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Taxes and the Investment Recovery

THROUGHOUT 1983 and 1984, the United States experienced an exceptionally strong recovery of capital formation from the depths of the 1980–82 recession. Between the fourth quarter of 1982, the recession trough, and the fourth quarter of 1984, total business fixed investment, even after adjustment for inflation, increased by 33 percent—more than double the average 15 percent gain at a comparable stage in previous post–World War II economic recoveries. Investment in producers' durable equipment was up a remarkable 42 percent.

There has been no shortage of explanations for the surge in investment spending. Most prominently mentioned is the 1981–82 tax act, which sharply reduced the tax rate on income from new investments.[1] Other explanations include the lower rate of inflation, which has improved the outlook for sustained economic growth in the United States, and the acceleration of technological change, reflected in the replacement of capital stock made obsolete by energy price changes during the 1970s and in the increasing use of computers in production. A few analysts even link the rise in the value of the dollar to increased investment. Their

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1. The Economic Recovery Tax Act of 1981 called for a phased liberalization of business taxation stretching over several years. Some of these provisions never took effect because of modifications to the law made in the Tax Equity and Fiscal Responsibility Act of 1982. These changes are explained in greater detail in a subsequent section. For simplicity I use "the 1981–82 tax act" to refer to the net effect of those two acts.

argument, which departs from the conventional view that a rise in the exchange rate increases the cost of domestic production and reduces investment incentives, is that a higher exchange rate presses American firms to invest to maintain a competitive position in world markets.

This paper investigates the investment expansion in recent years with an emphasis on the effect of tax changes. The issue is important, because the United States is engaged in another debate over tax reform, and the impact on capital formation is again emerging as a major criterion on which all tax proposals will be judged.

My analysis considers the composition as well as the level of investment spending. The 1981–82 tax act had widely different effects on tax rates for different types of capital assets. While the tax rates on income from investments in structures all declined substantially, rates for income from some types of equipment, such as trucks and office equipment (computers), actually increased. The range of tax rate changes offers an opportunity to explore further the link between taxes and investment decisions by examining the changes in the composition of investment spending since 1981 and relating these changes to changes in relative rates of taxation.

General Trends in Investment

A brief overview of the investment boom provides a useful background for the more detailed analysis that follows. A comparison of the current economic recovery with past postwar economic expansion is provided in table 1. In the first three columns of the table each component of investment is shown in index form with its value in 1982:4 (the recession trough) equal to 100. The growth of each component from 1982:4 to 1984:4 is compared with the average growth during the first two years of recovery from previous postwar recessions.

The spectacular recent gain in investment demand is concentrated in aggregate producers' durable equipment (PDE), where, after eight quarters, investment spending was 42 percent above its recession low, compared with an average rise of 20 percent in previous cycles. Since the standard deviation of the 20 percent average gain of earlier expansions is only 2.4 percent, it is clear that recent investment spending has been highly unusual. Particularly dramatic has been the growth of investment

Table 1. Indexes of Cyclical Growth in Business Investment, Previous Cycle Average and 1982–84

Index of 1972 dollars

Category	*Recession trough equals 100*[a]			*Previous peak equals 100*[b]		
	Trough quarter	*Fourth quarter after trough*	*Eighth quarter after trough*	*Trough quarter*	*Fourth quarter after trough*	*Eighth quarter after trough*
Gross national product						
Previous cycle average	100	107	112	98	105	110
1982–84	100	106	112	99	106	112
Nonresidential structures						
Previous cycle average	100	106	108	95	100	103
1982–84	100	99	115	102	101	117
Producers' durable equipment						
Previous cycle average	100	111	120	90	100	107
1982–84	100	121	142	91	110	128
Office equipment						
Previous cycle average	100	111	126	95	104	115
1982–84	100	124	159	159	197	252
Business automobiles						
Previous cycle average	100	145	140	85	120	110
1982–84	100	145	173	104	150	179
Other equipment						
Previous cycle average	100	108	119	90	96	106
1982–84	100	117	131	77	90	101
Domestic production of other equipment						
1982–84	100	112	120	70	79	85

Sources: National income and product accounts and author's calculations as described in the text.
a. Index = 100 in 1982:4, the trough quarter, for current cycle.
b. Index = 100 in 1979:3–1979:4 for current cycle.

spending for two types of assets: office equipment (computers) and business purchases of automobiles, with increases of 59 and 73 percent, respectively. Even so, spending for all other types of equipment has increased an average of 31 percent since the recession trough. The first-year gain in nonresidential structures investment was less than normal, but a strong expansion in 1984 carried the level of spending significantly above the prior cycle average—15 percent compared with 8 percent.

Interestingly, the overall recovery as measured by the growth of GNP, a primary determinant of capital requirements, has been no better than average. After eight quarters GNP has increased by 12 percent—

exactly the average of prior expansions. If GNP growth is not responsible for today's investment boom, what is?

The argument has been made that current investment spending has been growing rapidly only because it sank so low in the long 1980–82 recession, when high financing costs plus declines in total output exerted an unusual degree of restraint on investment spending. That argument is examined in the last three columns of table 1, where spending at the prior business-cycle peak (the average of the third and fourth quarters of 1979 for the current cycle) is set equal to 100. For the aggregate of PDE, spending at the trough of the recent recession was only 9 percent below its previous peak, compared with a historical average decline of 10 percent.[2] The level of aggregate spending on structures in the recession was typical of previous cycles. On this basis, the investment recovery since 1982 is, if anything, even more unusual than it appears at first glance.

A much more diverse pattern of behavior is evident among the components of PDE. Spending on office equipment, which has been expanding at a phenomenal pace since 1979, hardly slowed during the recession. It was 152 percent above its 1979 level at the end of 1984. In fact, office equipment accounted for 27 percent of total PDE in 1984:4 and for over two-thirds of the increase since 1979. Likewise, the growth in business spending on automobiles showed no decline during the recession and rose 79 percent between 1979 and 1984. Other types of equipment spending, however, declined very sharply (23 percent) during the recession and exceeded the 1979 level only in the fourth quarter of 1984.

Overall, office equipment and automobiles account for 93 percent of the growth in equipment spending since 1979—a pattern that causes problems for an explanation of the growth in investment spending that emphasizes the 1981–82 tax reduction. Not only did the tax act make almost no change in the tax treatment of automobiles, it actually increased the tax rate on computers.

Another important aspect of the current investment boom is revealed in an examination of the growth in the capital stock. If the United States

2. Surprisingly, the decline in GNP is also not particularly severe compared with the past. Of course, the recession was more severe than earlier downturns if it is measured in terms of the deviation from potential output, which continued to grow over the three years of depressed demand.

had had no recession after 1979 and if output had expanded steadily at the average growth rate of the 1979–84 period, the maintenance of investment rates at the level prevailing in 1979 would have yielded a specific capital stock, K. Instead, actual investment was low for several years and then rose sharply. Has the recent exceptional growth in investment been sufficient to overcome earlier losses and to leave the United States with a capital stock as large as, or larger than, it would have had along a steady growth path? A computation using the average growth of output between 1979:4 and 1984:4 and a net investment share of output equal to that of 1979 shows that the loss of capital exceeded 5 percent of the stock by the end of 1984. In other words, the capital-output ratio at the end of 1984 was roughly 5 percent lower than it would have been if the United States had had no recession and no tax cut. In fact, the shortfall is larger than the total amount of net investment made in 1984. Thus the United States will require several more years of exceptional investment simply to recover its earlier capital losses.

There is no mystery why the American capital-goods industries seem so unappreciative of the recovery in capital spending. A measure of domestically produced capital goods can be constructed by adding export demand to, and subtracting imports from, the measures of U.S. spending on capital goods, as shown in table 1. The index for nonautomotive, nonoffice equipment, shown at the bottom of the table, fell to 70 percent of the 1979 peak at the end of 1982 and had risen only to 85 percent by the end of 1984. Thus, for the American capital-goods producers the 1980–82 recession was very severe; the recovery, very incomplete. Not only is American investment being financed by well-publicized foreign borrowing; much of it is being built overseas.

The extent of the capital-goods boom is also in question because some observers dispute the classification of certain products as investment in the national income accounts. For example, the category of office equipment includes personal home computers, a product that could well be classified as a consumer good.[3] Similarly, the rapid growth of business purchases of automobiles reflects a movement by consumers from private ownership to leasing of automobiles, where the latter is classified as a business activity. Because the national income accounts measure

3. Office equipment does not include industrial computers (for example, numerical control equipment), which are allocated to other categories.

investment as a summation of sales (minus exports and plus imports) for specific classes of products, the data frequently fail to provide a basis for allocating individual products between consumption and investment applications.

An alternative approach is to use surveys that ask business firms how much they spend on capital goods. The business plant and equipment survey undertaken by the Department of Commerce shows a rise (14 percent) in total investment above its 1979 peak that is less spectacular than the national income account measure (33 percent), but that increase is still more than twice the 6 percent average growth during the first two years of earlier postwar expansions. Furthermore, the survey reports that nearly all of the above-average growth in investment is concentrated in manufacturing. Investment in a wide range of nonmanufacturing industries is normal or below normal for comparable stages of economic expansion.

An Aggregate View

Aggregate investment equations from the large econometric models provide one way to evaluate the impact of the 1981–82 tax legislation. Most of these statistical equations are based on the neoclassical model in which the desired capital stock is a function of the price of capital services (rental price) and anticipated future output. The model assumes that tax rate reductions will increase investment by lowering the rental price of capital, thereby increasing the desired stock. Because most of the available empirical models assume a unitary elasticity of the demand for capital with respect to its rental price, it would seem to be a relatively straightforward matter to evaluate the effect of the tax cuts simply by computing the change in prices implied by the tax change and checking the predictions of the equations against actual investments since 1981.

In practice, however, things are not so simple. For one thing, other determinants of investment demand are changing at the same time as the tax rate. For another, the existing empirical models differ significantly both in the treatment of these determinants and in the measurement of the magnitude of the tax change.

Nearly all of the investment equations used in the major econometric models underestimated the size of the current investment boom, even on an ex post basis in which actual values are used for the determinants

of spending.[4] The investment equation for PDE in the Federal Reserve Board (FRB) model, for example, underpredicted business investment in equipment between 1978 and 1981 by amounts ranging from 5 to 10 percent a year. The forecast error declined in 1982, when investment spending fell far more sharply than the model anticipated, but during the period of cyclical expansion, 1983–84, the equation captured only two-thirds of the rise in equipment investment. By the end of 1984, investment in PDE was about 10 percent higher than anticipated.

The neoclassical investment models' difficulty in accounting for the rise in recent investment spending is understandable in light of the widespread uncertainty over what happened during the 1980s to the rental price of capital. The cost of using a unit of capital for a specific time period consists of three components: the cost of acquiring it, the economic cost of using it for the time period (the real cost of funds plus depreciation), and taxes.[5]

$$(1) \qquad c = \frac{P_k}{P_q} \cdot (r + \delta) \cdot \left[\frac{1 - \rho z - k}{1 - \rho}\right],$$

where
c = rental price of capital
P_k = purchase price of capital
P_q = price of output
r = after-tax real cost of funds (discount rate)
δ = economic depreciation
ρ = corporate profits tax rate
z = present discounted value of depreciation deductions
k = investment tax credit.

