IMF WORKING PAPER

WP/88/34

INTERNATIONAL MONETARY FUND

Western Hemisphere Department

Tax Policy and Business Investment in the United States: Evidence from the 1980s

Prepared by Robert Corker, Owen Evans, and Lloyd Kenward 1/

Authorized for Distribution
by Yusuke Horiguchi

April 14, 1988

Abstract

This paper examines the behavior of business fixed investment in the United States in the 1980s. A background discussion of the long-term behavior of the components of business fixed investment is provided, setting the context for the empirical analysis. A standard neoclassical model of business fixed investment is specified and estimated, with output and the cost of capital the primary explanatory variables. Simulation experiments are then conducted with a view to assessing the importance of various contributing factors--in particular tax policy--in influencing the behavior of business fixed investment during the economic expansion that began in late 1982.

JEL Classification Numbers:
0233, 3212

1/ Mr. Corker is an economist in the Asian Department and Mr. Kenward is a senior economist in the Asian Department; when the initial research for this paper was conducted, both were in the Western Hemisphere Department. Mr. Evans is an economist in the Western Hemisphere Department. The authors are grateful to P.B. Clark, E. Hernández-Catá, and Y. Horiguchi for helpful comments on earlier drafts. Mrs. F. Pham provided capable research assistance.

Contents

Summary

The behavior of fixed investment in U.S. business in the current economic expansion has differed from its behavior during similar phases of earlier upswings. Investment surged in the early part of the expansion before declining in the later stages. This took place against a background of sweeping changes in tax legislation, beginning with the measures introduced in the Economic Recovery and Tax Act of 1981, which expanded tax incentives for investment. Subsequent tax policy became progressively less generous in its treatment of investment. By the time of the Tax Reform Act of 1986, public policy had shifted from encouraging investment through tax concessions to a less interventionist approach, under which the tax code was to be as neutral as possible.

This paper develops a model to explain the behavior of business fixed investment--disaggregated into plant and equipment investment and investment in nonresidential structures--during the present economic expansion. The explanatory variables are output, the cost of capital, and the capital stock. In turn, the cost of capital is defined in terms of interest rates, the cost of equity financing, expected inflation, and tax factors; it is through the tax variables that the direct impact of changes in tax policy on investment is examined.

According to the simulations conducted with the model, the most important factor behind the rapid rise in business fixed investment in the first phase (1983-85) of the current economic expansion was the robust growth of output, which accounted for roughly three fourths of the total rise in business fixed investment. Among the other factors, the steep decline in the cost of funds was the most important, while changes in tax policy made an appreciable but relatively small contribution. The main reason behind the stagnation of investment in producers' durable equipment from late 1985 to mid-1987 was the sluggish growth of output over that period, although the withdrawal of tax concessions under the Tax Reform Act had important secondary effects. The decline in investment in nonresidential structures during the same period is partially attributable to sluggish output growth and the impact of the plunge in world oil prices on petroleum drilling and mining. A significant portion of that decline remains unexplained, however, raising the possibility that the withdrawal of tax concessions under tax reform may be having a more pronounced effect on investment in nonresidential structures than the simulations indicate.

I. Introduction

A distinguishing feature of the early phase of the current economic expansion in the United States (from 1983 to 1985) was the exceptional strength of gross fixed business investment in the face of historically high real interest rates. By contrast, since late 1985 business fixed investment has declined while other components of output have continued to rise. Several explanations have been advanced to explain these movements in investment including: changes in inflation and interest rates; relative price changes; rapid technological advances that dramatically reduced the cost of processing information; the early unsustained vigor of the economic recovery; and frequent changes in important elements of tax policy.

This paper examines the behavior of business fixed investment over the course of the present expansion, and seeks to evaluate the relative importance of various contributing factors. In Section II recent changes in the composition of business fixed investment are reviewed in the context of longer term trends. Section III provides some empirical evidence on the relationship between the major components of business fixed investment and their determinants, especially the cost of capital. These relationships are then used in Section IV to examine the extent to which the behavior of investment may be attributed to changes in financial conditions, to changes in fiscal incentives, to the general expansion of the economy and other factors. Conclusions are presented in Section V.

II. The Behavior of Fixed Investment in the Present Expansion

In the current economic expansion, business fixed investment rose rapidly in the initial phase and stagnated subsequently--in contrast to other expansions of comparable length (upper panel of Chart 1). 1/ This section outlines the behavior of business fixed investment since 1982 in the context of previous cyclical episodes and provides a point of departure for the empirical work presented subsequently.

After declining substantially during the recession of 1981/82, nonresidential gross fixed investment reached a trough in the first quarter of 1983. 2/ It began to rise rapidly thereafter, against the background of exceptionally strong growth of real GNP. From mid-1985 to mid-1987, however, the level of business fixed investment declined appreciably while real GNP growth tapered off to an annual rate of 2-3 percent.

1/ The paper deals with data up to and including the second quarter of 1987.

2/ Real GNP reached a trough in the third quarter of 1982, before rising slightly in the fourth quarter of that year.

Change from Recession Trough

(In percent)

	Nonresidential Business Fixed Investment	Producers' Durable Equipment	Nonresidential Structures
First seven quarters of recovery			
1983:I - 1984:IV 1/	30.1	39.3	14.8
1975:II - 1977:I 1/	12.2	17.6	2.9
1961:I - 1962:IV	9.8	16.0	3.8
Seventeen quarters of expansion			
1983:I - 1987:II	28.2	48.8	-6.1
1975:II - 1979:III	42.0	48.3	31.2
1961:I - 1965:II	44.3	58.1	30.7

During the first seven quarters of this expansion (up to the end of 1984) business fixed investment rose more than twice as rapidly as in comparable periods of earlier recoveries (see tabulation above). 2/ Expansion took place against a background of fiscal incentives for investment which were made even more generous under the Economic Recovery and Tax Act of 1981, particularly with regard to depreciation allowances. Investment growth continued until mid-1985, but thereafter began to falter, despite the continued rise of real GNP. Investment in nonresidential structures peaked in the second quarter of 1985, and subsequently plunged in the period to the second quarter of 1987. Investment in producers' durable equipment reached a peak in the fourth quarter of 1985 and fluctuated close to that level subsequently. This curtailment of investment spending--while overall economic expansion continued--was in sharp contrast to the pattern evident in the upswings of the mid-1960s and late 1970s, which typically saw an acceleration of investment as the cycle progressed. The slowing down of investment coincided with legislation, culminating in the Tax Reform Act of 1986, that withdrew tax concessions on capital goods.

