 29.

[2] Net interest payments of nonfinancial corporations is equal to "monetary interest paid" less "monetary interest received". See Table 8.2 in "The National Income and Product Accounts of the United States, 1929-74, Statistical Tables"; a supplement to the *Survey of Current Business* (1977).

[3] The expected inflation rate is measured as a five-year average rate computed on the consumer price index; *i.e.*,

$$\pi(t) = \exp\ \{1/5 \ln [CPI(t)/CPI(t-5)]\} - 1.0$$

[4] The annual values of shareholder income were measured as corporate profits after corporate taxes plus the capital consumption adjustment plus the inventory valuation adjustment plus the purchasing power loss for holding demand deposits and currency plus the inflation-induced reduction in the value of corporate fixed-income liabilities. When viewed against this inflation-adjusted shareholder income series, the dividends paid by nonfinancial corporations in the seventies appear to be in line with historical experience.

[5] The market value of debt securities, D, is computed by the formula

$$D = NI\ \{1 - (1/(1+r))^5\} / r + F\ \left\{\frac{1}{1+r}\right\}^5$$

where NI is given by footnote 2, r is the Baa rate on corporate bonds (divided by 100), and the face value of the securities F is measured by the following variables from the Flow of Funds Accounts for nonfinancial corporations:

F = Credit market instruments
−(liquid assets − demand deposits
−currency + consumer credit)

The market value of equity is computed by the formula

$$S = DIV/d \text{ where}$$

d is the dividend-price ratio for the Standard & Poor's 500 industrial stocks.

Appendix II: The Estimated Equations, A Technical Note

For each asset category, an equation is estimated that relates the ratio of gross investment to the stock of capital to (a) the difference between the average rate of return excluding old tax benefits and the cost of capital, (b) the product of the investment tax credit rate and the cost of capital, and (c) the product of the present value of the tax write-offs on a dollar of new investment and the cost of capital. More formally, and following the notation of footnote 12, we may write

$$\frac{I}{K} = \alpha[r - cTo - c] + \beta[cITC] + \gamma[cDEPR] + \epsilon$$

In this equation I and K are measured in 1972 constant dollars. Capital stocks were computed by cumulating real investment flows and employing economic depreciation rates derived from the 1976 capital stock study published by the Department of Commerce. The calculation of r and c is discussed in Appendix I and that of the other variables in the text and Appendix III. In the equation, the term ϵ denotes an "error term" which may be correlated with its own past value.

In principle, the two tax variables should have equal weight in computing incentives to invest ($\beta = \gamma$). The regressions were estimated in constrained ($\beta = \gamma$) and unconstrained versions. The constrained versions are reported below. As a technical matter, the equations were estimated in level form using generalized least squares. In level form the basic equation may be rewritten:

$$I = \alpha[r - cTo - c]K + \beta[cITC]K + \gamma[cDEPR]K + \epsilon K$$

where the variance-covariance matrix of the errors ϵK is given by

$$V = \begin{bmatrix} K(1)^2 & \rho K(1)\,K(2) & \bullet\ \bullet\ \bullet & \rho^{T-1}K(1)\,K(T) \\ \rho K(1)\,K(2) & K(2)^2 & & \vdots \\ \vdots & & \ddots & \\ & & K(T-1)^2 & \rho K(T-1)\,K(T) \\ \rho^{T-1}K(1)\,K(T) & \bullet\ \bullet\ \bullet & \rho K(T-1)\,K(T) & K(T)^2 \end{bmatrix}$$

where ρ represents the autocorrelation coefficient for the errors ϵ. K(1) corresponds to the beginning of year capital stock for 1950. In the equation estimates reported below, the aggregative variables r, c, and T_o were lagged one year whereas the variables specific to the asset categories, ITC and DEPR, correspond to the current year.