Table 2 shows changes in each of these components over the 1980–84 period. The changes are measured in two different ways, and each measure is used within investment equations that are otherwise identical in their specifications.

4. The investment equations used in the models of Data Resources, Inc., the Federal Reserve Board, the University of Michigan, and Wharton Econometrics all underestimated investment.

5. Interest rates play two roles: the real after-tax cost of funds (opportunity cost), r, is an element of economic cost. In addition, changes in the nominal cost of funds, $r + \pi$, where π is the inflation rate, change the present value of depreciation allowances in the tax term. In the calculations that follow, the effect of changes in the nominal rate is assigned to the economic cost component, and the tax term is evaluated under a constant interest rate assumption.

Table 2. Percentage Deviation of the Rental Price of Capital and Its Components from 1980 Values

Year	*Acquisition price*[a]	*Tax*[b]	*Cost of funds*[c]	*Total*
		Federal Reserve Board Model		
1980	0.0	0.0	0.0	0.0
1981	−3.2	−5.9	6.5	−3.1
1982	−6.6	−5.5	16.2	2.5
1983	−9.4	−5.3	13.5	−2.6
1984	−11.1	−5.2	19.8	1.0
		Corcoran-Sahling-Akhtar Model (New York Federal Reserve Bank)		
1980	0.0	0.0	0.0	0.0
1981	−3.2	−5.9	5.5	−5.2
1982	−6.6	−5.5	9.5	−2.7
1983	−9.4	−5.3	−1.8	−16.2
1984	−11.1	−5.2	3.4	−13.9

Source: Computed by author as described in text on the basis of data obtained from the staff of the Board of Governors of the Federal Reserve System and the New York Federal Reserve Bank.

a. Based on the ratio of the price deflators for producers' durable equipment and for domestic business output.

b. Percentage change in the tax component between 1980 and 1982.

c. Includes changes in the real cost of funds and the effect of changes in the nominal discount rate in altering the present value of depreciation allowances.

The 1981–82 tax changes affected the rental price of capital in contradictory ways.[6] The 1981 act sharply reduced the time period over which assets could be depreciated, and increased the investment tax credit for certain types of equipment. The 1982 act, on the other hand, cut off much of this liberalization of depreciation accounting. It required that half of the investment tax credit be deducted from the asset price before depreciation allowances could be computed, and denied firms the use of the accelerated depreciation formulas common in 1980.[7] The combined result of the 1981 and 1982 acts was estimated, within the FRB model, to have reduced the rental price for the average unit of equipment by about 5 percent.

6. There is confusion in the literature over whether the term "cost of capital" refers to r or c. To avoid this confusion, I will refer to c as the rental price of capital and to r as the cost of funds.

7. Before 1981, firms could use 200 percent of declining balance, with a switch to sum-of-the-years digits for equipment and certain types of structures. The 1982 law restricted accelerated depreciation to 150 percent of declining balance while continuing to allow a switch to sum-of-the-years digits. Structures investment received more favorable tax treatment, being allowed 175 percent of declining balance, compared with 150 percent in 1980, with a switch to straight-line.

At the same time, the real acquisition price of capital appears to have fallen substantially after 1980. The price deflator for PDE rose at less than half the general rate of inflation throughout the first half of the 1980s. Relative to the average price of nonfarm business output, equipment prices fell 11 percent between 1980 and 1984. Thus, at least for equipment, the decline in the relative price was a more important stimulus to investment than the tax act. The combined result of lower tax rates and prices would appear to have provided a powerful stimulus to investment in both equipment and structures.

The problem is that there is a great deal of uncertainty about what happened to the real cost of funds—an unobserved variable—in the 1980s. The rise in the nominal rate of return on financial assets, together with the decline in inflation, implies that the opportunity cost of investment in real assets increased. That is the conclusion reached in the FRB model. In fact, the FRB measure of the cost of funds rises sufficiently to offset fully the decline in capital-goods prices and taxes—leaving the overall rental price of capital slightly higher in 1984 than in 1980.

An alternative approach is taken in a recent set of papers by Patrick J. Corcoran and Leonard G. Sahling, and Sahling and M. A. Akhtar, reporting on research carried out at the New York Federal Reserve Bank.[8] They use a conceptual framework similar to that of the FRB model, but differ in how they adjust the cost of debt finance for inflation expectations and in how they combine the costs of debt and equity finance into a single overall measure. According to their estimate, the cost of funds, shown in table 2, increased only slightly during the 1980–84 period, so that the fall in relative prices and taxes translates into a large reduction in the rental price of capital.

Sahling and Akhtar inserted their newly developed measure of the cost of funds into the FRB model while leaving other elements of the specification unchanged. Although their version failed to track the decline of investment in 1980–82, it did capture the full extent of the 1983–84 recovery: their error in predicting investment grew to $11 billion during the recession but remained constant between 1982 and 1984 as

8. Patrick J. Corcoran and Leonard G. Sahling, "The Cost of Capital: How High Is It?" *Quarterly Review of the Federal Reserve Bank of New York*, vol. 7 (Summer 1982), pp. 23–31; Leonard G. Sahling and M. A. Akhtar, "What Is Behind the Capital Spending Boom?" *Quarterly Review of the Federal Reserve Bank of New York*, vol. 9 (Winter 1984–85), pp. 19–30.

investment picked up. A comparison of the forecast errors beginning in 1980 is shown below, in billions of 1972 dollars.

Year	Actual PDE investment	Forecast error (Actual minus predicted)	
		FRB model	Sahling-Akhtar
1980	117.0	5.9	6.5
1981	121.8	12.2	12.5
1982	113.5	3.5	11.0
1983	121.8	2.5	10.0
1984	148.0	12.5	11.0

Thus major differences in the investment forecasts result from disagreements about the measurement of the cost of funds, not taxes. Did the cost of funds rise in the 1980s, as the authors of the FRB model believe, so as to offset the benefits of the tax reduction; or did it remain unchanged, as Sahling and Akhtar believe? In a later section, these ambiguities in measuring the cost of funds are discussed in greater detail.

A Disaggregate View

The discussion of the effect of the tax system on capital formation has evolved considerably over the last decade. In the mid- and late-1970s, much of the research emphasized the interaction between inflation and the tax system, and reached the conclusion that because depreciation had not been adjusted for inflation, the tax on capital income had increased during the 1970s.[9] This discovery motivated much of the subsequent legislative effort to provide tax relief for capital income.

More recently, several studies have concluded that inflation has little or no net effect on the tax rate applicable to *new* investment, and that that rate actually fell throughout the 1970s.[10] The discussion of tax policy

9. For a recent example, see Martin Feldstein and Lawrence Summers, "Inflation and the Taxation of Capital Income in the Corporate Sector," *National Tax Journal*, vol. 32 (December 1979), pp. 445–70.

10. Mervyn A. King and Don Fullerton, eds., *The Taxation of Income from Capital: A Comparative Study of the United States, the United Kingdom, Sweden, and West Germany* (University of Chicago Press, The National Bureau of Economic Research, 1984); Don Fullerton and Yolanda K. Henderson, "Incentive Effects of Taxes on Income from Capital: Alternative Policies in the 1980s," in Charles R. Hulten and Isabel V. Sawhill, eds., *The Legacy of Reaganomics: Prospects for Long-Term Growth* (Washington, D.C., Urban Institute Press, 1984), pp. 45–90.

and investment has now shifted to a new issue: the wide dispersion of effective tax rates across different types of capital assets and the highly variable effect that inflation has on the tax rates applicable to disparate investments financed in different ways. For certain types of investment, the effective tax rate is actually reduced by inflation; for others, it is sharply increased. The new concern is not so much with the impact of taxes on the total level of investment, as with the resource distortions that result if investment decisions are based more on tax advantages than on economic benefits.

This new research interest results from a fuller consideration of the tax treatment of interest payments in an inflationary economy. Nominal interest payments are a fully deductible business expense for borrowers. They are also taxable income to recipients. Inflation increases both interest deductions and receipts, but the impact on effective tax rates is not a wash, because far more interest is claimed as an expense by borrowers than is ever reported as taxable income by recipients. In addition, the marginal tax rates of borrowers who claim the interest deduction are higher, on average, than those of recipients.[11] As a result, the overall (corporate plus personal) tax rate on capital income varies sharply by type of asset, method of financing, and owner.

Any conclusions about specific rates of overall taxation remain uncertain, however. Our current tax system places only a modest burden on users of capital (borrowers) and collects most of the revenue from suppliers (lenders). This allocation may make little difference for calculations of the overall tax rate on capital income in a closed economy where savers and investors can be viewed simply as opposite sides of the same coin; in an open economy with international capital flows, however, the taxation of domestic investors and savers cannot simply be combined to obtain the overall tax rate.[12] In fact, the major conclusion that emerges from the recent research is that the tax system is so diverse in its treatment of different investments that its net influence on investment decisions is virtually impossible to determine in any overall sense.

The 1981–82 business tax changes offer an opportunity to examine the change in the allocation of investment among assets with different business tax rates before and after 1982 and thus to obtain specific

11. Fullerton and Henderson, "Incentive Effects of Taxes," p. 54.

12. The need to assume a closed economy is a major limitation of those studies that attempt to evaluate the combined effective rate of the personal and corporate income taxes on capital and their influence on investment decisions.

evidence of the impact of taxes on investment decisions. Effective tax rates on the income from most types of capital were reduced, but by widely varying amounts. A rapid expansion of total investment followed two years later. If taxes have a major effect on investment decisions, those types of capital that had the largest reduction in effective tax rates should have led the recovery. Of course, the situation is not actually that simple, because the early 1980s have seen enormous changes in other determinants of investment demand: a large cyclical swing in output, higher real interest rates, lower inflation, and a dramatic rise in the foreign exchange value of the dollar. To the extent that these factors exert a common influence on all types of investment, however, a cross-section comparison should provide more evidence on the relative importance of taxes.

Earlier studies, using specific assumptions about the sensitivity of investment to differential tax rates, have examined the efficiency loss due to economic distortions introduced by those differential rates.[13] My purpose is a more limited one of seeking empirical evidence concerning the influence of taxes on the allocation of capital.

The analysis begins with an initial assumption (or null hypothesis) that changes in the rental price of capital do not influence the demand for capital. I estimated a set of investment equations for the period 1958–80 using quarterly time series data on investment in nineteen categories of PDE and two types of structures investment taken from the national income accounts. The structures investment covers only industrial and commercial buildings, not public utilities, agriculture, or nonprofit institutions. Net investment was related to a twelve-quarter weighted average of the change in gross domestic output of the nonfarm, nonresidential sector of the economy (a simple accelerator model) and a time trend to capture technological changes.[14] I used the equations to forecast investment from 1980 to 1984, taking the cumulative error in each category during 1983 and 1984 as a measure of the unanticipated growth in the desired capital stock.[15]

13. Alan J. Auerbach, "Corporate Taxation in the United States," *BPEA, 2:1983*, pp. 451–505; and Jane G. Gravelle, "Effects of the 1981 Depreciation Revisions on the Taxation of Income from Business Capital," *National Tax Journal*, vol. 35 (March 1982), pp. 1–20.

