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Investment, Tax Policy and the Tax Reform Act of 1986

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1. Introduction

The Tax Reform Act of 1986 shifted the U.S. tax burden from households to businesses while raising the overall tax burden facing new investment (Auerbach 1987). The tax burden on different types of investment also shifted. The repeal of the investment tax credit caused the effective tax rate on new equipment to rise, while the corresponding rate on business structures not qualifying for the investment tax credit fell, as the corporate rate reduction outweighed the impact of longer depreciation lifetimes.

These tax changes led many observers to predict that business fixed investment, especially investment in machinery and equipment, would suffer in the years that followed. However, a first glance at recent investment behavior suggests that such predictions failed to materialize. The continuing strength of the U.S. economy during the late 1980s was attributable in part to strong nonresidential investment, with equipment investment leading the way. This immediately suggests a problem for those who would attempt to explain investment behavior primarily in terms of responses to changes in fiscal policy.

Such difficulties have been recognized in the past. For example, Bosworth (1985) notes that the investment recovery following the recession of 1981-3, attributed by some to the Economic Recovery Tax Act of 1981, was led by investment in information processing equipment and automobiles, assets that did not benefit particularly from the 1981 changes.

Though it is a mistake to believe that fiscal policies largely determine the pattern of investment, one should not necessarily conclude that fiscal policy is entirely impotent in this area, either. Given the volatility of investment behavior, tax changes could significantly affect investment without such effects being discernable from an examination of overall trends. Detection of such effects requires a model of investment behavior that controls for influences other than taxes, so that one may estimate the marginal effects that tax policies have had. We use such a model in this paper, based on the theory of forward-looking investment behavior.

Our model suggests that tax factors have influenced business fixed investment during the postwar period, but that other factors, such as the profitability of investment and the real cost of funds, have played a significant role as well. It is also true, however, that much of the variation in investment cannot easily be explained statistically. Based on our analysis, we reach the following conclusions:

1. During the postwar years, tax factors have altered the pattern of U.S. fixed investment, particularly in machinery and equipment;

2. Before the Tax Reform Act of 1986, changes in taxation did not stabilize investment;

3. Aggregate equipment investment in 1986-7 was generally consistent with the model's predictions, as nontax factors outweighed the effects of the 1986 tax changes. However,

equipment investment was stronger than predicted in 1988, and investment in nonresidential structures for the entire period 1986-88 weaker.

4. The growth in equipment investment during 1986 and 1987 can be fully explained by the 47 percent increase in expenditures on Office, Computing and Accounting Machinery, suggesting an important role for technological explanations of the recent performance of investment. The surge in 1988, however, was due in part to growth in other sectors as well.

We begin our analysis with a brief review of investment behavior during the past three decades. Section 3 sketches the model we use to estimate the effects of profitability, financial costs and taxes on investment behavior and discusses the historical movements in each of these factors, showing how tax policy has influenced the overall incentive to invest over time. Using estimates of the impact of the sensitivity of investment to the cost of capital, we calculate in Section 4 the impact that tax incentives have had over time on investment, prior to the Tax Reform Act of 1986.

In Section 5, we turn our analysis to the Tax Reform Act of 1986, discussing the relevant provisions of the act. Section 6 reviews the past few years' investment performance, considering how the incentive to invest and investment behavior itself might have looked had the Tax Reform Act of 1986 not been enacted. In our concluding comments, we discuss some of the limitations of

the analysis and suggest other channels through which fiscal policy might affect investment beyond those considered here.

2. Postwar Investment Behavior

Table 1 presents statistics on U.S. nonresidential fixed investment during the past three decades, expressed in relation both to gross national product (GNP) and net capital stock estimates for equipment and structures.[1]

The patterns of behavior are different for the two investment aggregates. Expressed as a fraction of the capital stock, equipment investment has had two periods of weakness, from the late '50s through the early '60s, and briefly during the early 1980s. Equipment investment was especially strong during the late '60s, and again during the expansion of the late 1970s. Investment in structures, like that in equipment, strengthened in the mid-1960s. However, unlike investment, its performance was relatively weak in the late 1970s and relatively strong in the early 1980s. Perhaps the most striking difference between the two investment series has been seen during the past few years. While equipment investment has, in each year, exceeded its average of the past three decades, investment in structures has experienced its three lowest annual levels (relative to the capital stock) during the entire period!

Relative to output, rather than capital, each investment series appears to have an upward trend, reflecting the increasing capital-output ratio over the period. However, there are few

significant differences in the discernable patterns of investment.

3. Determinants of the Incentive to Invest

Given that tax policy shifted in favor of structures in 1986, it is immediately evident that one cannot explain the past few years' investment pattern with tax factors alone. Given the historical volatility of investment, however, a more relevant question is whether the act's influence was at all significant. To answer this question, we need a model that measures the impact of taxes, as well as other economic factors, on investment.

At least since the work of Jorgenson (1963), there has been a tension between the restrictions theory imposes on models of investment behavior and the difficulty of explaining investment behavior very well with such rigorous structural models. For example, a recent statistical evaluation of competing models of investment behavior by Bernanke, Bohn and Reiss (1988) found that naive, atheoretical models performed as well as models suggested by economic reasoning. In particular, variables not predicted by theory to matter, such as output, have a statistically significant effect on investment. In addition, the models' parameter estimates have been found to be quite sensitive to small changes in specification (Chirinko 1986).

Unfortunately, a structural model, in which the coefficients of policy variables may be interpreted as the partial effects of such variables on investment, is necessary if one is to perform

the sort of policy analysis done in this paper. In view of this, and informed by the failures of previous structural modelling attempts, we adopt the approach developed in Auerbach and Hassett (1989), which provides a theoretical justification for inclusion of explanatory variables typically found to influence investment while at the same time incorporating these determinants in a structural framework that can be used to study the effects of policy. Moreover, we consider alternative specifications to help ensure that our conclusions are not misleading.

The model we use is based on the assumption of forward-looking investment behavior by value-maximizing firms that are motivated by adjustment costs to smooth their capital expenditures over time. This behavior leads to a decision rule for investment that predicts that the ratio of current investment to the existing stock of capital should be determined by the present and expected future values of a composite term that is based on the various factors influencing both the cost of capital and the after-tax profitability of investment. Increases in this term, which we will call c, might be associated with increases in the costs of investment or declines in the cash flow such investment generates; either should decrease investment. One may view the term c as a comprehensive measure of the cost to the firm of a unit of capital services, controlling for fluctuations in productivity. The expression for c has five main determinants:

1. the price of investment goods, relative to the price at which firms can sell their output, g; the higher this ratio, the less attractive is investment;
2. the real cost of funds to the firm, expressed as a weighted average of the costs of equity and debt, r; increases make investment more expensive to finance;
3. the productivity of capital, θ; this may fluctuate, due in part to business cycle factors; decreases in productivity should discourage investment;
4. the tax treatment of investment; a higher marginal tax burden on the income from newly purchased capital should discourage investment; and
5. the rate of capital depreciation, δ; the higher this rate, the more expensive it is to use capital in production.

The formula for c is[2]:

$$(1) \qquad c = \frac{g(r + \delta)(1 - \Gamma)}{\theta(1 - \tau)}$$

where Γ is equal to the present value of after-tax depreciation allowances and investment credits received per dollar of capital purchased and τ is the corporate tax rate. The definitions of g, δ, and τ are straightforward. The terms r, θ and Γ require some further discussion.

A. The real cost of funds, r

Firms finance their investments using a mix of debt and equity. It is therefore logical to use some weighted average of the costs of debt and equity in computing the overall cost of funds for new investment. Using such a weighted average, rather than a simple interest rate or some constant assumed rate of return, is quite important given the gap between debt and equity returns and their potential to move independently because of such influence as individual taxes and risk.