Investment categories	α	$\beta=\gamma$	ρ	δ	DW	K_{1950}
Transportation equipment	4.24 (4.13)	8.00 (8.31)	0.75	.156	2.08	63.1
Office, accounting, and computing	3.82 (5.91)	9.00 (18.61)	0.5	.151	1.84	11.6
Production machinery	2.68 (6.81)	7.61 (26.88)	0.3	.132	1.88	99.6
Industrial structures	3.08 (5.48)	6.68 (8.64)	0.75	.068	1.63	39.5
Commercial structures	2.01 (4.23)	5.05 (6.96)	0.8	.051	1.69	54.4
Public utility structures	0.95 (2.66)	3.21 (5.20)	0.85	.056	1.55	112.1
Other structures	1.21 (3.52)	5.63 (14.43)	0.6	.080	1.93	51.0

Numbers in parentheses beneath α, β, γ coefficients are t statistics. The standard errors are conditional on the indicated ρ and δ (economic depreciation rate) values. The D.W. (Durbin Watson) statistic is calculated on the estimated ϵ residuals. K_{1950} is the beginning-of-year capital stock for 1950 measured in billions of 1972 dollars. All equations were estimated for the years 1950-77.

Appendix III

Tax service lives

The tax service lives were derived using sources [2] and [3] as a starting point. Initially, mean tax service life estimates for the 1950's were developed from [2] for the four broad categories transportation equipment, office, computing, and accounting machinery, production machinery, and structures. Important adjustments were made to take account of some sampling and other statistical problems in [2].

In the next step, tax service lives corresponding to the 1962 guideline lives were calculated. An important vehicle in this computation was commodity flow matrices for 1963 and 1967 which allocated capital goods purchases for twenty-two components of national income and product accounts (NIPA) equipment to about seventy industries.* Following a detailed coding procedure, industries were assigned the mean tax service lives indicated by the 1962 guideline procedure [1]. For asset categories falling within the production machinery sector, weighted average guideline lives were computed. An average guideline life was also computed for the aggregate production machinery category. For transportation equipment, office and computing machinery, and structures, a similar procedure was employed. The main difference was that industry weights were not so important here because these investments were governed primarily by asset guidelines—not industry guidelines.

The computed 1962 guideline tax lives for the broad categories provided a basis for comparison with the estimated lives for the 1950's. It was found that the latter lives were 10 to 15 percent below guideline levels depending on the category. An exception was structures where the mean tax life for the 1950's was even further below the guideline level.

The 1950's mean tax service life for production machinery was compared with an estimate in Vasquez [3] for the year 1970. The two estimates were essentially identical. The tax service life estimates in the post-1971 period also come primarily from Vasquez [3].

Investment tax credit rates

The effective tax credit rates shown in Chart 4 are the product of coverage ratios and a tax rate. The coverage ratio represents the fraction of investment outlays in a particular asset category eligible for the tax credit. In the annual *Statistics of Income* Treasury publications (United States Business Tax Returns and United States Corporation Tax Returns), the cost of property eligible for the investment tax credit is available at various levels of aggregation. The eligible investments were allocated across the asset categories for which investment equations were to be estimated.

By comparing different data sources, it was possible to allocate a portion of the cost of eligible property for public utilities to the asset category "public utility structures". This was done separately for (a) electric and gas utilities and (b) telephone and telegraph. For each sector, three sources of data were utilized: (1) cost of eligible property, (2) total investment outlays as reported in the plant and equipment survey published by the Department of Commerce, and (3) structures investment as reported in NIPA.

It was assumed that equipment outlays were all eligible so that the difference between (2) and (1) represented NIPA structures outlays that were *not eligible*. Thus, eligible structures outlays were taken to equal (3) minus (2) plus (1).