14. The equations utilize a twelve-quarter polynomial lag with an adjustment for autocorrelation.

15. The 1981–82 period was excluded because of the revision of the tax law in 1982. In

The distribution of forecast errors, shown in column 1 of table 3, resembles the earlier comparison, in table 1, of current investment with investment in previous cycles. Office equipment, automobiles, and commercial structures all have large positive errors, while other types of investment show a mixed pattern.

The hypothesis is that the errors made by a simple accelerator investment equation that ignores relative prices should be negatively correlated with changes in the rental price of capital. As before, the calculation of the rental price of capital on an asset-specific basis is broken into three separate components: the relative acquisition price, the economic cost of using the capital for a specific period (the cost of capital plus depreciation), and taxes, all as they were defined previously in equation 1.

TAXES

In measuring the effect of taxes on the rental price of capital, I took direct account of corporate taxes only. Changes in personal taxes should be reflected in market interest rates and thus in the cost of funds. Initially, the tax changes from 1980 to 1982 were evaluated under an assumed constant real cost of funds of 4 percent and an expected inflation rate of 6 percent—an after-tax nominal rate of 10 percent for purposes of valuing future depreciation allowances. I disregarded state income and property taxes, which are fairly uniform across assets and do not change significantly in such a short period.

The detailed information required to compute the change in the tax component of the rental price between 1980 and 1982 is provided in the appendix. The results appear in columns 2 through 4 of table 3. To me, the major surprise was the small magnitude of the tax rate reduction for most types of equipment. Indeed, some classes of assets, such as office equipment (computers), trucks, and construction machinery actually faced a higher tax in 1982.[16]

1981 and 1982, firms might have intended to postpone investment until the provisions of the 1981 act were fully phased in.

16. As discussed in the appendix, there is some uncertainty about the magnitude of the actual change in tax lives for depreciation because, before 1981, firms were allowed to group dissimilar assets and apply a common depreciation method. In the preliminary work, I used data on 1980 tax lives from three different studies, but the choice among them had little impact on the conclusions.

Table 3. Tax Rates and Changes in the Rental Price of Capital by Asset Category, 1980–84

Percent

Asset category	Excess capital[a] (1)	Effective tax rates		Rental price change				
				Components[b]			Total[c]	
		1980 law (2)	Post-1982 law (3)	Tax (4)	Acquisition price (5)	Cost of funds (6)	Version 1 (7)	Version 2 (8)
Furniture	0.8	−0.3	−0.3	0.0	−2.0	13.3	−2.0	11.1
Fabricated metals	−2.0	23.8	17.7	−2.7	3.5	15.2	0.7	16.0
Engines and turbines	−1.2	33.1	24.5	−4.9	9.0	16.8	3.7	21.1
Construction tractors	−0.4	9.0	−0.4	−2.0	4.6	9.9	2.5	12.6
Agricultural machinery	−3.8	−0.3	−0.3	0.0	5.3	14.6	5.3	20.7
Construction machinery	−2.4	−12.2	−0.4	2.0	5.4	9.4	7.5	17.7
Mining equipment	−0.6	14.1	−0.4	−3.2	15.4	9.8	11.7	22.6
Metalworking machinery	−4.0	9.1	−0.3	−2.5	3.3	12.3	0.8	13.1
Special industrial machinery	0.2	4.1	2.8	−0.4	2.6	14.0	2.2	16.5
General industrial machinery	−2.2	18.1	−4.0	−6.0	2.6	12.3	−3.6	8.3
Office equipment	12.4	−19.2	−0.6	2.0	−19.9	6.4	−18.3	−13.1
Service industrial machinery	−0.8	1.4	−0.4	−0.4	1.8	9.8	1.4	11.3
Communications and electrical	−2.0	23.5	16.4	−2.6	3.5	12.7	0.8	13.6
Trucks and buses	−1.4	−1.9	−1.1	0.1	3.6	6.8	3.7	10.8
Business automobiles	4.0	8.3	−3.8	−1.4	−21.2	5.3	−22.3	−18.1

Aircraft	−0.8	10.6	−0.4	−2.2	5.3	9.0	3.0	12.2
Ships and boats	−2.0	25.8	−0.2	−10.9	−0.3	17.4	−11.1	4.3
Railroad equipment	−2.0	12.2	−0.2	−5.1	−0.9	18.9	−6.0	11.8
Instruments	−2.2	21.8	14.4	−2.2	−8.2	10.5	−10.3	−0.8
Other equipment	−1.2	5.4	−0.4	−1.3	2.3	10.5	1.0	11.7
Industrial structures	−1.0	51.0	38.2	−14.8	−5.8	27.4	−19.7	2.3
Commercial structures	4.0	47.3	34.8	−14.8	−5.8	31.7	−19.7	5.8
Total	−8.8	22.1	14.6	−3.9	−2.4	17.0	−7.9	7.2

Source: Computed by author as explained in the text.

a. Forecast errors of equations relating net investment to a twelve-quarter weighted average of the change in nonfarm, nonresidential GDP and a time trend.

b. Column 5 shows the change in rental price arising from changes in the relative price of assets. It is measured by the change between 1979–80 and 1982–83 in the price of each asset relative to the price of output in nonfarm, nonresidential business.

Column 6 shows the change in the rental price component that would arise from an increase in the cost of funds from 4 percent to 6 percent.

c. Version 1 combines the effect of tax and price changes with constant cost of funds and is the geometric sum of columns 4 and 5.

Version 2 combines the effect of tax and price changes with the 2 percentage point increase in the cost of funds of column 6; it is the geometric sum of columns 6 and 7.

One popular method of evaluating the effect of taxes on the demand for capital is based on computing effective tax rates on net income from capital.[17] Measures of effective tax rates under the tax laws of 1980 and post-1982 are shown in columns 2 and 3 of table 3. Column 2 illustrates the wide disparity of tax rates that existed in 1980, ranging from −19 percent for office equipment to 51 percent for industrial structures. It also appears, from column 3, that the 1981–82 tax changes together slightly reduced the dispersion of tax rates. The standard deviation of the effective tax rates falls from 17 percentage points in 1980 to 12 percentage points in 1982.

In fact, the effective tax rate does not necessarily provide a good guide to the effect of taxes on the demand for capital because, for short-lived assets, depreciation and the cost of funds dominate taxes as cost factors. In evaluating the impact of a tax change on the demand for capital, it is more useful to look at the percentage change in the annual rental price induced by the tax change. That calculation, shown in column 4, ranges from a 2 percent increase in the cost of using computers and construction equipment to a 15 percent decline for structures. The average reduction in price (weighted by shares of the total capital stock) is about 4 percent.[18] If we assume uniform price elasticities of the desired capital stock, column 4 also provides the measure of the expected percentage change in the desired capital stock.

ACQUISITION PRICES

As noted earlier, the price deflator for equipment investment rose after 1980 at a rate far below that of the general price level—contributing to an apparent 11 percent decline in the rental price of equipment between 1980 and 1984. An examination of investment on a more disaggregate basis, however, reveals that two-thirds of that reported

17. The effective tax rate is computed as the difference between the service price of capital with and without taxes (the tax wedge), divided by the before-tax service price minus economic depreciation: $(c_1 - c_0)/(c_1 - \delta)$. The effective tax rate will vary under different assumptions about the real after-tax rates of return and inflation, which are set at 4 percent and 6 percent, respectively, in this study.

18. This estimate of the price effect of the tax change is considerably smaller than that assumed in the macroeconomic models discussed in the prior section. The reason is that the FRB model assumes a decline in service lives used in depreciating equipment from 10.5 to 4.5 years. On the basis of the detailed data shown in table 3, that seems excessive.

price decline was due to a simple shift in the mix of investment toward assets (computers and autos) whose prices were relatively lower in the 1980s than in 1972—the base year for computing the price indexes in the national income accounts. On a fixed-weight basis, the price of PDE declined only 3 percent relative to that of output.

Within that small average decline, there was a wide diversity of price changes among assets, as is evident in column 5 of table 3, which shows the percentage change in prices from the average of 1979–80 to 1982–83.[19] ("Price" is the price index for each asset divided by the price of output in the nonfarm, nonresidential business economy.)

The large relative price decline for office equipment is expected, because the national income accounts incorporate the assumption that the price deflator for computers is a constant 1.0.[20] The even larger decline in the relative price of business automobiles is more surprising but can be explained. While new car prices have been rising somewhat less rapidly than the general price level, the price index for used cars has exploded upward. Businesses typically buy new automobiles and sell them to private owners after a year or so. The sale of a capital good to the household sector is treated as a negative investment in the national income accounts. Thus, the investment price deflator reflects both low inflation for new automobiles and rapid inflation at time of resale.[21] In effect, the cost of using an automobile for a year or two has declined dramatically.

Also surprisingly, the relative prices of most other types of equipment have gone up, despite sharply increased U.S. purchases of imported capital equipment. The average price of imported capital goods has remained unchanged in recent years.[22] Finally, the relative price of

19. Initially, I measured the change from a weighted average of the price level where the weights were taken from the lag structure of the original investment equations for each asset. However, because that calculation yielded results very similar to those of the simpler procedure of computing changes in annual averages, I reverted to the latter formulation. A one-year lag is used as a rough allowance of the gestation period for investment.

20. Recent work by the Bureau of Economic Analysis to develop a true price index suggests that a more accurate measure of the relative price decline would be at least twice that shown in the table.

21. In part, this reflects an inconsistency in the data: new car prices are adjusted for quality changes; used car prices are not.

22. There is some question about the quality of the price index data at this level of detail, but there is no reason to expect that the biases in the data changed in any particular direction after 1980. One exception should be noted. Existing price deflators for capital growth do not directly incorporate the price of imported equipment.

structures, which had been steadily rising for decades, declined by nearly 6 percent over the three-year period.

COST OF FUNDS

As I explained in the preceding section, there is substantial disagreement among economists about the change in the cost of funds after 1980. My approach was to experiment with a range of values to test for the sensitivity of the results to different alternatives. For illustrative purposes, a measure of the change in the rental price that would occur in each asset if the real cost of funds rose 2 percentage points is shown in column 6. The results demonstrate vividly the critical role that financing costs play in determining what has happened to investment incentives. The rental price changes in column 6 range from as low as 6 percent for computers and automobiles, whose prices are dominated by depreciation cost, to a high of 32 percent for commercial structures, where annual depreciation is small. In fact, the rental price varies far more due to changes in the cost of funds than to tax changes.