Variations in the growth profiles of the components of business fixed investment have also been pronounced during this expansion. With regard to the major components of producers' durable equipment, spending on high technology items (primarily computers), and equipment for transportation, construction, and agriculture rose substantially from the

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1/ The recession trough for real GNP was earlier than that for business fixed investment.

2/ The episodes beginning in 1961 and 1975 are the only postwar upswings of comparable length to the present expansion and were therefore chosen for comparison.

first quarter of 1983 to the fourth quarter of 1985 (Table 1), while investment in heavy industrial equipment increased less rapidly. From the fourth quarter of 1985 to the second quarter of 1987, producers' durable investment was essentially unchanged, with the high technology component rising and equipment for heavy industry, transportation, and construction and agriculture declining.

With respect to the major components of investment in nonresidential structures, the sharpest divergence has been between petroleum drilling and mining, and the remainder of nonresidential structures, as a result of pronounced fluctuations in the world price of oil (Chart 2). In the seven quarters to the end of 1984, investment in petroleum drilling and mining rose by 14 percent, before dropping during 1985, under the influence of a falling real oil price. During 1986, when the world price of oil plummeted, mining and drilling investment dropped by 41 percent; in the first half of 1987, it stabilized at a level 35 percent below its level in the recession trough of early 1983.

Investment in nonresidential structures excluding petroleum drilling and mining increased by 22 percent from the recession trough to the fourth quarter of 1985, driven primarily by investment in commercial structures, which includes office building and hotels--a component strongly influenced by tax concessions in the Economic Recovery and Tax Act (ERTA) of 1981. From the fourth quarter of 1985 to the second quarter of 1987, investment in nonresidential structures excluding petroleum fell by 12 1/2 percent.

These variations in growth patterns among the components of business fixed investment are to an extent a continuation of longer-term trends. As illustrated in the lower panel of Chart 1, the share of producers durables in total business fixed investment increased from 51 percent in 1958 to nearly 71 percent in 1986, while the share of nonresidential structures declined correspondingly. The increased share of real producers' durables has been primarily accounted for by high technology goods (upper panel, Chart 3), as a consequence of the dramatic advances in the quality--and sharp price declines--of computing equipment in recent years. 1/ In contrast, the share of heavy industry equipment has dropped markedly in the 1980s, reflecting the long-term decline in the relative importance of this sector.

The strongest increases in gross business fixed investment have been in assets with relatively short service lives. For example, almost two thirds of the increase in business fixed investment during the present recovery has been accounted for by high technology goods which,

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1/ The implicit deflator for high technology equipment fell by 23 percent from the first quarter of 1983 to the second quarter of 1987, compared with a 1 percent decline for the deflator for total business fixed investment and a 14 percent rise for the GNP deflator for the same period.

as noted earlier, consist mainly of computing equipment; these have an estimated average service life of less than ten years (Table 2). 1/

As the investment mix has shifted toward short-lived assets, the average service life of gross additions to the capital stock has declined markedly (upper panel of Chart 4). The volume of investment necessary to maintain the existing capital stock has increased along with the decline in the average service life of the capital stock. As a result, the ratio of depreciation to gross nonresidential fixed investment has exhibited a distinct upward trend since the late 1960s (lower panel of Chart 4).

The rising trend in the proportion of gross investment devoted to replacement has been reflected in a growing gap between gross and net investment. The ratio of gross business fixed investment to GNP (both measured in constant dollars) rose relatively steadily over the past three decades, and reached a postwar high in 1985 before declining in 1986 (upper panel of Chart 5). By contrast, the ratio of net investment to net national product has not exhibited a long-term rising trend, and in recent years has remained well below its historical peak. The net addition to the productive capital stock in 1983 was near a postwar low despite the strong upturn in gross fixed investment and it remained low by historical standards in 1984-86 (see lower panel of Chart 5).

III. The Determinants of Business Fixed Investment

The empirical framework developed in this paper relates business fixed investment to its proximate macro-economic determinants--aggregate demand, the cost of funds, and tax factors. The aims are to determine whether the unusual behavior of fixed investment in the current economic expansion can be adequately explained in a relatively aggregative framework, and to examine the importance of tax effects in that explanation. It should be noted that, while the aggregate determinants of investment are themselves endogenous to the economic system, no attempt is made to analyze business investment in terms of more fundamental explanations--such as fiscal and monetary policies, changes in technology, and the like. In this section, a brief review of other studies is first provided. Then the theoretical basis underlying one commonly used formulation of investment equations is presented, together with estimation results and details regarding the construction of the cost of capital variables--the variables through which the effects of fiscal incentives are transmitted to investment.

1/ Details regarding estimates of average service lives are provided in Fixed Reproducible Tangible Wealth in the United States, 1925-79 (Washington, D.C., U.S. Government Printing Office, 1982) and Musgrave (1976).

1. Review of other studies

Analyses of business fixed investment in the United States may be divided into several categories. One group of studies treats investment in terms of its fundamental determinants, such as fiscal and monetary policies, using complete macro-economic models of the U.S. economy (for example, Brayton and Clark (1985)). A second approach--that which is most common in the literature and into which category this study falls--is essentially partial-equilibrium, and relates investment to its proximate macro-economic determinants. A third approach dismisses conventional empirical techniques and argues that changes in tax incentives in recent years have been so powerful as to invalidate the conventional macro-economic approach to the behavior of business investment (for example Roberts (1982)). However, whatever the analytical approach taken, the dominant issue in recent empirical studies of fixed investment has been the importance of fiscal incentives. Excellent surveys of the literature on the impact of tax policy on business investment have recently been provided by Bosworth (1984) and Chirinko (1986). These surveys note that overall agreement does not appear to exist as to the role of tax policy, with some studies ascribing very little influence to tax variables in affecting the course of business fixed investment, while others indicate a more substantial role. To the extent that a consensus exists, it appears to be that the predominant determinants of business fixed investment are major macroeconomic variables, such as the rate of growth of output, the level of interest rates, and the state of inflationary expectations. Tax policy, while generally found to be significant, appears to play a subsidiary role.