Once one knows a firm's risk class, it is relatively straightforward to estimate the relevant interest rate associated with debt finance. We multiply this interest rate by the factor $(1-\tau)$ to account for the deductibility of interest payments by business borrowers.

Computation of an equity cost of capital is considerably more difficult, because we do not observe expected rates of return on equity the way we observe interest rates on bonds. There are a variety of possible proxies for the unobservable expected return to equity, and we have considered two in our research. One is the expected earnings-price ratio for the firm, after taxes and corrected for the capital consumption and inventory valuation adjustments. The other is the expected return to equity in the market, equal to the dividend yield plus rate of capital gain on shares. The latter is a more direct measure of the cost of equity funds, but more difficult to compute. In our empirical investigation, we experimented with

both definitions.[3] Because the results were generally similar, we report only those based on the earnings-price definition in order to conserve space.

A final issue in the computation of r concerns the inflation rate. Since we are interested in the real cost of funds, we must subtract an appropriate inflation rate from the weighted average of nominal required returns to debt and equity. In this context, such an inflation rate equals the rate of increase in the effective price of investment goods. This price has two components. The first is a general price level, which we represent using the GNP deflator. The second is the out-of-pocket cost per dollar of capital expenditures, Γ, which accounts for the effective price reduction provided by investment incentives. The full inflation rate is the sum of the rates of increase of these two components.

B. <u>The productivity of capital, θ</u>

An important determinant of an investment's attractiveness is the additional cash flow such an investment would generate. Like the expected return to equity, this marginal return is not observable. As a proxy in our regressions for this marginal return to new capital, we use a corrected (to incorporate capital consumption and inventory valuation adjustments) measure of the average return to capital, earnings before interest and taxes, divided by the company's net capital stock. Auerbach and Hassett (1989) provide a theoretical justification for the use of this

measure, although its relevance for investment is not difficult to understand; similar measures may be found in the previous investment literature (e.g. Feldstein 1982, Abel and Blanchard 1986).

The term θ will account for factors changing the profitability of capital, other than the capital intensity of production itself. Such factors will include supply disturbances, which will affect the productivity of capital directly, as well as demand disturbances which, through the price of output, will affect the level of profitability, given the productivity of capital.

C. The present value of investment incentives, Γ

The present value (per dollar of investment) of the tax benefits of investment tax credits and depreciation allowances equals:

$$(2) \qquad \Gamma = k + \sum_{s=t}^{\infty} (1+r)^{-(s-t)} \tau_s D(s-t)$$

where k is the rate of investment tax credit, and D(a) is the depreciation allowance received by an asset of age a. It has been customary in past empirical analyses to assume that τ is constant. However, this formula is correct only if the tax rate τ does not change over time. It is true, of course, that future tax rate changes cannot be known with certainty, but our

empirical analysis allows for this by using only predicted values of future costs of capital.

D. The determinants of investment over time

Our model of investment predicts that current and future expected values of c, as defined in expression (1), should affect current investment. Their relative importance, in theory, should depend on the adjustment costs facing firms. With high costs of adjustment, future terms are very important because the firm must plan its investment far in advance. Based on evidence concerning adjustment costs as well as unconstrained regression estimates of the impact of future values of c on investment, we define a composite, smoothed measure of c, which we call ck, based on the current and three successive years' individual values, with each year's value given half the weight of the one before it.

The first column of Table 2 presents our estimated costs of capital, ck, (with the equity cost of capital based on the earnings-price ratio) for the two components of nonresidential fixed investment, equipment and structures, over the period 1957-85'. To permit an evaluation of the importance of different factors, the table also provides measures of ck holding constant variations in productivity and tax parameters. The second column, labelled "No Tax-1", is the estimated cost of capital absent all taxes. The third column, labelled "No Tax-2", omits all tax effects except the deductibility of interest. Which of these numbers is more relevant depends on one's assumptions about the

behavior of interest rates in response to rates of tax. The first No Tax variable corresponds to the assumption that before-tax interest rates are invariant with respect to corporate taxation, while the second corresponds to the assumption that after-tax interest rates are invariant with respect to taxation[5]. The last column of the table gives the cost of capital term with taxes but without the productivity term, θ. This last term corresponds to the traditional user cost of capital. Figures 1 and 2 show these series for equipment and structures, respectively.

The means and standard deviations of each measure over the sample period are given at the bottom of each column. Dividing the standard deviation of a series by its mean yields its coefficient of variation, a measure of the series' volatility. Comparing the coefficients of variation for the Total and No Tax costs of capital suggests that tax policy has not been used effectively as a tool for stabilizing investment. For both structures and equipment, each No Tax series is less volatile than the Total series that incorporates the incentive effects of taxation. One major exception to this pattern occurs during the early 1980s, when low profitability and high real interest rates drove the cost of capital to historical highs. The generous provisions of Economic Recovery Tax Act offset this increase[6].

Comparing Figures 1 and 2, we also note a difference in the general trend of the cost of capital for equipment and structures. Since the late 1950s, the cost of capital for

structures has generally risen while there is a downward trend for equipment. The difference is due largely to the investment tax credit, which applied only to a small class of (public utility) structures but most equipment.

While the analysis presented thus far is useful, it tells us only how the incentive to invest, and not investment itself, has been influenced by tax policy. Theory suggests that investment should be responsive to these incentives, but only empirical evidence relating to investment itself can enlighten us about the effects of tax policy on investment.

4. Explaining Actual Investment Behavior

The previous section described the determinants of investment behavior and how they have changed over time. This section provides estimates of how these determinants actually have influenced investment, showing in particular how investment in equipment and structures has been altered by tax policy. We focus on the general success of tax policy in stabilizing investment during the postwar period leading up to the Tax Reform Act of 1986.

In our empirical investigation, we considered several model specifications. Rather than present full details of the empirical results, we offer a summary of our general findings and then discuss the actual models we use to estimate the effects of tax policy on investment in structures and equipment.

A. General Findings

Empirical research has often found that cost of capital terms influence investment, but that other factors, such as output and business cash flow, do as well. Our specification including expected current and future profitability in the cost of capital expression provides a rationale for such findings, in that (not surprisingly) these variables appear to exert less influence investment once profitability is taken into account. However, one cannot rule out an independent effect for cash flow in all specifications.[7]

A second question that often has arisen in the past is whether taxes, when allowed to enter the estimated equation separately rather than being grouped together with other components of the cost of capital, help explain investment. In a variety of models we found that the estimated importance of the cost of capital term was sensitive to whether a combined cost of capital expression alone was used or the influence of tax factors was estimated separately, but that tax factors typically were important in explaining investment behavior, particularly for investment in equipment[8].

In general, our estimates were more satisfactory for equipment than structures, with coefficients in the structures equations typically more sensitive and less significant. It appears that investment in nonresidential structures does not conform as well to the predictions of our model. The better predictive power of the cost of capital for equipment

expenditures is suggested by Figures 3 and 4, which plot the cost of capital ck versus investment for equipment and structures, respectively. In Figure 3, we observe many instances in which investment and the cost of capital move inversely, while the pattern of structures investment seen in Figure 4 is much smoother and apparently less related to movements in the cost of capital.

A final empirical consideration is the relationship between equipment and structures investment. Since the two investment series have behaved quite differently over time, a disaggregate approach appears to be justified. However, one might still expect the structures and equipment investment decisions to be related, in that factors encouraging one type of investment might also cause a shift away from the other type'. To test this, we included the structures cost of capital term ck in the equipment investment equation and the equipment cost of capital term in the structures equation. In specifications that also included a cash flow term, such expressions had a significant, positive effect on investment.