In years where the aggregate estimate of the cost of eligible property minus NIPA equipment outlays exceeded eligible public utility structures investment, the remaining eligible property was allocated uniformly over the other structures categories. When this was not the case, the coverage ratio for equipment categories was diminished accordingly. It was neither possible nor suitable to make comparisons for all years, and missing years were interpolated. The last suitable year was 1974. The 1974 values of the coverage ratio were simply extrapolated forward through 1978. The coverage ratios used are based on unpublished work by P. J. Corcoran and L. Sahling.

As noted above, the coverage ratio for an asset category must be multiplied by the rate of tax credit appropriate for that category to obtain the series displayed in Chart 4. The rate of tax credit used was taken to be equal to the statutory "full credit" rate times a proportionality factor which depends upon the mean tax service life applicable to the asset category. For the years 1962-70, the factor of proportionality was taken to be as follows:

Factor of proportionality as a function of mean tax service life

Tax life (years)	2.5	5.0	7.0	9.0	11.0
Factor	0	⅓	⅔	⅚	1

Appendix III (continued)

When the mean tax service life fell between any two of the points shown above, the corresponding factor was interpolated. When the tax credit was first introduced in 1962, full credit was reserved for assets in accounts whose tax service life was at least eight years. However, this does not mean that an observed mean tax service life of eight years for a particular category ought to correspond to a factor of unity. This is because, for a mean life of eight years, there is a distribution of service lives across firms above and below eight years.

Since 1971, the factors shown in the table above correspond to a tax life which is one-year smaller than those shown in the table. For example, the factor of unity would correspond to a tax service life of at least 10.0 years, a factor of 2/3 would correspond to a life of 6.0 years, etc.

Finally, the product of the coverage ratio and the proportionality factor is multiplied by the full credit statutory rate. For the year 1969, the statutory rate is taken to be ¼ of 7 percent. The temporary suspension of the tax credit in the last quarter of 1966 and the first quarter of 1967 is ignored.

Present value of tax-depreciation streams

It is assumed that corporations set up composite or multiple-asset accounts for each of the twenty-two NIPA equipment categories and for each of the four broad structures categories considered. These tax accounts are closed at the end of the tax year. They are meant to correspond to so-called closed-end or year's acquisition accounts. This type of account is mandatory under ADR (asset depreciation range). The alternative type of open-end account is one which is continued from one year to the next and which contains investments from many different years. The mean remaining tax life of the account is then adjusted to reflect the mix of old and new assets in the account. The open-end account is difficult to model easily since the mean remaining tax life for the account depends on the history of past investments. In 1965, the Treasury outlawed open-end accounts for the straight-line and sum-of-year's-digits depreciation formulas.

The vast majority of investments are depreciated in multiple asset accounts. The recognition that firms' reported mean tax service lives refer to multiple asset accounts has important implications for the type of present-value formulas used. These implications are developed for straight-line depreciation and for double-declining-balance depreciation.

Tax benefits on old capital

It was assumed that the remaining tax-depreciation stream on old assets could be calculated by using the formulas which correspond to the year the assets were originally purchased. NIPA equipment was taken as an aggregate, and the pre-1971 mean tax service life was taken to be 10.1 years. The post-1971 life was 9.0 years. The mean tax service life for structures was 25.9 years.

* These unpublished data were made available as a result of the *BLS Capital Stock Study*. The basic sources and methodology of the study are described in Bureau of Labor Statistics Bulletin 2034 (October 1979).

References:

[1] United States Treasury Department, Internal Revenue Service, "Revenue Procedure 62-21, Depreciation Guidelines and Rules, Parts I and II, Publication No. 456, Revised August 1964".

[2] United States Treasury Department, Internal Revenue Service, "Statistics of Income—1959: Supplementary Depreciation Data from Corporate Income Tax Returns, with Special Appendix-Depreciation Methods and Amortization Data, 1954, through 1961" (mimeograph, June 1965).

[3] Vasquez, Thomas, "The Effects of the Asset Depreciation Range System on Depreciation Practices" (Office of Tax Analysis, Department of the Treasury, May 1974).