One substantial strand of the literature involves assessment of the impact on business fixed investment of the Economic Recovery and Tax Act (ERTA) of 1981 and the Tax Equity and Fiscal Responsibility Act (TEFRA) of 1982, the relevant provisions of which are outlined in Table 3. Bosworth (1985) examined the behavior of business investment from 1981 to 1984 and suggested that tax policy may not have been the major factor stimulating the growth of business investment. Although he found that aggregate equations underpredicted investment growth, the areas of strongest increase were not those which had received the greatest stimulus from tax policy. Brayton and Clark (1985) performed simulations using the Federal Reserve/MPS model of the U.S. economy. They found quite substantial ERTA/TEFRA effects on business investment, but the bulk of the impact stemmed from the multiplier/acelerator mechanism on output, with the magnitude of the pure tax policy effect--operating through the cost of capital--somewhat smaller. Sahling and Akhtar (1985) estimated two standard investment models--one based on the specification in the MPS model and the other on that of the Bureau of Economic Analysis (BEA) model. They found that conventional aggregative models tracked behavior quite well, and that the fast growth in business investment in plant and equipment in the early phase of the current expansion stemmed primarily from the rapid increase in output and the steep decline in the cost of funds. The role attributed to changes in tax policy was significant but secondary. Meyer (1984), also employing

an approach relying on the cost of capital, found that changes in tax policy helped to explain changes in investment behavior, but by no means fully. By contrast, Feldstein and Jun (1986) found more substantial tax policy effects than most other studies, but their methodology appeared to confound the conceptually distinct influences of changes in statutory tax policy and changes in effective tax rates attributable to variations in inflation and the associated taxation of artificial inventory profits.

A second major strand of the literature examines the potential impact of the Tax Reform Act (TRA) of 1986 on business fixed investment. This body of research is discussed in Evans and Kenward (1988), and will thus not be reviewed at length here. The essential conclusion from that literature is that TRA raised the cost of capital for both machinery and equipment and nonresidential structures through the elimination of the investment tax credit and the shift to less generous depreciation allowances. These factors are generally judged likely to outweigh a possible enhancement of the efficiency of investment, resulting from the shift to a more neutral tax system.

A distinguishing feature of the empirical results presented later in the present paper is that the effects of all major tax policy changes undertaken thus far in the 1980s--ERTA/TEFRA and TRA--are treated in a common framework permitting an overall evaluation to be made. Most other studies have analyzed one episode or the other but not both.

2. Investment equations

The equations used in this study are based on the standard neoclassical theory of capital accumulation, according to which the optimal combination of factor inputs used by firms depends on the relative prices of those inputs. If output is produced under competitive conditions and if the production function is of the Cobb-Douglas type, the desired capital stock at each point in time will be given by the expression: 1/

$$K^d = \alpha \frac{Y}{C} \qquad (1)$$

where

K^d = desired net capital stock.
Y = output.
C = real user cost of capital.
α = a constant.

1/ The assumption that the production function is of the Cobb-Douglas type (that is, that the elasticity of substitution between capital and labor in production is unitary) is critical and generates a specification that is potentially susceptible to large effects of tax policy and the cost of capital on investment.

The flow of net investment is the change in the actual capital stock as it adjusts toward a new desired level. Because the actual capital stock can be changed only gradually over time, net investment (i.e., the change in the net capital stock) will depend on current and lagged values of the desired capital stock:

$$I_t^N = \beta(L)\Delta K_t^d \qquad (2)$$

where

I_t^N = net investment and

$\beta(L) = \beta_0 + \beta_1 L + \ldots + \beta_n L^n$

is a polynomial in the lag operator, L, such that $(L^j x_t = x_{t-j})$. Combining (1) and (2) and assuming that replacement investment is proportional to the lagged capital stock, we can write gross investment, I^g, as:

$$I_t^g = \gamma(L)\ \Delta(Y/C)_t + \delta K_{t-1} \qquad (3)$$

where

$\gamma(L) = \alpha\beta(L)$ and

δ is the rate of economic depreciation.

Equations such as (3)--pioneered by Jorgenson (see Hall and Jorgenson (1967))--are commonly used in empirical studies of investment behavior (for example, Kopcke, 1985). The variation that is used in this paper is based on the work of Bischoff (1971), as interpreted by Clark (1979). Bischoff's version of the neoclassical model incorporates the empirical observation that most changes in the capital-output ratio are embodied in new equipment and structures; existing capital goods are less often modified in response to fluctuations in the cost of capital. On this basis, Bischoff allows for different lags on the output and relative price terms so that the level of investment is affected by the level of relative prices and the change in output. That is:

$$I_t^g = \gamma_1(L)(Y_t/C_{t-1}) + \gamma_2(L)(Y/C)_{t-1} + \delta K_{t-1} \qquad (4)$$

Equation (4) was used in the empirical work presented subsequently, although it was found that the restrictions $\gamma_{1i} = -\gamma_{2i}$ could be imposed, resulting in gross investment being a function of a distributed lag on the change in output divided by the level of the cost of capital.