B. Estimated Equations

The basic specifications we use for measuring the impact of the cost of capital on investment include as explanatory variables only the composite cost of capital, ck, and a constant.[10] Based on these equations, we simulate the historical effects of tax policy on investment under the assumption that our

estimated no-tax cost of capital measures would have prevailed in the absence of taxation. In Figures 5 (equipment) and 6 (structures), we plot series of the estimated impact of taxes on investment against investment itself. Due to the relatively small coefficients on the cost of capital, the estimated impact is not large relative to the variability of investment itself, particularly for structures.

What do these series tell us about the effectiveness of tax policy in stabilizing investment? Given the greater variability of the cost of capital due to taxes, it is not surprising that this increases the predicted variability of investment itself.

For equipment, the effects of taxes over the historical period is estimated to have lowered the average level of investment by .2%, and increased the standard deviation by 3.5%. Under the assumption that the real after-tax interest rate stays constant as taxes change (our "no-tax-2" assumption discussed above), the estimated effects of taxes on both the mean and standard deviation of equipment investment are larger, with the mean of investment predicted to have been 1.6% lower and the standard deviation 10.5 percent higher. For structures, the impacts are considerably smaller.

Use of an alternative specification of investment including cash flow and the other type of investment's cost of capital led to a larger direct cost of capital coefficient[11] However, it did not alter the general pattern of predicted investment for the post-1986 period. Therefore, while we recognize the uncertain

pedigree of any particular model of investment, we are more confident that our characterization of the role of taxes after 1986 is accurate.

5. The Tax Reform Act of 1986

The Tax Reform Act of 1986 contained several provisions with potential effects on the incentive to invest. Among the most important of these were the reduction in the corporate tax rate, the lengthening of depreciation lifetimes, and the repeal of the investment tax credit.

The corporate tax rate, previously equal to 46 percent, was reduced to 40 percent for 1987 and 34 percent for 1988 and years thereafter. The investment tax credit, previously equal to 10 percent of qualifying investment expenditures, primarily those on new machinery and equipment, was repealed, with a retroactive effective date of January 1, 1986. Depreciation lifetimes for tax purposes, which had been 5 years for most equipment, 3 years for light equipment and 19 years for business structures, typically increased, with most classes of equipment in the pre-1986 5-year class being written off over 7 years and most nonresidential structures being written off over 31.5 years. For equity-financed investments, the drop in the corporate rate was outweighed by the reduced value of depreciation allowances and investment tax credits, with these provisions together leading to an increased tax burden on newly purchased equipment.

For nonresidential structures not previously qualifying for the investment tax credit, the cut in the corporate tax rate was more significant than the reduction in the value of depreciation allowances. However, some structures (generally public utility strutures) had previously qualified for the credit. For this latter category, the effect of the act was like that for equipment, to increase the marginal tax burden.

There were many other ways in which the tax reform was expected to influence investment. The reduction of the corporate tax rate also lowered the benefits of the interest deduction associated with debt-financed investment, while the reduction in individual tax rates and repeal of the capital gains tax preference were expected to change the costs of equity and debt capital firms faced. Additional provisions, including the strengthening of corporate and individual minimum taxes, were generally expected to discourage investment. As we discuss below, it may be in this area that the effect of the tax policy was most evident.

Although careful calculations (e.g. Fullerton, Gillette and Mackie 1987) found relatively small increases in the total marginal tax burden on new investment, taking account of all tax changes, there was a general consensus that the tax burden on business fixed investment had risen, particularly for machinery and equipment. Proponents of these provisions argued in terms of the potential gains from an improved allocation of capital, with

few claiming that the change in law would encourage investment overall.

6. Recent Investment and the Tax Reform Act

Table 3 repeats, for convenience, the ratios of investment to the capital stock for equipment and nonresidential structures for the period 1986-88, under the heading "Actual." As already mentioned, equipment investment has been strong during the period, apparently confounding the predictions that it would be stifled by the 1986 act. However, equipment investment during 1986 and 1987 was not out of line with our basic model's predictions, given in the second column of Table 3[12]. In part, this is due to the relatively small impact predicted by the model to have occurred because of the 1986 act, given in the last of column of the table[13]. In general, economic conditions for equipment investment were relatively good, even taking account of the Tax Reform Act. More difficult to explain are the strong growth of equipment spending in 1988 and the general weakness of structures spending throughout the past three years.[14]

At least part of the explanation for strong equipment investment may relate to changes in technology that are difficult to capture with our model. Table 4 provides a breakdown of equipment investment by category for the period 1985-88. As can be seen from the figures in this table, essentially all the real growth in equipment spending during 1986 and 1987 was attributable to investment in Office, Computing and Accounting

Machinery. While real (1982$) spending on this type of "high-tech" capital good rose from 65.0 billion dollars in 1985 to 95.5 billion dollars in 1987, the (by comparison) "low-tech" residual of nonresidential equipment spending was roughly constant, falling from 239.0 billion dollars to 237.7 billion dollars.

However, even this flat performance shines in comparison to the drop in real structures spending from 149.5 billion dollars in 1985 to 122.3 billion dollars in 1987. Moreover, even "low-tech" equipment investment grew strongly in 1988, from 237.7 billion dollars to 257.9 billion dollars, a real growth rate of 8.5 percent. Nonresidential structures investment, on the other hand, declined slightly, from 122.3 billion dollars to 122.2 billion dollars.

Thus, even if one ignores the fast-growing information processing equipment category altogether, equipment investment has grown more strongly than structures both during 1986-7 (when equipment spending was constant and structures spending fell considerably) and 1988 (when equipment investment rose considerably and structures spending was constant). This result is particularly important, given the uncertainty that some have expressed about the accuracy of the measure of the implicit price deflator. While an understated quality-adjusted price for computers could lead to an overstatement of real computer purchases, it cannot explain the relative strength of other equipment investment.

A potential explanation for the weak performance of structures investment is that we may have left out of our model significant tax factors of the 1986 act affecting certain types of structures investment. For example, the act contained various provisions aimed at restricting the use by individual investors of tax losses generated by passive investments, including real estate.

In this regard, however, one must remember that, in considering nonresidential structures investment, we have not even included the primary type of real estate investment against which such provisions were aimed, rental housing. Indeed, had we included multifamily housing construction in our measure of structures investment, the 34 percent drop in this category between 1986 and 1988 (in 1982 dollars, from 29.1 billion dollars to 19.3 billion dollars), the overall performance of the past few years would have been even worse. Since construction of single-family housing units increased over the same period, this does provide evidence of an effect of the tax reform on residential investment, but leaves us with our original puzzle unresolved.

A significant part of the answer can be found in a further disaggregation of nonresidential structures investment, given for the period 1985-88 in Table 5. About two-thirds of the drop in real structures spending between 1985 and 1988 is attributable to one category of investment, Mining, Exploration, Shafts and Wells. The sharp decline in new oil exploration that occurred

after the significant oil price decline in 1985, rather than any change in tax policy, seems the likely explanation here.

The remaining drop in investment since 1985 has been shared fairly uniformly by the other categories of structures investment, with purchases of Industrial, Commercial and Public Utility structures declining by 15 percent, 12 percent and 10 percent, respectively. However, if one considers the drop since 1986, when the tax reform act was passed, the decline is less evenly shared, as investment in Public Utility Structures and Commercial Buildings declined while Industry Building construction has been roughly constant.

This pattern since 1986 is consistent with the relative tax treatment of these categories under the new law, as many utility structures had previously qualified for the now repealed investment tax credit, and some of those commercial buildings not owned by corporations may have been subject to new rules limiting the deduction of real estate losses.

Perhaps the clearest tax incentive provided structures investment by the Tax Reform Act was in the Industrial Buildings category, since few of these structures are owned by individuals potentially subject to the passive loss restrictions. However, as just indicated, investment in this category has been essentially constant in real terms, while investment in Industrial Equipment, which lost the investment tax credit, was growing by 10 percent.