RESULTS

The forecast residuals of column 1 were expressed as a percentage of the respective net capital stock. Simple correlation coefficients were computed for the relationship between the error in forecasting the capital stock and changes in the various constructed measures of the rental price of capital and its components. The possible combinations included: the change in the tax component alone, column 4; the change in the acquisition price component alone, column 5; the change in the rental price due to the combined effect of tax and acquisition price changes, with the assumption of no change in the cost of capital, column 7; and an alternative measure of the rental price that incorporates a rise in the cost of funds, column 8. The correlations, weighted by the capital stock of each asset category, were performed for the full set of 22 assets and for a subset (16 assets) that excluded farms, equipment for regulated utilities, and mining. A summary of the *F*-statistics and the significance from those correlations is provided opposite.[23]

23. The equations are shown in full in appendix table A-2.

	Taxes	*Acquisition price*	*Rental price* *Version 1*	*Version 2*
Full sample (22)	−0.7	26.7	9.1	17.5
Restricted sample (16)	0.3	29.2	7.6	12.8

Critical F value (0.01 level)
22 cases = 5.9
16 cases = 6.5

First, there is no significant correlation between those assets that have a higher-than-expected capital stock and the relative magnitudes of tax reduction. Second, there is a strong correlation between changes in the capital stock and changes in acquisition prices, but the significance level actually declines if the tax and acquisition price changes are combined into an overall measure of the rental price—taxes make a negative contribution to explaining the pattern of forecast errors. Finally, the assumption that the cost of funds rose during the 1980s improves the explanation of the distribution of errors among assets, even though it implies that on average the rental price of capital actually rose, with the increase in financing cost offsetting the benefits of the tax reduction.

These statistical results support several arguments that have been made in other investment studies. First, they offer evidence for the hypothesis implicit in the neoclassical models that the rental price of capital does influence the level and composition of investment spending. It appears, however, that the literature places too much emphasis on the role of taxes and too little on the specification of the cost of funds. For many categories of equipment, taxes are such a small component of the rental cost that they are overwhelmed by changes in the other factors.

Second, it is possible that the effect of taxes is still not accurately reflected in the analytical measures of the rental price used above because the measures do not explicitly incorporate the role of debt finance.[24] That is a question to which I will return in a following section.

Cost of Funds

As mentioned, existing empirical studies of the cost of funds have reported widely divergent results. The FRB and Corcoran-Sahling (C-S)

24. Fullerton and Henderson, "Incentive Effects of Taxes."

measures discussed above are shown in figure 1, together with an earlier estimate published in this journal by William C. Brainard, John B. Shoven, and Laurence Weiss.[25] All three measures have similar movements up to the mid-1970s. At that point there is a drastic departure. In the Brainard, Shoven, and Weiss model (B-S-W), the cost of funds increases because of the decline in stock market values; in FRB, it declines because of accelerating inflation; in C-S, it shows a mild upward drift.

The disparities are puzzling because all the studies profess to begin with the same conceptual model. The cost of funds is that discount rate (internal rate of return) required to equate the expected future stream of capital income, E, to the present market value of the firm, V. The cost of funds is also the opportunity cost of drawing resources from other uses. In that sense, the cost of funds is externally determined, and increases in the cost of funds raise the rate of return, the hurdle rate, that a specific project must earn in order to be economically viable:

$$V_0 = \int_0^{\infty} e^{rt} E_t^e \, dt. \tag{2}$$

If the expected value of the future income stream can be captured in the concept of "permanent" capital income, $\overline{E}$, then the cost of capital is[26]

$$r = \frac{\overline{E}}{V}, \tag{3}$$

or

$$r = \frac{\overline{PBT} - \overline{T} + \overline{INT}}{S + D}, \tag{4}$$

where PBT equals equity income before tax, T equals taxes, and INT equals interest payments. The bar refers to the "permanent" value of a variable, and S and D represent the market value of equity and debt, respectively.

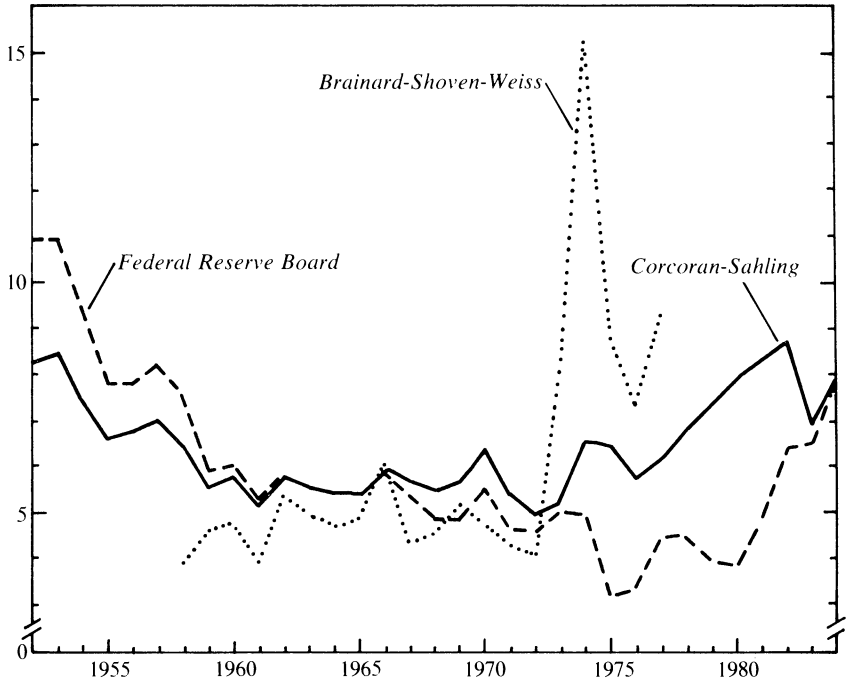
On the further assumption that dividends are used as a signal to stockholders of expected "permanent" (after-tax) equity income, the

25. William C. Brainard, John B. Shoven, and Laurence Weiss, "The Financial Valuation of the Return to Capital," *BPEA, 2:1980*, pp. 453–502.

26. Corcoran and Sahling, "The Cost of Capital," pp. 25–26. A similar but more elaborate concept is used by Brainard, Shoven, and Weiss.

Figure 1. Alternative Measures of the Cost of Funds, 1952–84

Percent



Sources: William C. Brainard, John B. Shoven, and Laurence Weiss, "The Financial Valuation of the Return to Capital," *BPEA, 2:1980*, p. 482, column 2; Patrick J. Corcoran and Leonard G. Sahling, "The Cost of Capital: How High Is It?" *Quarterly Review of the Federal Reserve Bank of New York*, vol. 7 (Summer 1982), pp. 30–31 (updated data supplied by the authors); and the quarterly data book of the Federal Reserve Board Quarterly Model.

"permanent" return to capital is a multiple, α, of dividends, plus interest, minus the loss of bondholders' purchasing power due to expected inflation, π; and

$$r = \frac{\alpha\, Div + INT - \pi D}{S + D}. \tag{5}$$

The deduction of the inflation loss on debt (a gain to equity holders and the government) is an adjustment made by Corcoran and Sahling on the assumption that it is captured by dividends as an index of expected future equity income.[27] Equation 5 is the specification implemented by Corcoran and Sahling for nonfinancial corporations.

27. This adjustment is explained further below.

Alternatively, equation 5 can be rewritten to express the cost of funds as a weighted average of the return on equity and the return on debt:

$$r = \alpha \frac{Div}{S} \cdot \left(\frac{S}{S+D}\right) + \left(\frac{INT - \pi D}{D}\right) \cdot \left(\frac{D}{S+D}\right). \tag{6}$$

The Federal Reserve uses a modified version of equation 6 by computing a weighted average of the corporate bond rate (i_b) on an after-tax basis and the dividend-price ratio (r_{dp}), and setting $\alpha = 2$:[28]

$$r = \alpha \cdot r_{dp} \cdot w + [(1 - \rho) i_b - \pi] \cdot (1 - w). \tag{7}$$

If the weight (w) equals $S/(S + D)$, equation 7 is identical to equation 6.

The FRB and C-S measures of the cost of capital differ primarily in the estimate of expected inflation that each uses to obtain a measure of the real return on debt. The FRB model uses a three-year average of past actual inflation rates with geometrically declining weights; the C-S version uses a straight five-year average. As a result, the FRB measure of expected inflation declines rapidly with actual inflation after 1980, raising the real cost of debt finance, while the C-S measure hangs at a much higher level. Between 1980 and 1984, the two models show a major discrepancy of 4.5 percentage points in the estimated change in the expected rate of inflation.

Moreover, because the FRB measure of the real cost of debt finance is so much lower than that for equity (which is twice the dividend-price ratio), shifts in the weights used to combine them have a large impact on the final estimate of the cost of capital.[29] The weight assigned by FRB to debt declines from 50 to 23 percent between 1980 and 1984. In C-S the debt share declines less—from 39 to 35 percent over the same period—and the gap between equity and debt cost is smaller. The difference in weights exists because the FRB model attempts to measure marginal rather than average financing costs. The assumption is that at the margin firms shift rapidly away from debt finance when the real rate of interest rises relative to the dividend-price ratio.

28. C-S estimates α as the trend average of the ratio of dividends to current period equity income (after-tax) plus the inflation loss to bondholders. The average value of α is close to the fixed value of 2.0 used in the FRB model, and it is not a significant source of difference.

29. The real payment on debt is not intended to measure the full cost of debt finance, because the issuance of debt imposes greater risk on equity holders and should raise the dividend-price ratio.

There are some interesting conceptual differences between the two models. The C-S study adjusted the debt cost for expected inflation, even though such a correction is not required in equation 4. C-S made the adjustment because it used the term $\alpha \cdot Div$ as an index of expected real equity earnings and needed a true concept of equity income to compute α. FRB goes even further and reflects the tax deductibility of interest as it affects equity income.[30]

If the reduction in the real interest income of bondholders due to inflation is subtracted from the income of debt holders, it must be added to the return of government and of equity holders. Similarly the tax saving from deducting interest expenses accrues to equity holders. The definition of α then becomes

$$\alpha = \frac{PBT + \rho \cdot INT + \pi \cdot D - T}{Div}. \tag{8}$$

C-S makes the adjustment for inflation but not for the tax deduction of interest, and approximates α with a simple time trend. FRB makes both adjustments, but uses a fixed value of α equal to 2.0.

A recent study by George Hatsopoulos provides a further example of the uncertainty surrounding empirical measures of the cost of funds. Hatsopoulos argues that the cost of funds, and thus the rental price of capital, increased dramatically during the 1970s.[31] He focuses on the real cost of equity finance, $\bar{r}$, but uses the same conceptual model of the cost of funds—market value equals the discounted value of expected future income—as B-S-W, FRB, and C-S. Hatsopoulos differs only in that he incorporates an assumption of an expected exponential growth rate, g, for dividends (adjusted for inflation), rather than a notion of "permanent" equity income:[32]

$$S_0 = \int_0^{\infty} e^{-\bar{r}t} \cdot (Div \cdot e^{gt})\, dt. \tag{9}$$

30. The required adjustments can be illustrated as a modification of equation 4:

$$r = \frac{[PBT + \pi D + \rho INT] - T + [INT - \pi D]}{S + D} \tag{4'}$$

31. George N. Hatsopoulos, *High Cost of Capital: Handicap of American Industry* (American Business Conference, Inc., 1983). This study has been widely cited by advocates of further business tax reductions.