3. Fiscal incentives and the cost of capital

The cost of capital (C) plays a central role in the theory of investment outlined in the previous sub-section. This concept stems from the neoclassical theory of optimal capital accumulation (Hall and Jorgenson, 1967) in which the price of a capital asset is equated to the present value of after-tax services expected to accrue from that good. According to this approach, the cost of capital in real terms may be expressed as follows: 1/

$$C = q[i + \delta - \dot{p}^e(1 - \tau)] \ (1 - k - uz)/(1 - u) \qquad (5)$$

where,

- u = the marginal corporate tax rate.
- i = the average cost of funds. 2/
- δ = the rate of economic depreciation.
- $\dot{p}^e$ = the expected rate of change of the price of fixed assets. 3/
- τ = the tax rate on capital gains. 4/
- k = the investment tax credit per dollar of new investment.
- z = the present value of a dollar of depreciation deductions.
- q = the price of capital assets relative to the GNP deflator.

An important implicit assumption in the traditional cost of capital formulation is that each asset is depreciated for tax purposes only once. However, as observed by Gordon, Hines and Summers (1986), if a

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1/ For a derivation and detailed explanation of this formula, see Ott, Ott, and Yoo, 1975. It should be noted that if there are no taxes ($u = \tau = k = 0$), the formula reduces to $C = q(i + \delta - \dot{p}^e)$.

2/ A weighted average of the ten-year BAA corporate bond rate, the Standard and Poor's dividend/price ratio for common stocks and the three-month Treasury bill rate, which is used as the alternative cost of internally generated funds. Both the BAA bond rate and the Treasury bill rate are entered on an after-corporate tax basis. The weights are the respective proportions of total credit market debt owed by private business, an estimate of total business equity, and corporate cash flow, in the sum of these items.

3/ From 1979 onward, the ten-year ahead survey of expected inflation conducted by Drexel Burnham Lambert Inc. Prior to 1979, a four-quarter moving average of the University of Michigan's survey of one-year ahead consumer price expectations. A regression of the ten-year ahead survey on the moving average of the Michigan survey over the period 1979-84 had yielded a regression coefficient of unity.

4/ The maximum rate on capital gains.

liquid secondary market exists for a particular asset category (as is the case, for example, with several types of transportation equipment and pre-eminently with commercial structures), it may be possible for an asset to be depreciated for tax purposes several times by different owners. Such a practice--described as "asset churning"--would likely magnify the effects of depreciation concessions for such assets, and concomitantly, would magnify the negative effects stemming from withdrawal of previous concessions. Gordon et al suggest that such a process may have been at work in the case of hotels and office buildings, for which investment expenditure rose sharply in the wake of The Economic Recovery and Tax Act of 1981; subsequently there was a sharp decline in such expenditures when it became clear that the Tax Reform Act of 1986 would curtail previously generous depreciation allowances.

Capital gains taxation raises the level of the cost of capital--via the expected inflation term--and affects the time profile when either tax rates or inflation are changing (see equation (5)). In constructing the cost of capital in real terms, the variable τ is approximated in the empirical work by the (legislated) maximum rate on capital gains. It may be noted, however, that this may not be representative of the effective capital gains tax rate because capital gains are often deferred or excluded from tax at the end of the lifetime of the asset. To illustrate the implications of alternative assumptions about the tax rate on capital gains, two measures of the cost of capital variables are provided in the following tabulation. The first measure sets the capital gains tax rate to its maximum, while the second sets the tax rate to zero. The effect of setting the capital gains tax rate to zero is to lower the level of the cost of capital, especially in the early part of the decade when inflation was high.

	1982	1983	1984	1985	1986
Equipment					
Real cost of capital					
With capital gains tax rate set to maximum rate	9.7	8.6	9.4	9.3	8.3
With capital gains tax rate set to zero	8.1	7.3	8.2	8.3	7.3
Structures					
Real cost of capital					
With capital gains tax rate set to maximum rate	7.2	5.1	5.9	5.8	4.5
With capital gains tax rate set to zero	5.2	3.4	4.3	4.5	3.2

4. Estimation

Equations corresponding to (4) above were estimated by ordinary least squares (with a correction for serial correlation) over sample periods beginning in the first quarter of 1964. All variables were normalized with respect to middle expansion path GNP in order to reduce potential heteroskedasticity, and the restrictions $\gamma_{1i} = -\gamma_{2i}$ were imposed, as noted earlier. 1/

The changes to the investment tax laws during the 1980s were substantial and, in the case of the Tax Reform Act of 1986 (TRA), involved a fundamental shift in philosophy away from the previous approach of using tax concessions to encourage investment. Under these circumstances, a conventional investment function such as equation (4) could well fall victim to the so-called Lucas critique. 2/ In particular, after a change in tax regime, the behavioral responses of economic agents--in this instance, businesses--might change, with the result that empirical parameters, such as the Cobb-Doublas coefficient (α) or the adjustment coefficients (γ) might not be constant over time. Such a result would undermine the simulations reported in the next section.

With this in mind, Chow/Fisher tests to examine parameter stability were conducted. The equations were first estimated over a period to the third quarter of 1981, before the introduction of ERTA. The estimation period was then extended to the fourth quarter of 1985, covering the implementation of ERTA and TEFRA. Finally, the equations were estimated over a period extending to the second quarter of 1987. The producers' durable equipment equation passed the tests at the 5 percent significance level for both of these sub-periods. The structures equation exhibited stability in the first sub-period but marginally failed the Chow test at the 5 percent significant level--although it passed at the 1 percent significance level--in the latter sub-period. Reflecting these results, the out-of-sample dynamic forecast performance of the structures equation from the first quarter of 1986 to the second quarter of 1987 was poor while the machinery and equipment equation tracked developments reasonably well. A large part of the forecast error pertaining to the structures equation stemmed from the collapse of investment in the oil sector following the oil price fall at the end of 1985. This factor is not captured in the structures equation.

Passing a Chow test is only a necessary condition--it is not sufficient--for parameter stability; nevertheless, the test results provide some confidence that the 1980s tax legislation did not alter fundamental

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1/ The restrictions were not rejected at the 5 percent level by the appropriate F-test for both the structures and equipment equations.