Thus, certain obvious nontax factors, such as the boom in information processing and the decline in petroleum exploration, explain a significant part of the divergent performance of equipment and structures investment during the past few years. Within the structures category, there appears to be some change in composition consistent with the provisions of the new law. However, there remains an overall shift from structures to equipment investment that is not consistent with the incentives presented by the Tax Reform Act and for which there is no simple explanation.

Such a shift has been observed in the past. Looking once again at the last two columns of Table 1, one can see a surge in the ratio of equipment to structures spending beginning around 1963 that, arguably, has carried through to the present. As we also noted, however, the cost of capital for equipment drifted lower through 1985, while the cost of capital for structures did not. Therefore, a tax-related explanation for the shift was possible until 1986.

The evidence in this paper, however, argues against such an explanation. First, our estimates of the impact of tax policy on investment are not strong enough to explain such a trend (see Figures 5 and 6). Second, the trend has continued and, if anything, intensified during the past few years, when tax factors pointed in the opposite direction.

7. Conclusions

Our primary findings in this paper, as summarized in the introduction, are that tax factors have not stabilized nonresidential investment over the postwar period, and that the Tax Reform Act of 1986 has played a relatively unimportant role in explaining the level and especially the pattern of investment in equipment and structures during the past few years.

It is important to exercise some caution when viewing these results. In analyzing the impact of tax policy, we have taken other macroeconomic factors, such as the level of profitability and the real interest rate, as given. To the extent that these factors would have been different under alternative tax regimes, our conclusions would require modification, although the size and direction of such corrections is not easily calculated. Nevertheless, our results suggest that tax policy may have been given too much prominence (relative to those other factor we consider here, such as interest rates and profitability, and those we don't, such as technological innovation) in past discussions of investment behavior.

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Footnotes

1. Throughout the paper, we focus on gross, rather than net investment. There has been a widening gap over the postwar period between these two figures, as depreciation has become more significant. However, this is largely due to the shift toward investment in equipment, which we discuss below. Because we focus separately on equipment and structures investment, the gross-net distinction is not as important.

2. This expression is basically the user cost of capital familiar from the investment literature and first derived by Jorgenson (1963), except that it includes the productivity term, θ. This term replaces the frequent but ad hoc inclusion of cyclical measures such as output.

3. Because we do not observe expectations directly, we estimate them by regressing actual realized returns on observable variables such as past rates of return and output-capital ratios. This is discussed further below.

4. Estimated values are obtained by regressing ex post values of ck on information available at the current date, including a constant, trend, and lagged values of c and the output-capital ratio.

In calculating the ex post values of c, we use the short-term commercial paper rate for the nominal cost of debt, the earnings-

price ratio of the Standard and Poor's 500 companies for the cost of equity, and calculate the tax parameters τ and Γ using the same methodology as Auerbach and Hines (1988).

5. When analyzing the effects of tax policy on investment, below, we use the no tax-1 variable. Calculations based on the no tax-2 variable did not differ significantly.

6. Through its impact on the federal budget deficit, the 1981 act may very well have contributed to the rise in real interest rates that occurred. However, in terms of revenue cost, the bulk of the 1981 tax cut came through reductions in individual tax rates (Auerbach 1982).

7. Other recent investment studies, notably the work of Fazzari, Hubbard and Peterson (1988), have found that cash flow does matter for a class of smaller firms, when a more traditional measure of the cost of capital is included as an explanatory variable. The inclusion of cash flow can be justified as providing a proxy for capital market imperfections that make internal funds less expensive to the firm than funds obtained at the market rates appearing in the cost of capital expression.

Whether cash flow matters for this reason, or because of a general misspecification of the investment equation is an important question that deserves further attention.

8. We allowed for a separate tax effect in two different ways. One specification added either the no-tax-1 or no-tax-2 measure of ck to the basic equation including ck. In this case, we typically found that both the no-tax and the total measure of ck had significant coefficients, suggesting that nontax factors may have a more important role than taxes relative to the theory. To control for the possibility that this weaker influence of taxes may have been due to our using poor measures of expected tax variables, we also tried including actual values of these future values. The results for this specification were similar to those of the first.

In each case, the implied effects of taxes is typically not significantly different from the impact implied by the basic specification based on the combined cost of capital expression. It is this basic specification that we report below and use in our simulations.

9. One would expect this type of model to result from the specification of a general production function including the two types of capital, although we have not been able to obtain a simple closed form expression for investment in this case.

10. Our estimated equations are based on the measures of the cost of capital shown in Figures 3 and 4. Since we are using annual data, the statistical theory of time aggregation (Working 1960) suggests that the aggregated equation will contain an ma(1) error

term. Indeed, there is strong evidence of serial correlation, so we also correct for a first-order moving average process. It should be noted, however, that the point estimates of the moving average error terms are higher than is predicted by the theory, implying that the models may be omitting important explanatory variables.

The actual equations are (with standard errors given in parentheses):

Equipment: I/K = .193 - .165 * CKE
(.007) (.040)

RBAR-SQUARED = .520
MA(1) COEFFICIENT = .879
DURBIN-WATSON STATISTIC = 1.79

Structures: I/K = .089 - .029 * CKE
(.002) (.024)

RBAR-SQUARED = .454
MA(1) COEFFICIENT = .971
DURBIN-WATSON STATISTIC = 1.92

11. The actual equations are (with standard errors given in parentheses):

Equipment: I/K = .106 - .475*CKEEQ + .428*CKEST + .348*CASH(-1)
(.031) (.127) (.155) (.083)

RBAR-SQUARED = .239

MA(1) COEFFICIENT = .301

DURBIN-WATSON STATISTIC = 1.85

Structures: I/K = .019 - .070*CKEST + .133*CKEEQ + .258*CASH(-1)
(.017) (.058) (.053) (.084)

RBAR-SQUARED = .249

MA(1) COEFFICIENT = .233

DURBIN-WATSON STATISTIC = 1.52

where CASH is retained earnings plus dividends plus depreciation divided by the capital stock, CKEEQ is the equipment cost of capital and CKEST is the structures cost of capital.

The ma(1) terms in this specification are more in line with those predicted from the theory of aggregation discussed above, in footnote 10.

12. These predictions are the fitted values for 1986-8 based on a reestimation of the model through 1988. Values of ck for the last three years depend on post-1988 values of c, which are not

observable. For the estimation, we use the actual 1988 value of c for these unobservable values.

13. The effects of the act are estimated by multiplying the coefficient from the basic investment equation, given in footnote 10, by the difference between the actual value of ck and the value that ck would have taken had the tax law been kept constant in 1986. The generally small effects are due in part to the small size of these coefficients.

The reason for the positive effect estimated for equipment in 1986 is that, even though equipment had lost the investment tax credit, it still had and was about to lose accelerated depreciation allowances. This provided a powerful incentive to invest.

The negative effect for structures in 1987 and 1988 is attributable to the inclusion in this category of public utility structures that lost the investment tax credit in 1986.

14. The picture does not change appreciably if one uses the alternative investment equations that include both capital costs and cash flow. Again fixing each capital cost to its 1986 value with no tax change, and assuming that after-tax cash flow would have had the same ratio to before-tax cash flow in 1986 and 1987 as it did in 1985 (the last year before tax payments were affected by the change in law), the net effect of taxes on equipment investment in 1987 and 1988 is about fifty percent larger than before but still less than one-half percentage point (i.e., less

than 3 percent of equipment investment) in each year. The effect on structures investment is also slightly larger in each year, but still no more than about one-tenth of one percentage point (i.e., about 1.5 percent of structures investment) in each year.

These equations predicted values of equipment and structures investment, like those of the basic model, fail to track the jump in 1988 equipment investment nor the weakness of structures investment throughout the post-reform period, when estimated over the full sample period 1957-88.