32. The computation of g is based on a large set of underlying ratios. See Hatsopoulos, *High Cost of Capital*, appendix C, for the details.

Thus,

$$\bar{r} = \frac{Div}{S} + g, \tag{10}$$

compared with the C-S and FRB formulation of

$$\bar{r} = \alpha \cdot \frac{Div}{S}. \tag{11}$$

Because g is a constant exponential growth rate extending forever into the future, the cost of equity finance is very sensitive to small variations in g and the current dividend-price ratio. Furthermore, the method of computing g makes it relatively independent of variations in the dividend-price ratio. The implicit assumption, therefore, is that a decline in stock market prices reflects a rise in $\bar{r}$ rather than a reduction in investors' expectation of future dividends. In fact, Hatsopoulos's measure of $\bar{r}$ increases more than the rise in the dividend-price ratio over the 1970s, because his estimate of the expected dividend growth rate rises from a low of 1.94 percent in 1969 to 2.86 percent in 1981, a period of severe recession.

All of these models illustrate the extreme difficulty of measuring the cost of funds, an unobserved variable, on the basis of equally unobservable expected future returns. It is doubtful that the static multiplication of current dividends by a historical constant or the computation of a single exponential growth rate for dividends can fully capture the dynamics of investor evaluations of future equity income prospects. The cost of funds is basically an externally determined measure reflecting investment alternatives elsewhere in the economy. The effort to compute it as an internal rate of return makes the result highly dependent upon the method of projecting the future dividend stream.

More interesting is the relationship between the issue of what happened to the cost of funds and the issue of why q, the ratio of the market value of corporations to the replacement cost of their assets, fell so dramatically beginning in 1974. The connection between the two concepts is made evident by restating q as the expected return from physical capital divided by the cost of funds:

$$q = \frac{(\bar{E}/K)}{(\bar{E}/V)}. \tag{12}$$

The B-S-W measure sees the fall in q as a reflection of the change in investor valuation of the income stream, a rise in the cost of funds. By contrast, the C-S version finds little change in the cost of funds, implying that the decline in q must result from a lower productivity of the existing capital stock. Since the FRB version shows a substantial fall in the cost of funds after 1973, it implies an even more dramatic decline in the marginal productivity of capital. On the other hand, the FRB measure of the cost of funds rises sharply in the 1980s, while q remains low, suggesting that the productivity of capital has turned around and now is rising.

The study by Brainard, Shoven, and Weiss is a much more elaborate effort than either C-S or FRB to estimate expected future capital income. However, the structure of the equation used to project earnings excludes the possibility of a major decline in the rate of return on capital, forcing the fall in q to be reflected in a rise in the cost of capital.[33]

The measure of q implied by the market value data used by C-S is shown in table 4. The rise in q during the 1950s and 1960s and its fall during the 1970s closely parallels the course of q found by other researchers.[34] In addition, while the expected return on existing capital is no more measurable than the cost of capital from the financial side, it is possible to calculate the annual before- and after-tax rates of return on capital for nonfinancial corporations. Those measures are also shown on both an actual and a cyclically adjusted basis in table 4.[35]

A simple inspection of the data lends some support to the argument that much of the fluctuation in q can be accounted for by changes in the

33. This restriction is pointed out by the authors. It may be appropriate for their sample of firms, because there is less evidence of a decline in the rate of return on capital for the sample than for the total on nonfinancial corporations. See Brainard, Shoven, and Weiss, "The Financial Valuation," pp. 463–64. However, they did encounter severe measurement problems in constructing the appropriate data on an individual firm basis, and the differences between their measure of the rate of return earned by their sample of 187 firms and that for the total of all nonfinancial corporations may reflect those measurement problems.

34. See Brainard, Shoven, and Weiss, "The Financial Valuation," p. 466.

35. The rate of return is based on capital income data from the national income accounts and the balance sheet data of the Flow of Funds Division of the Board of Governors of the Federal Reserve System. The definition of K includes the replacement value of tangible assets (structures, equipment, and inventories, plus land) and net noninterest-bearing financial assets. The cyclical adjustment is based on a regression relating the rate of return to the utilization of potential GNP and annual changes in GNP as described in Barry P. Bosworth, "Capital Formation and Economic Policy," *BPEA, 2:1982*, p. 292.

Table 4. Financial Variables for Nonfinancial Corporations, 1952–84
Percent unless otherwise specified

			Rate of return			
			Before tax		*After tax*	
Year	*q (ratio)*	*Cost of funds*	*Actual*	*Cyclically adjusted*	*Actual*	*Cyclically adjusted*
1952	0.60	8.3	9.3	8.4	4.0	3.6
1953	0.57	8.5	8.8	7.9	3.6	3.2
1954	0.69	7.4	8.1	9.6	3.9	4.8
1955	0.81	6.6	10.1	9.1	5.0	4.4
1956	0.79	6.8	8.7	8.9	4.0	4.2
1957	0.69	7.0	7.9	8.2	3.8	4.1
1958	0.80	6.5	6.7	8.3	3.4	4.3
1959	0.88	5.6	8.4	7.9	4.4	4.0
1960	0.85	5.8	7.7	8.2	4.1	4.4
1961	1.00	5.2	7.6	8.4	4.1	4.5
1962	0.86	5.8	8.6	8.2	5.1	4.8
1963	1.03	5.6	9.3	9.3	5.5	5.5
1964	1.12	5.4	10.1	9.5	6.2	5.9
1965	1.22	5.4	11.1	10.1	7.0	6.4
1966	0.96	6.0	11.1	9.6	7.0	6.2
1967	1.03	5.7	9.9	9.5	6.4	6.2
1968	1.14	5.5	9.9	8.8	5.9	5.3
1969	0.95	5.7	8.7	8.2	5.1	4.9
1970	0.83	6.4	6.9	7.7	4.2	4.7
1971	0.84	5.4	7.4	7.4	4.6	4.7
1972	0.99	5.0	7.9	7.1	5.0	4.5
1973	0.86	5.3	7.9	6.7	4.8	4.1
1974	0.57	6.6	6.1	7.1	3.3	4.0
1975	0.65	6.5	6.6	8.6	4.3	5.4
1976	0.73	5.8	7.2	7.2	4.4	4.3
1977	0.62	6.2	7.7	7.3	4.9	4.6
1978	0.63	6.8	7.6	7.1	4.8	4.5
1979	0.55	7.4	6.7	6.7	4.1	4.1
1980	0.58	7.9	5.8	7.1	3.6	4.4
1981	0.53	8.3	6.3	6.9	4.4	4.8
1982	0.55	8.8	5.3	7.8	4.1	5.5
1983	0.63	6.9	6.4	7.5	4.9	5.4
1984	0.65	7.9	8.1	7.6	6.3	5.9

Sources: Author's calculations as explained in text based on data from national income and product accounts, table 1.13; Board of Governors of the Federal Reserve System, "Balance Sheets for the U.S. Economy 1945–83"; and unpublished data from the Federal Reserve Bank of New York. The 1984 data are preliminary.

rate of return on capital. The argument is particularly true if we assume that investors, observing the rise of reported earnings in the 1960s and their fall in the 1970s, expected those trends to continue. Between 1965–68 and 1978–79, q declined by about 50 percent. During the same period, the after-tax rate of return (cyclically adjusted) declined about 30 percent—not enough to explain the full decline in q. It would be reasonable, however, to argue that there was some increase in the cost of funds during the 1970s. Higher inflation and other sources of increased economic uncertainty make such an increase likely, and the measure reported by C-S does rise, after all, from an average of 5.6 percent in 1965–68 to 7 percent in 1978–79. The point is that it is not necessary to assume a drastic revision in investor evaluations of capital income prospects in order to account for the decline in q.

This does not help much to determine what actually happened to the cost of funds during the early 1980s. It does, however, suggest extreme caution in the use of some of the current measures in evaluating the change in investment incentives during the period. It is interesting to note, from table 4, that there is no major recovery during the 1980s in either q or the before-tax rate of return on existing assets that would suggest a major change of future capital income prospects. On the other hand, the 1981 tax act did reduce tax liabilities of firms to the point that by 1984 the after-tax return on existing capital had regained the peak level of the mid-1960s. If investors realize, however, that this surge in corporate cash flow is largely a transitory phenomenon related to changes in the timing of depreciation allowances made by the 1981–82 tax changes, there should be no proportionate change in the value of q.

Taxation and Debt Finance

One of the most consistent findings of studies of capital income taxation is that income from structures investments is taxed at a far higher rate than that from equipment. One reason for the higher rate is that equipment investments receive an investment tax credit. Another is that because depreciation allowances are not indexed for inflation, long-lived structures have high effective tax rates. The phenomenon is

evident in table 3: the tax rate on structures is close to 35 percent, whereas many categories of equipment have negative rates of taxation.

In view of this fact, it is puzzling that structures investments are often described as especially good vehicles for tax shelter—implying that they offer greater-than-average tax benefits. Indeed, when the Treasury proposed, in November 1984, to equalize the tax treatment of different assets, it was the real estate industry that opposed the reform most vigorously. Buyers and producers of equipment investments seemed less concerned—citing the advantages of the proposed lower overall tax rates.

One possible resolution of this paradox emerges from a consideration of the influence of debt finance on effective tax rates. By means of a model that combines the provisions of the corporate and the personal income tax codes, Don Fullerton and Yolanda K. Henderson have shown that the effective tax rate on corporate capital income varies from 64 to −85 percent, depending upon the proportion of equity and debt finance.[36] Debt financing imparts a tax subsidy because the firms that deduct interest as an expense have higher marginal tax brackets than the recipients of the interest income.

Studies that compare effective tax rates across assets, however, normally incorporate a common rate of debt finance. What they do not consider is the possibility that some types of assets are inherently more compatible with higher rates of debt finance than are others. If the rate of debt finance were allowed to vary across assets, the distribution of tax burdens would be quite different from that shown in columns 2 and 3 of table 3.