2/ Lucas (1976) criticized standard econometric techniques of policy evaluation, arguing that when government policy changes in a fundamental way--when there is a "regime change" in his terminology--private economic behavior would shift in response, invalidating the assumption of constant economic structure.

investment behavior so that the effects of the tax changes can be adequately analyzed via their effects on the cost of capital using the empirically estimated equations. For the purpose of the counterfactual simulations discussed in Section IV, the estimation end period for both equations was chosen to be the fourth quarter of 1985, reflecting a desire to utilize as much information in the data sample as possible while retaining some residual doubts about parameter stability in the structures equation after the introduction of TRA.

Producers' durables

$$\frac{IE}{Y^*} = \sum_{i=0}^{14} w_i \frac{(Y_{-s} - Y_{-s-1})}{Y^*_{-s}\ CE_{-s-1}} \underset{(1.2)}{-10.31}\ (1/Y^*) + \underset{(22.0)}{0.088}\ (KE_{-1}/Y^*) - \underset{(2.2)}{0.003}D$$

$w_0 = 0.0066$ (4.8)
$w_1 = 0.0096$ (8.6)
$w_2 = 0.0118$ (10.5)
$w_3 = 0.0132$ (11.0)
$w_4 = 0.0139$ (11.1)
$w_5 = 0.0140$ (11.0)
$w_6 = 0.0136$ (10.6)
$w_7 = 0.0127$ (10.0)
$w_8 = 0.0115$ (8.9)
$w_9 = 0.0100$ (7.6)
$w_{10} = 0.0083$ (6.3)
$w_{11} = 0.0066$ (5.1)
$w_{12} = 0.0047$ (4.0)
$w_{13} = 0.0030$ (3.2)
$w_{14} = 0.0014$ (2.4)

$\Sigma w_i = 0.1410$

$\bar{R}^2 = 0.967$; DW = 2.15; $\rho = \underset{(13.0)}{0.82}$

Sample 1964:1 - 1985:4

Nonresidential structures

$$IS/Y^* = \sum_{i=0}^{12} v_i \frac{(Y_{-i} - Y_{-i-1})}{Y^*_{-i}\, CS_{-i-1}} + \underset{(1.2)}{23.39}\,(1/Y^*) + \underset{(4.7)}{0.037}\,(KS_{-1}/Y^*)$$

$v_0 = 0.00090$ (1.8)
$v_1 = 0.00099$ (2.3)
$v_2 = 0.00116$ (2.5)
$v_3 = 0.00138$ (2.8)
$v_4 = 0.00162$ (3.2)
$v_5 = 0.00185$ (3.7)
$v_6 = 0.00205$ (4.1)
$v_7 = 0.00218$ (4.3)
$v_8 = 0.00222$ (4.3)
$v_9 = 0.00214$ (4.2)
$v_{10} = 0.00190$ (4.0)
$v_{11} = 0.00149$ (3.8)
$v_{12} = 0.00086$ (3.6)

$\overline{\Sigma v_i} = 0.02074$

$\bar{R}^2 = 0.934$; DW = 1.30; $\rho = \underset{(19.0)}{0.90}$

Sample period 1964(1) - 1985(4)

Notation:

IE = investment in producers' durables, 1982 dollars.
IS = investment in nonresidential structures, 1982 dollars.
Y = GNP, 1982 dollars.
Y* = middle expansion path GNP, 1982 dollars. 1/
CE = the real cost of capital for producers' durables.
CS = the real cost of capital for nonresidential structures.
KS = the gross stock of nonresidential structures, 1982 dollars. 2/
KE = the gross stock of producers' durable equipment, 1982 dollars. 2/
D_2 = a dummy variable to allow for credit controls in 1980:II.
$\bar{R}^2$ = the adjusted coefficient of determination.
DW = the Durbin-Watson statistic.
ρ = the estimated serial correlation coefficient.

1/ See de Leeuw and Holloway (1983) and Holloway et. al. (1986) for a discussion of this concept.

2/ The use of the gross capital stock implies that economic depreciation follows a straight line rule. Using the net capital stock instead would imply exponential depreciation. The series for the quarterly capital stocks were constructed by a two stage process. First, given an assumed initial value, the actual quarterly gross investment flows, and depreciation rates, an initial quarterly capital stock series was constructed. The final quarterly series was then constructed by interpolating the available annual end-of-year capital stock series according to the pattern of the initially constructed series.

w_i and v_i are coefficients estimated using third degree Almon polynomial distributed lags with a zero end point constraint, and figures in parentheses beneath coefficients are t-statistics.

IV. Simulations with the Model

The estimated equations explain business fixed investment in terms of its proximate macro-economic determinants, such as output, expected inflation, the cost of funds, and tax variables. In this section, the results of simulations that assess the relative importance of the various contributing factors--in particular changes in tax incentives--are reported.

It should be noted that an additional avenue--the importance of which cannot be assessed in the present framework--through which changes in tax policy may affect macro-economic performance is via the efficiency of investment, rather than its magnitude. By reducing or eliminating a large number of tax preferences, the Tax Reform Act of 1986 (TRA) sought to "level the playing field"--that is, to ensure that different investment projects are taxed similarly--so that investment choices could be made on the basis of economic considerations, rather than for tax reasons. According to the 1987 Report of the Council of Economic Advisers, the investment efficiency effect of TRA would likely be to raise the level of output by only 0.1 percent in the long run; 1/ consequently the failure to incorporate this channel of influence is unlikely to be of major importance.

1. The effects of tax policy on the cost of capital

The 1981 Economic Recovery and Tax Act reflected the underlying view which had prevailed through much of the 1960s and 1970s--that the tax code should be used to encourage some activities and discourage others. In this instance, the activity to be encouraged was capital formation, and to this end incentives were provided to promote business fixed investment. The investment tax credit (ITC) was liberalized to cover a broader range of short-lived equipment, and the Accelerated Cost Recovery System (ACRS) for asset depreciation was introduced. Both these measures reduced the after-tax cost of capital for new equipment and nonresidential structures; the extension of the investment tax credit to a broader range of equipment raised the value of the variable k in equation (5) while ACRS increased the present value of depreciation allowances--the variable z in equation (5).

1/ Presumably the previous extension of tax preferences under ERTA had a negative investment efficiency effect, by making the playing field less level.