Table 1

Investment Behavior

	Relative to Capital		Relative to GNP	
Year	Equipment	Structures	Equipment	Structures
1957	0.163	0.098	0.055	0.048
1958	0.134	0.088	0.048	0.046
1959	0.147	0.087	0.050	0.044
1960	0.147	0.090	0.050	0.046
1961	0.139	0.088	0.047	0.045
1962	0.151	0.090	0.049	0.045
1963	0.157	0.087	0.051	0.044
1964	0.172	0.091	0.054	0.045
1965	0.193	0.102	0.060	0.049
1966	0.205	0.103	0.065	0.049
1967	0.187	0.096	0.062	0.046
1968	0.185	0.095	0.062	0.046
1969	0.186	0.096	0.065	0.047
1970	0.171	0.090	0.063	0.046
1971	0.161	0.084	0.061	0.043
1972	0.172	0.084	0.064	0.042
1973	0.195	0.087	0.073	0.043
1974	0.185	0.083	0.074	0.042
1975	0.154	0.072	0.066	0.038
1976	0.156	0.071	0.066	0.037
1977	0.176	0.073	0.073	0.037
1978	0.189	0.079	0.078	0.038
1979	0.190	0.085	0.081	0.041
1980	0.168	0.086	0.076	0.043
1981	0.164	0.091	0.076	0.046
1982	0.143	0.085	0.071	0.045
1983	0.148	0.074	0.071	0.039
1984	0.176	0.082	0.080	0.041
1985	0.183	0.083	0.084	0.041
1986	0.175	0.070	0.082	0.035
1987	0.177	0.067	0.083	0.033
1988	0.190	0.067	0.090	0.032
Mean	0.170	0.085	0.067	0.043

Table 2

Components of the Cost of Capital - Equipment

(Using Earnings-Price Measure)

Year	Total	No Tax-1	No Tax-2	No Theta
1957	0.234	0.124	0.125	0.250
1958	0.220	0.139	0.133	0.237
1959	0.231	0.140	0.140	0.244
1960	0.159	0.129	0.118	0.201
1961	0.207	0.144	0.139	0.228
1962	0.146	0.144	0.138	0.159
1963	0.128	0.131	0.120	0.152
1964	0.116	0.131	0.124	0.155
1965	0.130	0.122	0.113	0.160
1966	0.123	0.114	0.107	0.152
1967	0.146	0.109	0.101	0.178
1968	0.142	0.108	0.104	0.147
1969	0.131	0.109	0.099	0.132
1970	0.151	0.124	0.112	0.165
1971	0.176	0.136	0.124	0.179
1972	0.121	0.130	0.118	0.108
1973	0.114	0.132	0.119	0.107
1974	0.107	0.146	0.126	0.121
1975	0.196	0.151	0.131	0.171
1976	0.179	0.159	0.142	0.154
1977	0.136	0.163	0.145	0.127
1978	0.159	0.171	0.149	0.136
1979	0.153	0.183	0.154	0.124
1980	0.158	0.205	0.172	0.119
1981	0.129	0.222	0.190	0.088
1982	0.107	0.203	0.172	0.072
1983	0.130	0.228	0.198	0.104
1984	0.112	0.163	0.155	0.090
1985	0.112	0.122	0.111	0.083
Mean	0.150	0.148	0.134	0.150
Standard Deviation	0.037	0.033	0.025	0.048

Table 2

(Continued)

Components of the Cost of Capital - Structures

(Using Earnings-Price Ratios)

Year	Total	No Tax-1	No Tax-2	No Theta
1957	0.074	0.041	0.042	0.089
1958	0.051	0.045	0.043	0.068
1959	0.054	0.024	0.029	0.071
1960	0.012	0.046	0.037	0.039
1961	0.095	0.041	0.039	0.104
1962	0.081	0.040	0.037	0.085
1963	0.081	0.051	0.043	0.088
1964	0.064	0.053	0.047	0.074
1965	0.074	0.061	0.051	0.081
1966	0.087	0.066	0.056	0.087
1967	0.087	0.070	0.060	0.087
1968	0.088	0.056	0.051	0.084
1969	0.066	0.062	0.051	0.070
1970	0.073	0.062	0.052	0.074
1971	0.075	0.054	0.046	0.073
1972	0.076	0.056	0.045	0.073
1973	0.088	0.060	0.050	0.083
1974	0.085	0.077	0.058	0.077
1975	0.134	0.068	0.048	0.114
1976	0.092	0.064	0.050	0.079
1977	0.075	0.075	0.061	0.069
1978	0.099	0.082	0.066	0.086
1979	0.125	0.111	0.085	0.099
1980	0.147	0.133	0.103	0.110
1981	0.155	0.144	0.116	0.101
1982	0.145	0.151	0.116	0.093
1983	0.056	0.154	0.127	0.057
1984	0.058	0.106	0.092	0.044
1985	0.077	0.086	0.072	0.073
Mean	0.085	0.074	0.061	0.080
Standard Deviation	0.031	0.035	0.026	0.017

Table 3

Recent Investment and The Tax Reform Act of 1986
(Relative to the Capital Stock)

Year	Equipment		
	Actual	Predicted	Due to Reform
1986	0.175	0.176	0.0007
1987	0.177	0.174	-0.002
1988	0.190	0.174	-0.003
	Structures		
	Actual	Predicted	Due to Reform
1986	0.070	0.085	0.001
1987	0.067	0.084	-0.0002
1988	0.067	0.085	-0.0002

Table 4

Nonresidential Equipment Investment: 1985-88
(billions of 1982 $)

	Year			
Category	1985	1986	1987	1988
Office, Computing and Accounting Machinery	65.0	73.1	95.5	113.7
Other Information Processing and Related Equipment	54.3	55.6	57.4	60.5
Industrial Equipment	64.6	62.3	61.9	68.4
Transportation and Related Equipment	61.5	59.9	58.9	65.7
Other Equipment	58.6	57.4	59.5	63.3
Total	304.0	308.3	333.2	371.6