In order to highlight the role of debt finance, it is useful to focus on the investment decision from the perspective of the equity holder.[37] The equity investor has after-tax income equal to the after-tax rental receipts on the project plus depreciation allowances, and expenses of interest and principal repayments on the portion of the asset financed by debt. Nominal interest payments are tax deductible. The debt-equity ratio is assumed to be maintained at a constant proportion, ϕ, of the asset's

36. Fullerton and Henderson, "Incentive Effects of Taxes," pp. 76–77. Their analysis assumes the absence of risk.

37. The basic model is taken from Charles Hulten, "An Analysis of the 167(k) Accelerated Depreciation Program," Working Paper (Urban Institute, May 27, 1983), pp. 13–16. I have made some changes to simplify the presentation.

value over its life. The asset must generate a net income stream that is equal in present value terms to the equity holder's share of its acquisition price:

$$(13) \qquad (1-\phi-k-\rho z)\,P_k = \int_0^{\infty} e^{-(\bar{r}+\delta)s}\,[(1-\rho)\,c\cdot P_q - [(1-\rho)\,i + (\delta-\pi)]\phi P_k]\,ds.$$

The first part of this expression (and the definition of the terms) is the same as that typically used to derive the standard measure of the rental price given in equation 1. The difference lies in the additional after-tax cost to investors of interest and principal repayments, $(1-\rho)i$ and $(\delta - \pi)$, respectively.[38] As an offset to these costs, the present value of the net income must cover only the equity share, $(1-\phi)$, of the purchase price. Finally, the discount rate, $\bar{r}$, has a different interpretation here than in earlier sections of the paper because it applies only to the stream of equity income. For the present, it can be viewed as the after-tax opportunity cost of investment in alternative assets of comparable risk.

The solution of the above expression yields a new definition of the rental price of capital:

$$(14) \qquad c = \frac{P_k}{P_q}\left[(\bar{r}+\delta)\frac{1-\rho z-k}{1-\rho} - \frac{\bar{r}-(1-\rho)\,i+\pi}{1-\rho}\phi\right].$$

The only difference from equation 1 is the addition of the debt finance term. If the asset is all equity financed ($\phi = 0$), the rental price is the same as before. It would also be the same—and there would be no advantage to debt finance—in a world where the after-tax return to equity, $\bar{r}$, and the borrowing rate, $(1-\rho)i-\pi$, are equal.[39]

In general, however, the return to equity will exceed the borrowing rate. If there is initially no debt finance, the equity holders will require a return, $\bar{r}$, that exceeds that of riskless debt, as compensation for assuming the risk of a variable return.[40] In the case of perfect capital markets, that risk premium, α, can be reduced to the limits of the asset's systematic

38. Principal repayments rise with depreciation and fall with the inflation rate.

39. This is the modified Fisher rule of Feldstein-Darby that, in a world with taxes, market interest rates must change more than proportionately with respect to expected inflation.

40. I have ignored any potential differences in the taxation of debt and equity income at the personal income tax level.

risk. As the proportion of debt in the financial structure is increased, equity holders will require a higher return as compensation for the increased risk per dollar of invested capital. In a world without taxes the rise in $\bar{r}$ is just sufficient to offset the effects of debt leverage, and debt finance has no effect on the rental price.[41]

Under present tax law, however, firms can increase the value of the overall project by issuing debt. Since the interest payments are deductible for tax purposes, the government's return is reduced and that of the equity holders increased. The result is that an increase in debt will reduce the required rental price of capital.[42] In fact, as long as firms can borrow at the riskless rate, all investment should be financed with debt. The interaction of the tax law and debt finance does not lead to any one asset being favored over another, however.

Several arguments have been put forth to explain why in practice the optimal financial structure might stop short of all debt finance.[43] All hinge upon the introduction of an additional cost element that is positively related to debt, or it is assumed that risk, and thus the discount rate, rises as a function of debt by more than the pure effect of debt leverage. A common means of doing so is to assume that there is significant risk of bankruptcy proceedings and reorganization, and that the risk of bankruptcy increases with the probability of a negative cash flow.[44]

Bankruptcy risks can be incorporated into the measure of the rental price by the addition, in equation 13, of a term, $\beta f(\phi)$, to the expression for net cash flow. The proportionate loss of asset value that results from

41. This is demonstrable in equation 14 by eliminating the tax parameters and setting $\bar{r} = i + [\alpha/(1 - \phi)] - \pi$. The result simply reflects the Modigliani-Miller theorem that in the absence of taxes the overall riskiness and value of an investment project cannot be altered by changes in its financing.

42. Robert E. Hall, "Tax Treatment of Depreciation, Capital Gains, and Interest in an Inflationary Economy," in Charles R. Hulten, ed., *Depreciation, Inflation, and the Taxation of Income from Capital* (Washington, D.C., Urban Institute Press, 1981), pp. 161–66.

43. For a summary see Alan Auerbach, "Taxation, Corporate Financial Policy, and the Cost of Capital," *Journal of Economic Literature*, vol. 21 (September 1983), pp. 905–40. The relationship between debt finance and risk is discussed in Roger H. Gordon and Burton G. Malkiel, "Corporation Finance," in Henry J. Aaron and Joseph A. Pechman, eds., *How Taxes Affect Economic Behavior* (Brookings Institution, 1981), pp. 131–92.

44. Joseph E. Stiglitz, "Taxation, Corporate Financial Policy, and the Cost of Capital," *Journal of Public Economics*, vol. 2 (February 1973), pp. 1–34; Gordon and Malkiel, "Corporation Finance."

bankruptcy is measured by β; $f(\phi)$ is the expectation of such an event. The net rental price is

$$(15) \quad c = \frac{P_k}{P_q}\left[(\bar{r}+\delta)\frac{(1-\rho z-k)}{1-\rho} - \frac{\bar{r}-(1-\rho)\,i+\pi}{1-\rho}\phi + \frac{\beta f(\phi)}{1-\rho}\right].$$

A simplified version of equation 15 that illustrates the role of bankruptcy costs is obtained by assuming that tax depreciation equals economic depreciation so that $z = \delta/(\bar{r}+\delta)$, that there is no investment tax credit, and that the relative price of capital is unity. Furthermore, with full capital market diversification, the required return to equity holders is simply

$$\bar{r} = i + \frac{\alpha}{1-\phi} - \pi.$$

Thus,

$$(15') \quad c = \frac{(1-\rho\phi)\,i - \pi + \alpha}{1-\rho} + \delta + \frac{\beta f(\phi)}{1-\rho}.$$

The effects of a marginal increase in debt finance is shown by differentiating equation 15′ with respect to ϕ:

$$(16) \quad \frac{\partial c}{\partial \phi} = \frac{-\rho i}{1-\rho} - \frac{\rho\phi}{1-\rho}\frac{\partial i}{\partial \phi} + \frac{\beta f'(\phi)}{1-\rho}.$$

The first term represents the tax benefits of borrowing. It is also possible, as represented by the second term, that the borrowing rate will rise because lenders no longer believe that they are fully protected against risk. In that case, the investor loses the advantage of a widening financial margin, and the rental price of capital increases with debt finance; thus the model admits the possibility of an optimal degree of debt leverage short of unity. The issue of lender risk is closely connected with bankruptcy risk, however, so the third term is more interesting.

The inclusion of bankruptcy costs implies that the optimal degree of leverage depends both upon the actual costs of bankruptcy and upon the extent to which its probability is an increasing function of the leverage ratio. An increase in contractual payments to the bondholders increases the probability of bankruptcy because it reduces the firm's net cash flow. The probability will also differ among assets depending upon the variance of the expected income stream. Since that variance can be reduced through diversification, however, the probability is probably best thought of as a characteristic of the firm rather than the asset.

Whatever the probability of bankruptcy, its actual cost will still vary among assets depending upon the quality of the available resale markets. If the remaining value of the asset's income stream can be easily sold, the costs of bankruptcy should be limited to legal and administrative fees. Thus, bankruptcy costs should impose a relatively minor limitation on debt finance for assets such as commercial real estate, automobiles, and aircraft, which have active resale markets with considerable depth. Other assets, however, are tailored to the specific uses of their current owners and have few alternative uses—implying a very limited resale market. They take on the risk characteristics of the firm as a whole.

The rental cost is minimized when the marginal costs of bankruptcy equal the tax benefits of another increment of debt, ρi. If equation 16 is set equal to zero and $\delta i/\delta\phi = 0$,

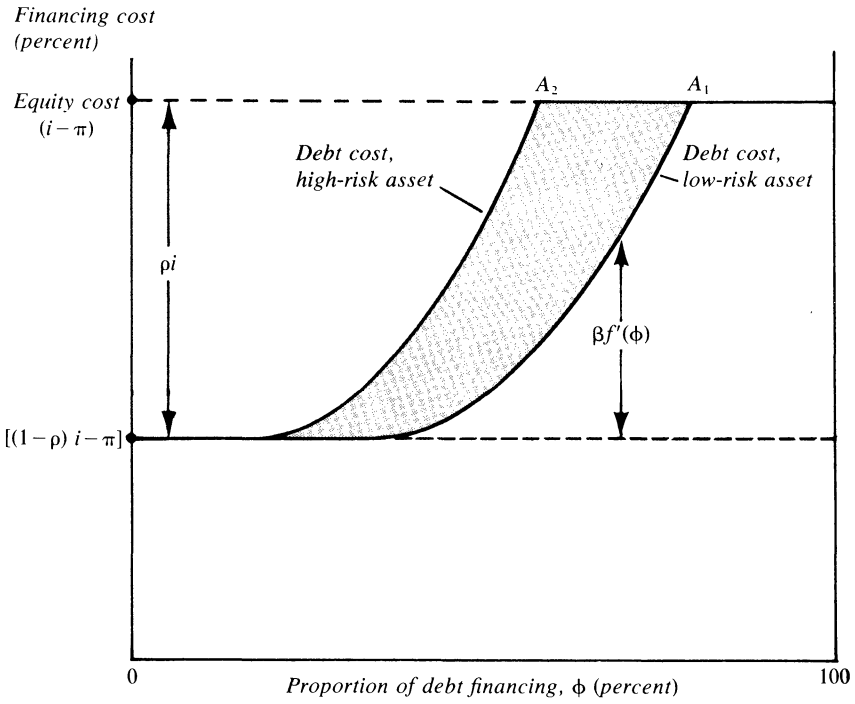
$$\beta f'(\phi) = \rho i. \tag{17}$$

This balancing of the marginal costs and benefits is shown in figure 2 for two assets that differ in their bankruptcy costs. There will be an initial range of debt finance that will have no appreciable effect on the probability of default. After that point the firms will pursue debt financing until the increasing marginal costs of bankruptcy are equal to the tax wedge between the risk-adjusted return on equity and debt finance; this occurs at points A_1 and A_2 in the figure. While the costs and benefits will be equated at the margin, there will be inframarginal benefits, represented in the figure by the area between the cost of equity finance and the marginal costs of debt finance. The differential advantage of the asset with low bankruptcy costs is represented by the shaded area.

The magnitude of those inframarginal returns can be substantial. For example, assume investors require a real return of 4 percent on equity and 2 percent on riskless bonds, and that the inflation rate is 4 percent. At a tax rate of 50 percent, a 10 percentage point differential in the leverage rate between two assets would translate into a 3 percent reduction in the rental price for office equipment, which has a high rate of depreciation, but a 12 percent reduction for commercial structures. It would cut the effective tax rate on an asset such as commercial buildings by 12 percentage points.[45]

45. A risk differential of 2 percentage points is the average value reported in Brainard, Shoven, and Weiss, "The Financial Valuation," p. 482. In addition, there were periods in the 1970s when very low implicit real interest rates in markets implied a larger return to leverage.