Under the 1982 Tax Equity and Fiscal Responsibility Act (TEFRA), tax incentives to investment were reduced, offsetting in part the effects of ERTA. 1/ The rationale for the changes was essentially twofold: first it was judged necessary to take measures aimed at reducing fiscal deficits, and second, the reduction in taxation of corporate income resulting from ERTA had led to concerns about tax equity. The planned extension of ACRS toward even more favorable depreciation methods (175 percent declining balance compared with 150 percent declining balance under ERTA) was withdrawn. In addition, some of the benefits of the ITC were withdrawn by reducing the depreciable base of assets by 50 percent of the ITC. Notwithstanding the changes introduced in TEFRA, the underlying approach of using the tax code to encourage business investment remained in place.

The Tax Reform Act of 1986 (TRA) made further substantial changes to tax laws affecting business fixed investment. 2/ In particular, the underlying philosophy of tax policy with regard to business investment became substantially less interventionist; henceforth, the tax code was to be as neutral as possible, rather than actively encouraging investment. The new view was that the additional investments encouraged by tax preferences were likely to be relatively inefficient. Consequently, it was better for investment decisions to be made with reduced attention to tax consequences. Such a result could be achieved by eliminating investment incentives, and at the same time lowering tax rates. In this vein, the investment tax credit was abolished, effective from the beginning of 1986, although the legislation was not passed until late in the year; depreciation schedules for both equipment and structures were made substantially less generous; and the maximum tax rate on capital gains was raised to 28 percent while the maximum corporate tax rate was reduced from 46 percent to 34 percent, effective from 1988. 3/

1/ The measures affecting business fixed investment contained in the Deficit Reduction Act (DEFRA) of 1984 were relatively minor.

2/ The provisions and possible implications of TRA are discussed in detail in Evans and Kenward (1988).

3/ In 1987, the rate was 40 percent.

Effect of Tax Changes on the Real Cost of Capital 1/

	1982	1983	1984	1985	1986	First Half 1987
A. Equipment						
Present value of depreciation allowances 2/	0.86	0.88	0.88	0.89	0.91	0.89
Excluding tax policy changes 3/	0.78	0.82	0.82	0.83	0.86	0.86
Real cost of capital	9.7	8.6	9.4	9.3	8.3	9.6
Excluding tax policy changes 3/	10.6	9.3	10.2	10.0	8.8	8.3
B. Structures						
Present value of depreciation allowances 2/	0.65	0.70	0.67	0.66	0.71	0.53
Excluding tax policy changes 3/	0.46	0.52	0.50	0.53	0.59	0.61
Real cost of capital	7.2	5.1	5.9	5.8	4.5	5.0
Excluding tax policy changes 3/	8.5	6.3	7.2	6.9	5.2	4.5

Chart 6 and the above tabulation show the estimated effects of tax policy changes on the real after tax cost of capital since 1981. In the case of equipment, the effect of ERTA was to raise the present value of a dollar of depreciation allowances from 78 cents to 86 cents. The changes in depreciation allowances, when combined with the more generous ITC, lowered the real cost of capital for equipment by 1 percentage point in 1982. As regards structures, the present value per dollar of depreciation allowances increased due to ERTA from 46 cents to 65 cents. As a result, the cost of capital for structures was 1 1/4 percentage points lower than it would have been in the absence of ERTA.

The benefit of the ITC on producers' durable equipment was reduced by TEFRA in 1983, offsetting in part the effects of ERTA on the cost of capital (see preceding tabulation). In 1983, the combined effects of ERTA/TEFRA lowered the cost of capital for equipment by 3/4 percentage points relative to what it would have been in the absence of both pieces of legislation. In the case of structures, both TEFRA and the 1984 Deficit Reduction Act had little impact on the cost of capital. In

1/ Figures for the present value of depreciation allowances are in dollars, while those for the cost of capital are in percent. Figures presented exclude relative price effects.

2/ Historical values for variable z in equation 5.

3/ Historical values that would have prevailed in the absence of changes in tax policy.

1984, the combined effect of all three pieces of legislation was to lower the cost of capital for structures by 1 1/4 percentage points compared with what it otherwise would have been.

As noted above, the Tax Reform Act of 1986 brought about further major changes to business taxation. The net effect was to increase the cost of capital substantially for both equipment and structures. The combined effect of ERTA/TEFRA/DEFRA and TRA was to push up the cost of capital for equipment and structures by 1 1/4 and by 1/2 percentage points, respectively, relative to what they would have been in the absence of all these pieces of legislation.

2. Tax policy simulations 1/

The first tax policy simulation was performed by assuming no change in the tax treatment of investment over the period 1981-87, and by comparing the path of investment simulated under that assumption with the path of investment predicted by the equation. It should be noted that actual values of output and interest rates were used in the simulation; no attempt was made to determine the secondary effects of tax policy on these variables or any repercussions of these effects on investment. The results of the simulation are presented in Table 4. On this basis, the stimulative effect of the legislative changes on investment amounted to roughly 2 percent of the level of both producers' durables and nonresidential structures by 1985.

By the second quarter of 1987, with the negative effects of the 1986 Tax Reform Act beginning to feed through, the joint impact of tax policy on both components of business fixed investment was estimated to have been positive by 1 percent--relative to a baseline simulation where none of the packages was enacted. Alternatively stated, these tax policy changes accounted for 1.3 percentage points of cumulative investment growth from the first quarter of 1983 to the second quarter of 1987.

In order to assess the long-run implications of the various tax packages, simulations were conducted from 1981 to 1991, with baseline values for the period 1987:3-1991:4 for GNP, interest rates and inflation in line with the August 1987 version of the IMF World Economic Outlook exercise. This approach was made necessary because the full impact of the Tax Reform Act (which took effect only in late 1986) would not be fully evident in simulations terminating in mid-1987. The

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1/ In the simulations, it was assumed that the retroactivity of ERTA to the beginning of 1981 was not anticipated by investors; the simulation was carried out as though there had been no change in legislation affecting the first three quarters of 1981. However, the retroactive abolition of the ITC under TRA, effective from the beginning of 1986, is assumed to have been fully anticipated--as it was widely forecast in the financial press. The other provisions of TRA were assumed to take effect from 1986:4.

results suggested that, by 1991, the effects of TRA on business fixed investment would dominate those from ERTA/TEFRA; by the fourth quarter of 1991 total business fixed investment would be 1 3/4 percent lower than had the tax code remained entirely as it was before 1981.