Source: Survey of Current Business, July 1989, Table 5.7

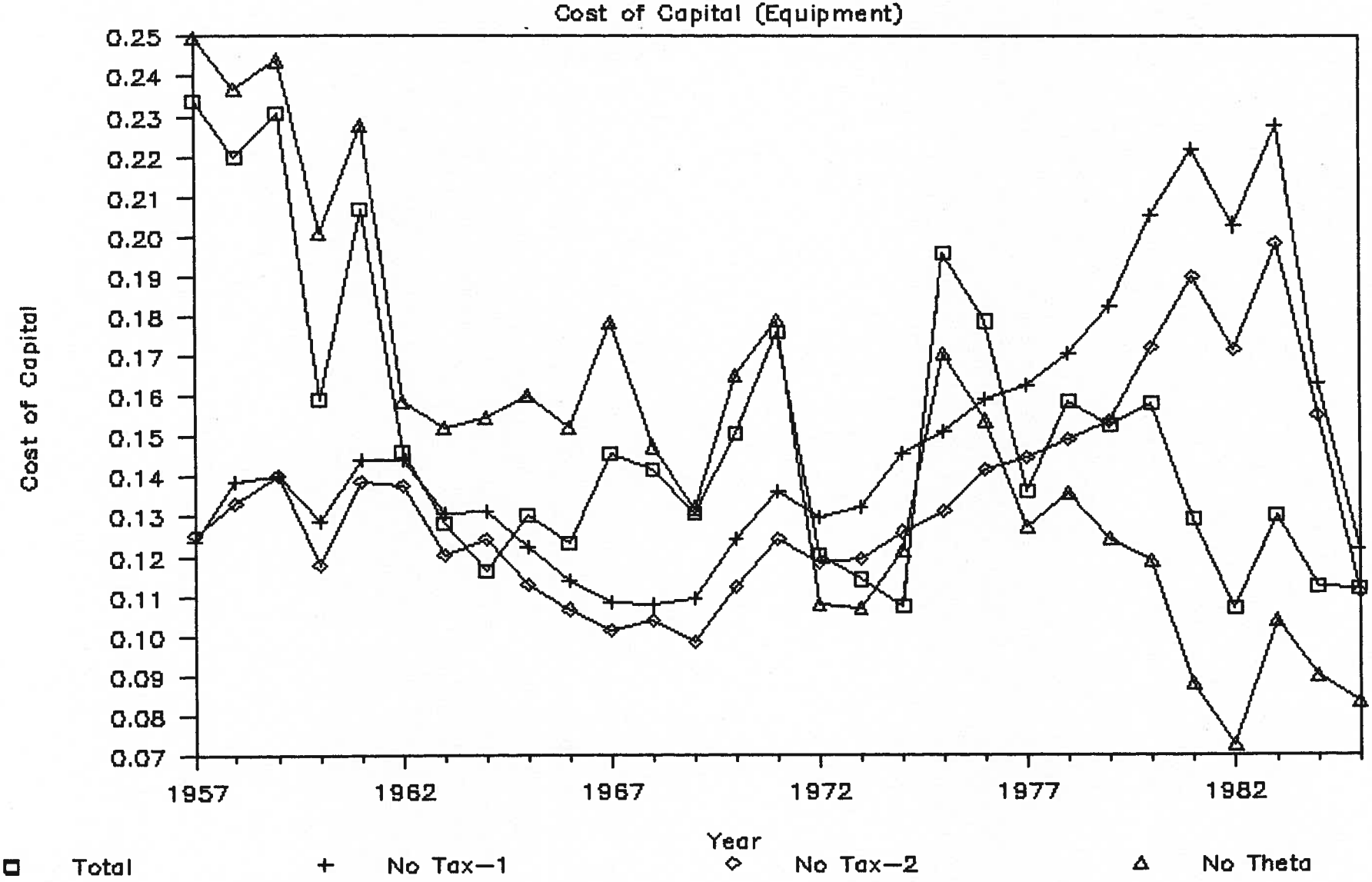
Table 5

Nonresidential Structures Investment: 1985-88
(billions of 1982 $)

	Year			
Category	1985	1986	1987	1988
Industrial Buildings	15.0	12.7	12.1	12.8
Commerical Buildings	53.3	49.4	46.4	46.9
Public Utilities	25.1	25.7	22.5	22.6
Mining Exploration, Shafts and Wells	35.2	20.7	18.2	17.2
Other Structures	20.9	21.6	23.1	22.7
Total	149.5	130.1	122.3	122.2

Source: Survey of Current Business, July 1989, Table 5.5

Figure 1


Cost of Capital (Equipment)
Cost of Capital
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0.24
0.23
0.22
0.21
0.20
0.19
0.18
0.17
0.16
0.15
0.14
0.13
0.12
0.11
0.10
0.09
0.08
0.07
1957
1962
1967
1972
1977
1982
Year
Total
No Tax—1
No Tax—2
No Theta

Figure 2

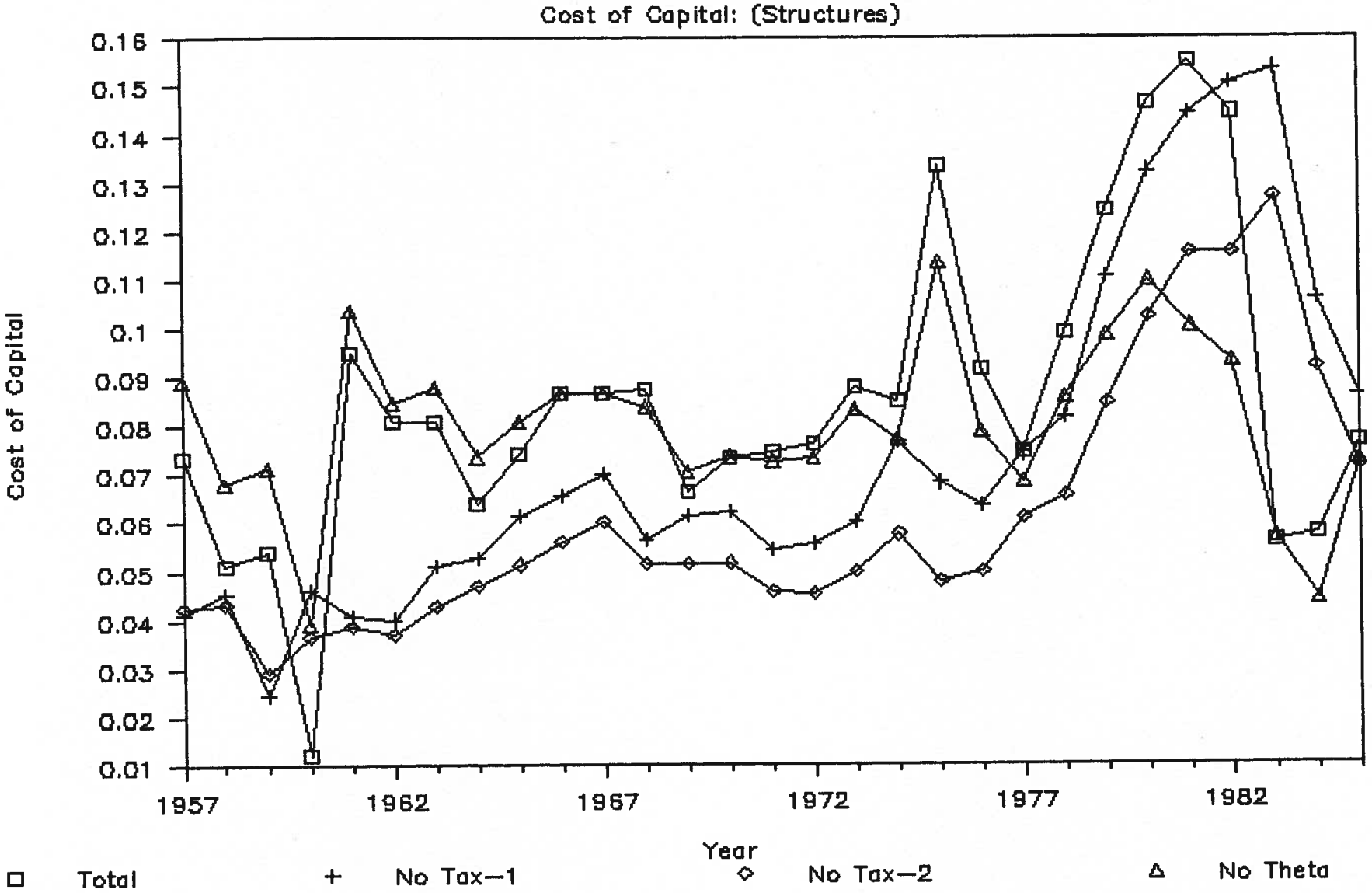

Cost of Capital: (Structures)
Cost of Capital
0.16
0.15
0.14
0.13
0.12
0.11
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
1957
1962
1967
1972
1977
1982
Year
Total
No Tax—1
No Tax—2
No Theta