Figure 2. Marginal Costs and Benefits of Debt Finance



Even if the marginal costs of bankruptcy are assumed to rise linearly from the point of zero debt to the optimal debt ratio (A_1 and A_2 in figure 2), the net reduction (tax saving minus increased bankruptcy risk) in the rental price would be cut by only 50 percent. Data are not available to compute the leverage ratio, ϕ, on either an asset or industry basis. A rough estimate of the potential range of differences, however, can be found by computing the share of net interest payments in capital income (interest, profits, and proprietor income) at the industry level. Such a computation understates the level of ϕ by failing to adjust for differences in rates of return between debt and equity. Still, differences in the reliance on debt finance are substantial. The share of income going to bondholders varies from a low of 10 percent in manufacturing and services to a high of 70 percent in real estate. Industries such as mining, communications, and transportation are in an intermediate range of 30 percent.

Generally, the finance literature has emphasized the link between debt leverage and the variability and risk associated with a firm's potential

earnings. It has given less consideration to the influence of asset-specific factors such as the depth of resale markets. Differences among assets in the optimal degree of debt finance would exist even in the absence of taxes. As a result, it can be highly misleading to evaluate the relative burden of a tax system that rewards debt finance under the assumption of equal rates of debt leverage across firms and assets.[46]

Summary

The major finding of this paper is that there is room for doubt about the role of the 1981–82 tax reduction in the recovery of business investment in 1983–84. Total investment has increased substantially since the recession, but the expansion has been far more uneven than generally recognized: more than 90 percent of the growth in business investment since 1979 is due to a rise in outlays for office equipment, business automobiles, and commercial structures.

I found no correlation between the growth in specific categories of investment and the relative magnitude of tax reduction by asset. For example, there was no significant tax reduction for either automobiles or computers; and spending on commercial buildings rose while investment in industrial structures declined, although both had equally large tax reductions. One reason why the 1981–82 tax cut had so little effect is that it produced a smaller overall reduction in effective tax rates on capital income than is generally thought. The liberalization of depreciation allowances greatly increases corporate cash flow in the short run, but it has a smaller effect on the price of an asset over its lifetime.

The absence of any correlation between changes in investment and changes in tax rates need not imply that the neoclassical model of investment behavior is wrong in its focus on changes in the price of capital. When measures of changes in the rental price of capital between 1980 and 1984 include acquisition prices and the cost of funds, they show a significant correlation with the pattern of investment growth. Taxes are often simply outweighed as a determinant of the rental price of capital by changes in acquisition prices and the cost of funds.

46. It is also interesting to note that if high debt leverage is more compatible with low risk assets, the interest deduction feature of the corporate tax may act to discourage investment in high risk assets.

It is virtually impossible at the empirical level to reach a conclusion as to whether incentives for investment have increased during the early 1980s. There is too much uncertainty about the direction, much less the magnitude, of change in the cost of funds. The vexed issue of financing costs, however, cannot be divorced from the evaluation of the effects of the 1981–82 tax act on investment. The tax reduction contributed to the current federal budget deficit and is, in part, responsible for the rise in market interest rates.

Finally, the explanation for the lack of correlation between changes in the pattern of investment and changes in relative tax rates may be that the tax rate measures are wrong. Specifically, the commonly cited calculations of relative tax burdens ignore variations by asset in the reliance on debt financing. It is, however, demonstrable that some types of assets—those with low variance of future incomes and well-developed resale markets—are inherently more compatible than others with a high degree of debt leverage, and that the use of debt finance for such assets provides tax benefits. On the basis of plausible parameters it is possible to conclude that assets such as commercial real estate have low or even negative rates of taxation, even though the standard conclusion of the investment literature is that they are heavily taxed. That standard conclusion seems more appropriate for assets such as industrial structures, which have a limited value in resale markets.

In recent years economists have directed considerable attention to distortions in the allocation of capital induced by differential rates of taxation among assets.[47] The tax system has become so complex that the interaction of provisions intended to promote certain activities may result in far different outcomes in practice. The effort to create a simpler, more uniform structure of capital income taxation should be a major objective of future reform efforts. The findings of this paper make it clear that the short-term incentive effects of tax changes are relatively small and frequently overwhelmed by other developments. If the tax system is to encourage efficiency, it must be made to do so over the long haul.

47. Many of the issues raised by a consideration of alternative financial arrangements in evaluating capital income taxation are discussed in C. Eugene Steuerle, *Taxes, Loans, and Inflation: How the Nation's Wealth Becomes Misallocated* (Brookings, 1985).

APPENDIX

Data Sources

THIS APPENDIX describes data sources and presents two tables. Table A-1 shows tax parameters by assets, and table A-2 displays regression equations for investment by assets.

The calculation of the rental price of capital required tax information by asset category for both 1980 and 1982. The calculation for 1982 was quite simple because the 1981–82 tax act reduced the number of possible asset categories to four (assets with three-, five-, ten-, and fifteen-year service lives) and specified an annual schedule of depreciation for each category. Since some of the asset groupings used in the national income accounts span two tax categories, it was necessary to compute weighted averages.

The calculation for 1980 was a different matter. Under the asset depreciation range (ADR) system, firms were allowed to group relatively heterogeneous assets and apply a common depreciation schedule. Thus, actual service lives varied depending upon the industry in which the asset was used. There are three published estimates of service lives by asset; all differ in the interpretation of the data.[48] In addition, firms were influenced in their choice of the service life to use in computing depreciation by the fact that longer-lived equipment received a larger investment tax credit. Thus, they had to choose a combination that minimized their tax liability. In individual cases the discrepancies between the three sources are quite substantial. In general, Fullerton and Henderson used longer tax service lives in 1980 and shorter lives in 1982, maximizing the impact of the 1981–82 tax changes. The data from Jane Gravelle and Robert Lucke are in close agreement. The tax measures used in the text are based largely on the series from Lucke and are shown in table A-1. The choice of a specific series, however, does not significantly affect the analysis reported in the text. The measures of economic depreciation are from a study by Charles R. Hulten and Frank C. Wykoff.[49]

48. One set, based on work by Jorgensen and Sullivan, was published in Fullerton and Henderson, "Incentive Effects of Taxes," p. 57. A second set was reported in Gravelle, "Effects of the 1981 Depreciation Revisions," p. 8. The third series was obtained from Robert Lucke, of the Congressional Budget Office.

49. The specific series was taken from Fullerton and Henderson, "Incentive Effects of Taxes," p. 57.

Table A-1. Tax Parameters by Asset Category

Asset category	*Depreciation rate*	*1980 law*		*1982 law*	
		Service life	*Investment tax credit*	*Service life*	*Investment tax credit*
Furniture	0.110	8.0	0.100	5.0	0.100
Fabricated metals	0.092	13.7	0.100	8.0	0.100
Engines and turbines	0.079	19.2	0.100	10.0	0.100
Construction tractors	0.163	8.1	0.090	5.0	0.100
Agricultural machinery	0.097	8.0	0.100	5.0	0.100
Construction equipment	0.172	7.0	0.100	5.0	0.100
Mining equipment	0.165	9.8	0.100	5.0	0.100
Metalworking machinery	0.123	9.4	0.100	5.0	0.100
Special industrial machinery	0.103	8.7	0.100	4.8	0.090
General industrial machinery	0.123	11.1	0.100	6.1	0.100
Office equipment	0.273	7.0	0.100	5.0	0.100
Service industry equipment	0.165	8.2	0.100	5.2	0.100
Communications and electrical	0.118	12.6	0.100	7.3	0.100
Trucks and buses	0.254	5.0	0.067	4.4	0.088
Business automobiles	0.333	3.0	0.033	3.0	0.060
Aircraft	0.183	9.2	0.100	5.0	0.100
Ships and boats	0.075	15.6	0.100	5.0	0.100
Railroad equipment	0.066	11.0	0.100	5.0	0.100
Instruments	0.150	11.4	0.100	6.7	0.100
Other equipment	0.150	8.7	0.100	5.0	0.100
Industrial structures	0.033	35.0	0.000	15.0	0.000
Commercial structures	0.023	35.0	0.000	15.0	0.000

Source: Author's calculations from data supplied by Charles R. Hulten, of the Urban Institute, and Robert Lucke, of the Congressional Budget Office.

Table A-2. Regression Equations for Investment by Asset and Changes in the Rental Price of Capital by Asset

Source of change in rental price	*Constant*	*Rental price coefficient*	R^2	*F statistic*
		Full sample (22 cases)		
Taxes	0.07	−0.07	0.04	−0.70
Acquisition price	0.28	−0.30	0.57	26.65
Rental price-1[a]	0.13	−0.14	0.31	9.08
Rental price-2[b]	0.25	−0.24	0.47	17.53
		Restricted sample (16 cases)		
Taxes	0.02	−0.01	0.01	0.25
Acquisition price	0.35	−0.36	0.68	29.21
Rental price-1[a]	0.15	−0.18	0.35	7.63
Rental price-2[b]	0.27	−0.25	0.48	12.75

Source: Equations based on data in table 3. Regressions are weighted by the net capital stock. The restricted sample excludes fabricated metals, turbines, agriculture machinery, tractors, mining machinery, and communications and electrical equipment.

a. Includes combined effect of taxes and acquisition price changes.

b. Includes two percentage point increase in cost of funds.

In computing the present value of depreciation allowances in 1980, I assumed that firms used an optimal combination of double-declining balance and sum-of-the-years digits for equipment, and a combination of 150 percent of declining balance and straight-line depreciation for structures.[50] The schedules under 1982 law are those published by the Treasury Department.[51]

50. The formulas were taken from Don Fullerton and Yolanda Henderson, "Long-Run Effects of the Accelerated Cost Recovery System," Working Paper 828 (National Bureau of Economic Research, 1981).

51. The schedules were taken from Joint Committee on Taxation, *General Explanation of the Economic Recovery Act of 1981*, 97 Cong. 1 sess. (GPO, 1981), pp. 80–84.

Comments and Discussion

John B. Shoven: Barry Bosworth's paper offers a challenge to those who argue that the 1981 business tax cuts are the cause of the strength in business investment in the 1982–84 economic expansion. It confirms that the growth in investment has indeed been unusually great, a fact that is consistent with the tax cut hypothesis. In fact, Bosworth shows that the growth in GNP in the period 1982–84 was normal for the first two years of a recovery, whereas the growth in producer durable equipment was more than twice as great as usual. Actually, capacity utilization has recovered more slowly than usual, so investment-per-unit recovery may be even more impressive than the paper indicates. The composition of the growth in investment, however, is inconsistent with the pattern of the cuts in effective marginal tax rates. Office equipment (computers) and business automobiles have been especially strong in this recovery, and have accounted for an astounding 93 percent of the growth of investment in all producers' durable equipment since 1979. These two categories of investment, however, did not benefit from large tax cuts in 1981 and 1982. In fact, the marginal tax rate on investment in computers actually increased, while that on autos fell, but only by 1.4 percent.