3. Other simulations

Three other sets of simulations were carried out to separate the contributions of different explanatory variables to the behavior of business fixed investment in the current expansion. In the first set of simulations, the average cost of funds was maintained at its exceptionally high level of the third quarter of 1982, while all other variables--including inflation--followed their actual historical paths. 1/ As a supplementary exercise, an additional experiment was run in which both the cost of funds and the inflation rate were held at their levels in the third quarter of 1982. 2/ In the second, the growth of output was constrained to equal the average growth of output in the only two postwar expansions of comparable length to the present one (see footnote 1 to Table 4). In the final simulation, the deflators for the two categories of investment goods--which declined relative to the GNP deflator during the recovery--were constrained to increase at the same rate as the GNP deflator during the current expansion.

4. Summary of simulation results

a. Factors underlying the growth of business investment, 1981-85

The most important factor accounting for the rapid rise in business fixed investment in the first phase of the expansion was the robust growth of output, which accounted for roughly three quarters of the total rise in fixed investment (Table 4). Among the other factors, the large drop in the cost of funds appears to have been the most important. Roughly three quarters of the effects attributed to the decline in the cost of funds stemmed from the reduction in real interest rates, while the remainder reflected positive effects from the simultaneous decline of both the nominal cost of funds and the rate of inflation. When both the inflation rate and the nominal borrowing cost decline, the present

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1/ In all simulations the capital stock was treated endogenously and assumed to accumulate in line with simulated investment.

2/ One major channel through which changes in inflation may influence after-tax profitability is with respect to inventories. When inflation increases, businesses become increasingly subject to taxation of artificial inventory profits, reducing profitability. If inventory accumulation and investment in fixed assets are both integral elements of the production process, then such taxation of artificial profits may curb not only the incentive to purchase inventory but also to accumulate fixed assets. However, in the standard formulation, as used in this paper, the incentives underlying accumulation of fixed capital are distinct from those affecting inventories, with the result that the mechanism just outlined is not present.

value of depreciation allowances is raised, which lowers the cost of capital, while at the same time the real after-tax borrowing cost increases because of the tax deductibility of interest payments. In the simulation conducted, the former effect outweighed the latter. The effect of the changing relative price of capital goods had a somewhat smaller impact, as did changes to tax policy. Each of these factors explained roughly 2 percentage points of the 36 percent growth in business fixed investment in the period to the fourth quarter of 1985. 1/

The simulation results account almost fully for the actual rise in business fixed investment in the period to the fourth quarter of 1985. However, this result reflects in part offsetting errors in the equations for producers' durable equipment and for nonresidential structures. The inability of each equation to explain fully the recent change in the composition of investment spending may reflect a shift in demand away from more traditional investment goods (such as industrial structures), toward high technology items such as electronic computing equipment where dramatic technological breakthroughs have occurred in recent years.

b. Factors underlying the behavior of business fixed investment, 1986-87

From the fourth quarter of 1985 to the second quarter of 1987, producers' durable spending remained roughly constant while investment in nonresidential structures plummeted. According to the simulation results presented in Table 4, the stagnation of producers' durable spending largely reflected the subdued rate of output growth compared to corresponding periods of other expansions of comparable length. Had output grown as rapidly as in comparable periods of the expansions beginning in 1960 and 1975, producers' durable spending would have been over 10 percent higher by mid-1987 than it actually was. In addition, the cost of funds and relative prices, while still moving so as to raise investment, had less pronounced effects than during the earlier years of the expansion. Finally, the implementation of TRA was working to reduce equipment spending.

The collapse of investment in nonresidential structures in the recent period is less well explained. Sluggish output growth played a role, and withdrawal of tax concessions was also important, as indicated in Table 4. A large part of the failure to explain developments in structures investment in this period is due to the collapse in oil sector investment following the plunge in world oil prices. Nevertheless, even after this component is separated out (Table 4), a significant negative residual remains. This leaves open the possibility that there are aspects of the Tax Reform Act that are not adequately captured

1/ It should be noted that since a unitary elasticity of substitution in production between labor and capital was assumed, the specification was potentially favorable to the existence of large tax policy effects.

in cost-of-capital calculations--which would be the case if "asset churning" as discussed earlier, had been a significant phenomenon.

V. Conclusion

Business fixed investment in the United States grew rapidly in the early stages of the current economic expansion. By contrast, from the end of 1985 to mid-1987, investment in producers' durable equipment stagnated while investment in nonresidential structures dropped sharply. A notable feature of the results of this paper is that these atypical developments in business fixed investment can largely be explained by a framework that relies on standard macro-economic factors.

According to the simulations carried out, the major reason for the robust growth of investment--particularly as regards producers' durable equipment--in the early years of the expansion was the rapid growth of output. The decline in the cost of funds was also important, while the falling relative prices of capital goods, and tax incentives provided by the 1981 and 1982 tax legislation played significant--but distinctly subsidiary--roles. The argument that the exceptional strength of investment in this phase of the expansion was a direct consequence of tax policy is not borne out by the evidence. The estimated model captures well the growth of business fixed investment over this period.

The main reason for the stagnation of investment in producers' durable equipment from late 1985 to mid-1987 is estimated to be the sluggish growth of output over that period, with the withdrawal of tax concessions under the Tax Reform Act of 1986 having appreciable, but secondary effects. Even after allowing explicitly for the collapse in petroleum drilling and mining, the decline in the remainder of investment in nonresidential structures is not well explained by the framework presented, suggesting that other factors may have been at work. In particular, it cannot be ruled out that the withdrawal of tax concessions under tax reform may be having a more pronounced impact than indicated here.