Figure 3

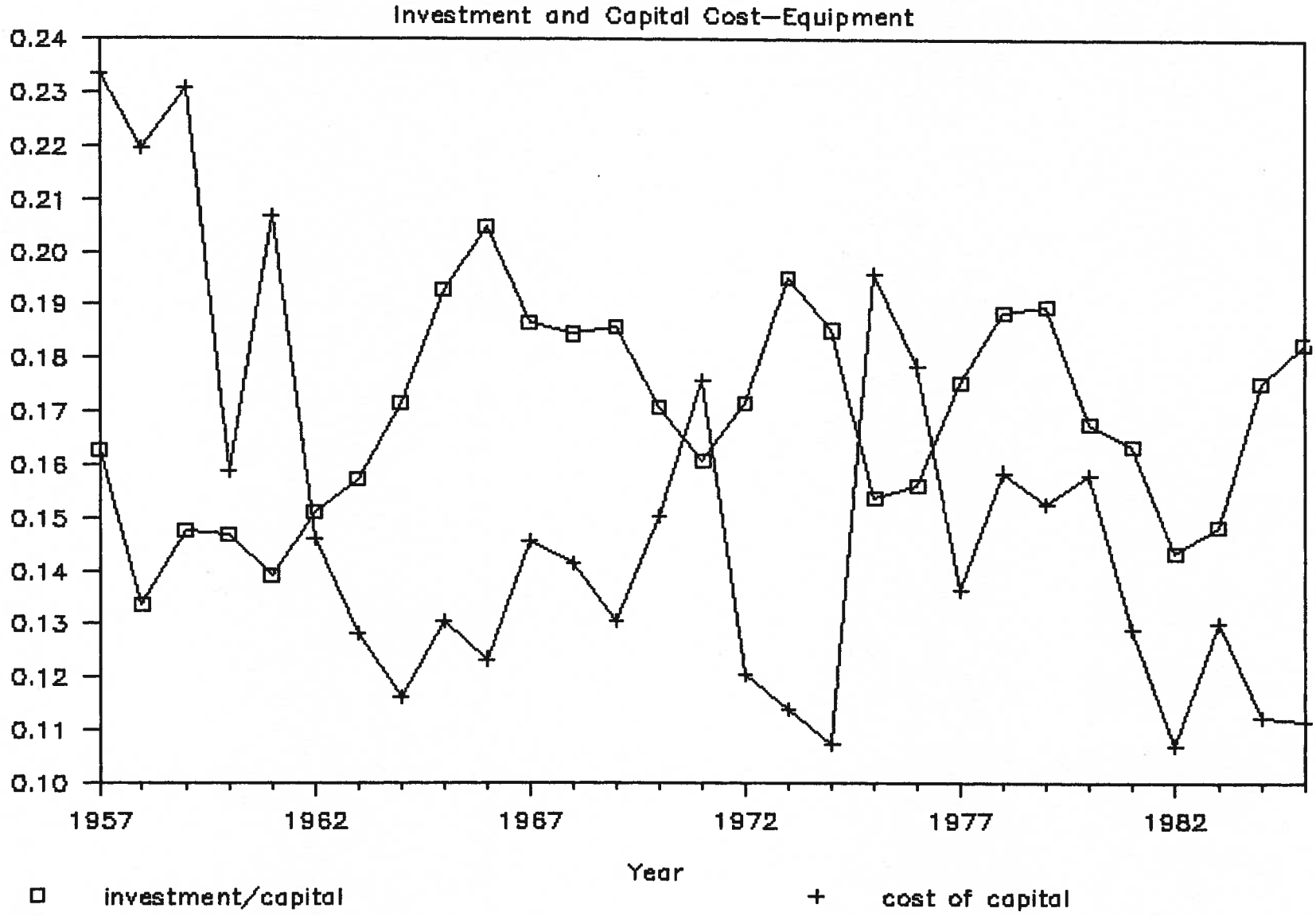

Investment and Capital Cost—Equipment
0.24
0.23
0.22
0.21
0.20
0.19
0.18
0.17
0.16
0.15
0.14
0.13
0.12
0.11
0.10
1957
1962
1967
1972
1977
1982
Year
investment/capital
cost of capital

Figure 4

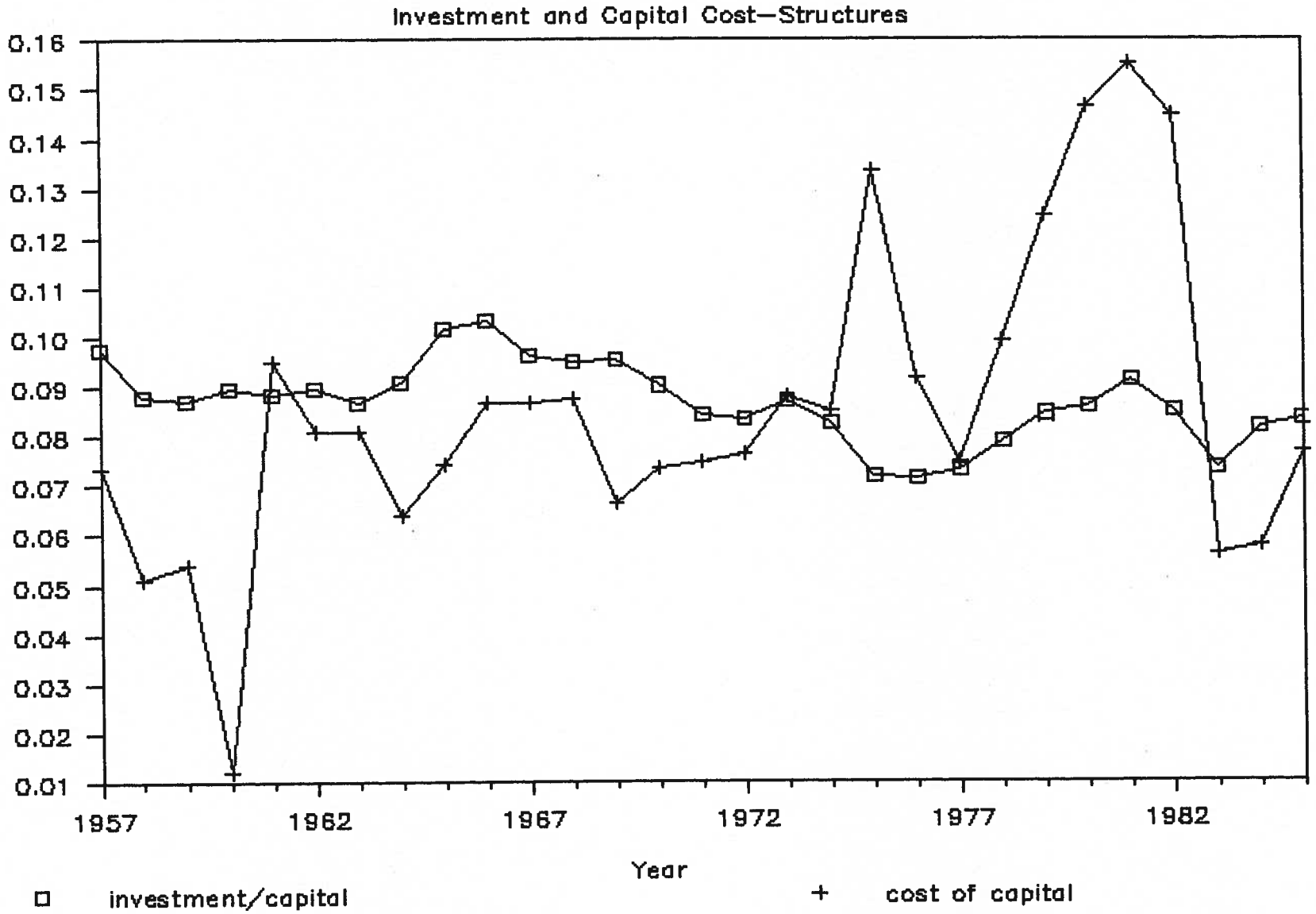

Investment and Capital Cost—Structures
0.16
0.15
0.14
0.13
0.12
0.11
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
1957
1962
1967
1972
1977
1982
Year
investment/capital
cost of capital