The evidence certainly does seem inconsistent with the idea of a tax-cut-driven investment boom. There are, however, definitional problems. Whether the purchase of a car shows up as a business investment or as the acquisition of a consumer durable by a household depends on the financing arrangement. The problem is that leasing a car is a very close substitute for financing it through a bank or a dealer. Investment statistics, however, treat leasing as very different from the other financing alternatives. With a lease, the car shows up as a business investment on the part of the leasing company, which can take advantage of the

investment tax credit and accelerated depreciation. I have the impression that leasing has been gaining in popularity, possibly because of the lower monthly payments typically offered in leasing, or possibly because of the tax treatment of leasing. The paper mentions this definitional problem but does not offer any statistics to help the reader to assess its importance.

The related problem with office equipment is that home computers are included in the figures. Again, what is often a consumer durable shows up as a business investment. How significantly this distorts the business numbers is again not easily determined, but clearly home computers have enjoyed an extraordinary growth in demand in the past five years.

Anytime you look at the two leading sectors in a category, there will be some special explanations. A look at the weakest category in business producers' durable investment could tell a different story. For example, investment in oil and gas drilling equipment has fallen sharply since 1979–80 for well-known reasons. In 1983, investment in mining industries was down by about 24 percent while the economy was recovering. Emphasizing the sharp fall in mining investment would leave one more impressed with the strength of business investment other than office equipment and autos. Even so, the tax cut hypothesis would fare no better, for the taxation of mining equipment was reduced in 1981 and 1982.

Bosworth emphasizes that the rental price of capital depends on the acquisition cost of the capital and the financial cost of funds, as well as on taxes. In fact, he makes a good case that the nontax factors may have changed more in recent years than have tax considerations. In general, the relative cost of capital goods has declined. The two categories of investment that grew the most, office equipment and autos, had the largest acquisition price declines, resulting in a relatively large fall in the rental cost of capital for these items. What has happened to the financial cost of funds is harder to gauge. This cost, which is the internal rate of return that equates the after-corporate-tax earnings of stockholders and bondholders with the value of the firm, is not directly observable. It depends on the future course of corporate earnings, which must be forecast in order to generate a measure of the cost of funds. Bosworth effectively emphasizes the inherent difficulty and arbitrariness of such measures by reviewing four studies that attempt to measure the cost of funds, each getting significantly different results. I, of course, have a

personal interest in one of those measures, the Brainard-Shoven-Weiss figures, and want to register an objection to his statement that our results precluded the possibility of a major decline in the real rate of return to capital.[1] In fact, we calculated the cost of funds using ten different models of earnings forecasting (including perfect foresight) and found our conclusion of a sharply rising cost of funds quite robust to model choice.

The last part of Bosworth's paper introduces a promising line of research. Recent studies have shown that debt-financed investment faces a much lower, and usually negative, rate of taxation when both the personal and corporate tax are considered. Bosworth raises the question whether the fact that he could establish no correlation between the corporate tax rate by asset category and investment may reflect the fact that some assets are more easily financed with debt than others. It is plausible that business automobiles, for instance, can be nearly 100 percent debt financed by firms. After all, they are regularly financed with very high leverage ratios by households. Office equipment may also have a reasonable used market and, therefore, may offer good collateral for debt financing. I think this line of reasoning is interesting and sound, and it may lead to lower estimates of the effective rate of taxation facing auto and office equipment investments. However, I doubt that it will salvage the line of argument that the investment boom is driven by tax cuts. The problem is that the debt carrying capacity argument, if valid, was also valid before the tax changes. It does not automatically follow that the 1981 and 1982 tax cuts actually reduced taxes for these items more than the earlier analysis suggested, only that the rate may have been lower, both before and after the changes in the tax law. Still, this section of Bosworth's paper offers a new insight into the calculation of taxation across asset types, and it is sure to spur further research.

The strength of the recovery in terms of investment is welcome news for the economy. Bosworth's paper suggests that it may have been only a lucky coincidence for those who advocated stimulating investment by means of tax breaks. Investment has boomed all right, only not so much in the areas where the stimulation was applied.

1. William C. Brainard, John B. Shoven, and Laurence Weiss, "The Financial Valuation of the Return to Capital," *BPEA, 2:1980,* pp. 453–502.

Lawrence H. Summers: Barry Bosworth's valuable paper assesses the current investment boom in the United States. Bosworth's focus is on the composition of investment and on the role of tax policy in explaining the recent behavior of investment. His conclusions are rather surprising. He confirms the widespread belief that investment has been unusually strong over the past several years, but rejects the obvious suspect—the 1981 Economic Recovery Tax Act reforms. His finding, if accepted, has important implications for the current tax reform debate, since increased capital formation is a crucial goal of competing policy alternatives.

Bosworth begins by documenting the abnormal strength of investment during the recent recovery. The strength of investment is especially surprising, given the size of federal budget deficits, the extraordinarily high level of real interest rates, and the drastic reduction in American competitiveness caused by the strength of the dollar. Bosworth notes that the lion's share of the growth in business investment has occurred in office equipment and automobiles. His emphasis on these categories of investment should not blind us to the resilience of other categories in the face of what we would have expected to be very adverse conditions. Anyone asked to predict the effect on investment of budget deficits exceeding 5 percent of GNP and real interest rates in the 5 percent range would surely have predicted a dramatic slowdown in most types of capital spending.

Much of the paper's analysis is concerned with isolating the role of changes in the cost of capital in explaining the behavior of investment. Bosworth properly stresses that the cost of capital depends critically on the cost of funds and the acquisition price of new capital goods as well as on tax policy variables. He examines a number of cost-of-capital measures proposed by various economists and notes that they vary widely. And he stresses that changes in the cost of funds seem to have had a much larger effect on the cost of capital than have variations in tax policy.

Bosworth's analysis is misleading in an important respect. The measures of the cost of capital that he surveys all rely heavily on the stock market as a measure of the cost of equity funds. Increases in the stock market reduce the measured cost of funds, regardless of their source. It seems plausible to expect that tax reductions such as those enacted in 1981, which would increase corporate cash flow by greater and greater amounts, would raise stock market values and price-earnings

ratios. Bosworth ascribes this effect to the cost of funds and gives no credit to tax policy. Nor does he treat the increase in the present value of depreciation allowances attributable to interest rate reductions over the past several years as part of the "tax policy component" of the cost of capital.

Aggregate information therefore does not cast much doubt on the hypothesis that the 1981 tax reforms served their intended purpose of substantially stimulating business investment. The centerpiece of Bosworth's paper is a cross-sectional analysis of this proposition. He attempts to correlate the "noncyclical" component of investment in different asset categories with the corresponding change in the effective tax rate. He finds essentially no correlation, in large part, perhaps, because the effective tax rate on office equipment and automobiles, two assets in which investment rose sharply, was not much affected by the 1981 act. He does, however, find some correlation of changes in investment with movements in the cost of capital for different types of investment. Because this correlation reflects the behavior of price indexes for new capital goods, including computers that are normalized to have a constant nominal price, it is not clear what to make of it.

I wonder if the finding that effective tax rates and investment performance are uncorrelated across asset types does not say more about economists' measures of effective tax rates than it does about the investment process. Since capital goods are, in general, substitutes or complements, the effective taxation of one type of capital good depends on the taxation of other types of capital goods. Standard effective tax rate measures take no account of the risk associated with different types of capital goods. As Jeremy Bulow and I demonstrated, this can make a substantial difference in calculations of interasset neutrality.[1] The standard calculations on which Bosworth relies also neglect the possibility that assets may be depreciated more than once if they are resold. Bosworth emphasizes what is probably the most important problem with standard measures—their failure to reflect the differential ability of assets to carry debt. Given all these difficulties, Bosworth's failure to find a cross-sectional relationship between investment and effective tax rates cannot be taken as evidence minimizing the role of tax policy in determining investment decisions.

1. Jeremy I. Bulow and Lawrence H. Summers, "The Taxation of Risky Assets," *Journal of Political Economy*, vol. 92 (February 1984), pp. 20–39.

In concluding his paper, Bosworth urges that tax reform efforts concentrate on improving the long-term efficiency of the tax system by increasing neutrality, rather than on providing short-term stimulus to investment. This was not the direction taken in 1981. It is the direction taken in the current administration tax proposal and in the Bradley-Gephardt tax reform bill.

The evidence in Bosworth's paper seems to me to support the opposite conclusion. Achieving neutrality requires an ability to measure tax burdens on different types of capital assets. Bosworth shows that the best measures available to economists and policymakers at present have essentially nothing to do with actual investment. Striving for neutrality based on these measures does not seem an important priority. On the other hand, the dramatic increases in cash flow and the strong stock market that followed the 1981 reforms have coincided with strong investment performance in an environment hostile to investment in many respects. We do understand how to use tax policy successfully to stimulate overall investment. It would be well to stick with this objective.

General Discussion

From Barry Bosworth's findings, Harvey Galper concluded that it was important to seek debt neutrality as well as depreciation neutrality in the tax system. He noted that several provisions of the original Treasury tax reform proposals offered in November 1984 attempted to deal with the distortions arising from the present tax treatment of interest: indexing of interest costs; limiting the use of interest expense to offset some individual income; extending this limitation to passive partnerships by passing their interest expenses through to individuals; and applying "at risk" rules to real estate similar to those that now apply to equipment. Joseph Pechman agreed with Galper and pointed out that the investment distortions appear to be very large: between 1980 and 1984, industrial construction was virtually unchanged, while commercial construction, which is a favored tax shelter in the present system, rose by nearly 70 percent. Robert Hall reasoned that the distortions from debt financing arose largely because interest is taxed when received rather than when paid. Because the U.S. tax system makes it easy to avoid paying tax on interest received, borrowing is effectively subsidized. Hall suggested taxing all interest income when paid as a way to remove that distortion.

Christopher Sims questioned whether borrowing could be identified with particular assets. Although there are instances in which a firm exists to invest in a particular class of asset, usually as part of a tax shelter that depends on reselling for capital gains, in the more typical case, a firm invests in a whole array of assets associated with its business. In such a case, the firm's ability to borrow depends on its overall creditworthiness and is not closely associated with any particular asset it is buying. Bosworth reasoned that the existence of a good resale market for some types of assets makes them separable because they can be pledged as collateral in order to obtain better borrowing terms. He agreed that for assets with poor resale markets, the firm rather than the asset may be the relevant unit for assessing borrowing risk. Martin Feldstein added that investment decisions such as the building of a plant involve equipment as well. The rate of return on that bundle of plant and equipment determines investment, so that the investment decision cannot be disaggregated by individual assets. This would help explain why industrial structures, which are filled with equipment when built, did not experience the same post-tax-cut boom as did commercial structures, even though the rental price of both declined by the same amount.

Benjamin Friedman related Bosworth's difficulty in explaining investment with rate-of-return variables to the ongoing debate over how to model cyclical variations in investment. He noted that both real accelerator variables and financial quantities such as profits and cash flow typically dominate rate-of-return variables in explaining business investment.