Figure 5

The Effect of Taxes—Equipment

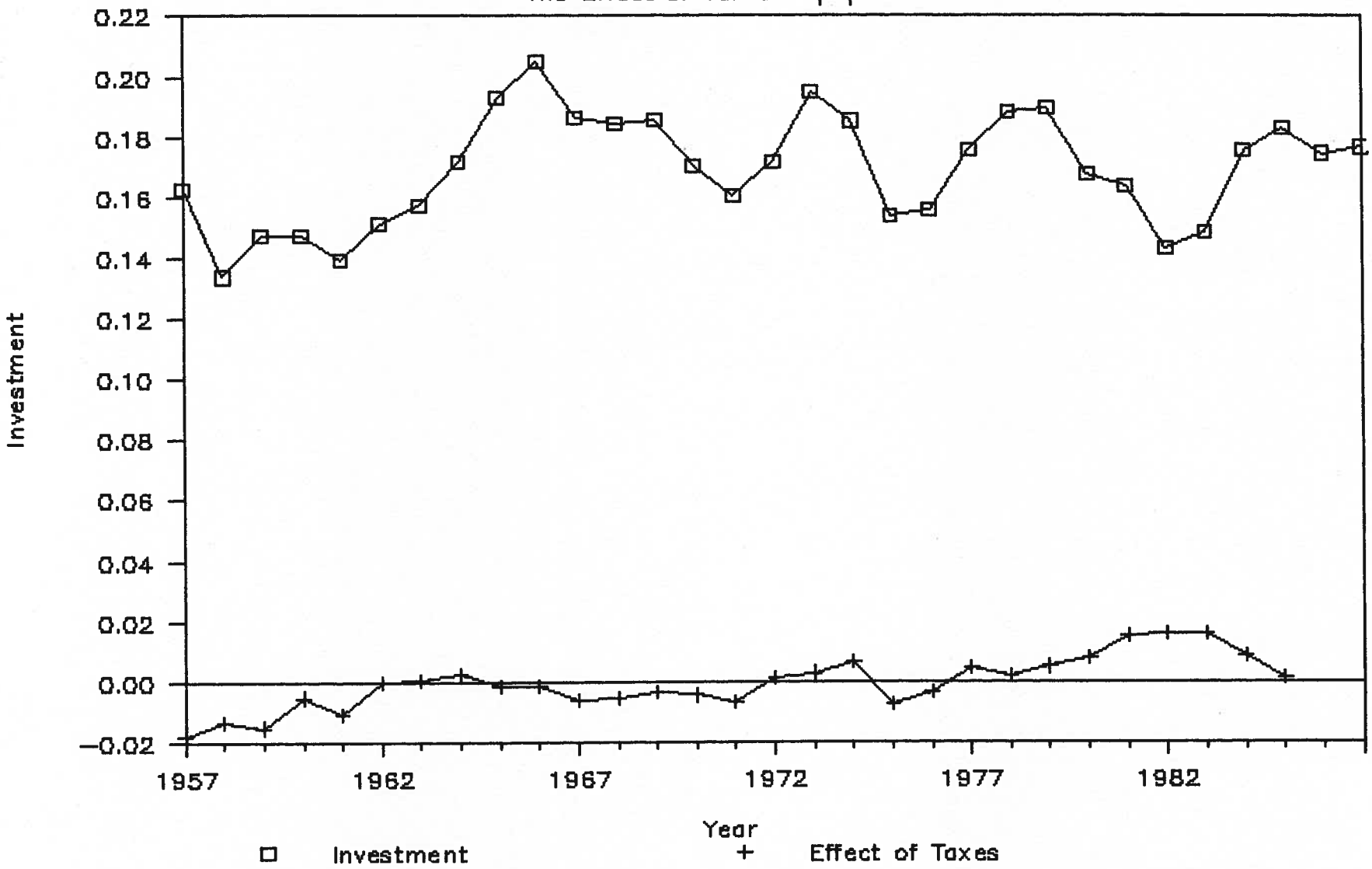
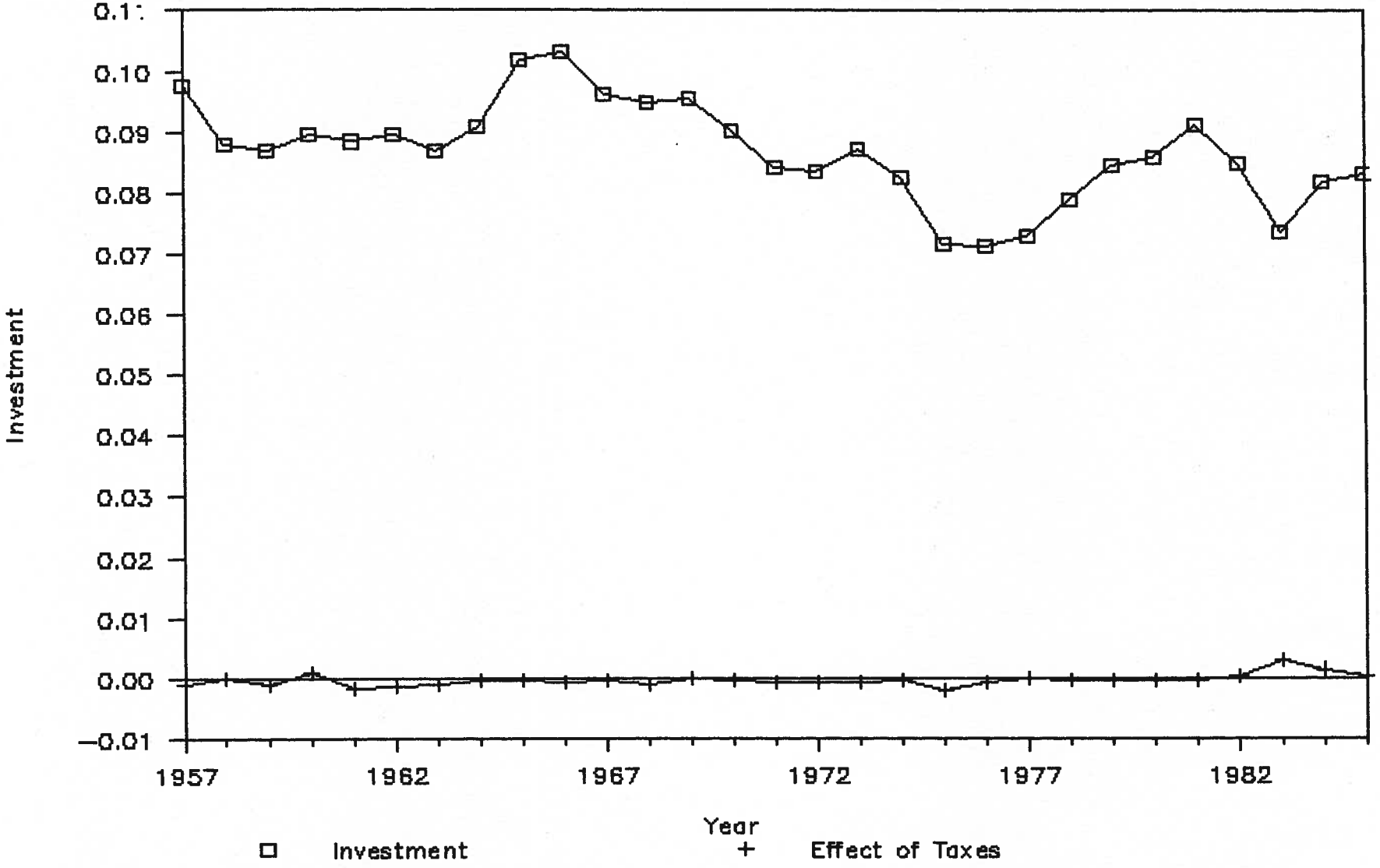


Figure 6

The Effect of Taxes—Structures



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