When simulations were conducted comparing actual business fixed investment with what would have occurred in the absence of all the tax packages over this period, the results indicated that the effect of the changes introduced in 1986 more than offset the effect of other changes to the tax code since 1981. Consequently, in the long-run, it seems likely that business fixed investment and the corporate capital stock could be lower than had none of these packages been enacted.

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Table 1. United States: Components of Nonresidential Fixed Investment

	1983:4	1984:4	1985:4	1987:2	1986:4	1987:2
	(Percentage change from first quarter of 1983)				(Percentage change from fourth quarter of 1985)	
Business fixed investment 1/	14.3	30.1	36.2	28.2	-4.7	-5.9
Producers' durable equipment	21.3	39.3	49.0	48.8	0.2	-0.2
High technology	23.5	58.4	85.0	88.2	4.1	1.7
Heavy industry	8.1	22.8	25.5	23.1	1.1	-2.0
Transportation equipment	35.5	44.8	46.4	39.5	-7.7	-4.7
Construction and agriculture	42.8	40.4	49.5	38.7	-11.9	-7.3
Other	9.2	17.4	12.7	22.3	5.7	8.5
Nonresidential structures	2.6	14.8	14.8	-6.1	-15.3	-18.2
Commercial	6.3	41.9	59.3	25.8	-13.3	-21.0
Public utilities	2.6	-4.7	-8.4	-5.7	0.9	3.0
Petroleum drilling and mining	5.8	13.7	-3.6	-39.3	-41.3	-37.1
Industrial	-21.2	-5.2	1.9	-25.3	-16.1	-26.7
Institutional 2/	8.3	6.1	10.6	12.8	2.6	2.0
Farm	7.8	-3.4	-47.5	-46.8	20.1	1.3
Other 3/	-4.9	56.8	99.6	33.1	-46.5	-33.2
Memorandum items:						
Business fixed investment excluding petroleum, etc.	15.2	31.9	40.7	35.8	-1.9	-3.5
Nonresidential structures excluding petroleum	1.5	15.2	21.6	6.2	-7.7	-12.7

Sources: U.S. Department of Commerce, Bureau of Economic Analysis; and staff calculations.

1/ High technology comprises office and store machinery (the great bulk of which is computers), communications equipment, scientific and engineering equipment, and photographic equipment. Heavy industry consists of steam engines, internal combustion engines, electric transmission and distribution equipment, metal-working machinery, special and general industry machinery, and fabricated metals. Transportation equipment includes trucks, cars, aircrafts, ships and boats, and railroad equipment. Construction and agricultural equipment comprises construction machinery and tractors, and farm machinery and tractors. The other component includes service industry equipment, household and other furniture and appliances, mining and oilfield machinery, miscellaneous electrical, and other equipment and scrap.

2/ Includes religious and educational buildings, and hospitals.

3/ Comprises brokers' commissions, net purchases of used structures and all other private nonresidential structures.

Table 2. United States: Selected Service Lives by Type of Assets

	Service Life (Years)	Share of Gross Fixed Business Investment (Percent)	
		1958	1986
Equipment			
Office, computing, and accounting machinery	8	1.3	16.2
Trucks, buses, and trailers	9	7.7	9.6
Autos	10	2.5	4.2
Electrical and communication equipment	14	2.8	9.3
Structures			
Industrial buildings	27	6.1	2.7
Commercial buildings	36	9.3	11.1
Institutional buildings	48	8.0	3.9
Public utilities	26-51	12.6	5.4

Sources: U.S. Department of Commerce, Bureau of Economic Analysis; and staff calculations.

Table 3. United States: Principal Legislative Changes Affecting Business Fixed Investment, 1980-87

1981	The Economic Recovery Tax Act (ERTA) was passed in August 1981 but was applicable to investment after December 31, 1980. Its main points included: (i) The introduction of the Accelerated Cost Recovery System (ACRS) for calculating depreciation allowances. Under this system the number of asset depreciation classes allowed under the previous Asset Depreciation Ranges System (ADR) was lowered to four and the average length of tax lives was reduced. For equipment the average life is estimated to have fallen from 10.5 to 4.6 years; for structures the estimated decline is from 40 to about 15 years. Partly offsetting this shortening of tax lives was a change to less generous depreciation schedules. For equipment, the 150 percent declining balance method replaced the previously allowed 200 percent declining balance and sum-of-years digits methods under ADR. More generous 175 percent declining balance methods were allowed for structures. Over the years 1983-86, the depreciation schedules were scheduled to become progressively more accelerated. (ii) The investment tax credit (ITC) was extended to some short-term assets not previously covered. For equipment, it is estimated that the average tax credit rose from 8.7 to 8.9 percent. (iii) Leasing laws were relaxed making it easier for a firm without current profits to take full advantage of investment tax allowances through intermediate leasing firms.
1982	The Tax Equity and Fiscal Responsibility Act (TEFRA) which was effective from January 1, 1983 contained the following changes: (i) The acceleration of depreciation schedules that had been proposed under ERTA was canceled. (ii) The depreciable base of an asset was reduced by 50 percent of the value of the ITC. 1/ (iii) Some of the "safe-harbor" leasing clauses of the ERTA were made more restrictive, although leasing was still comparatively easier than in the period before 1981.
1984	The Deficit Reduction Act (DEFRA), with effect from March 16, 1984 increased the top depreciation tax life from 15 to 19 years.
1986	The Tax Reform Act (TRA) took effect from October 22, 1986. Its enactment took almost 12 months to be completed, and some major provisions--such as the retroactive abolition of the investment tax credit--had been widely anticipated since late 1985. The investment tax credit was abolished effective from the beginning of 1986. The depreciation life for nonresidential structures was raised from 19 to 31.5 years, and for producers' durable equipment on average from 4.6 to 6 years. Machinery and equipment was to be depreciated by 200 percent declining balance (previously 150 percent) and nonresidential structures by straight line (previously 175 percent declining balance). The maximum tax rate on capital gains was raised to 28 percent and the maximum corporate tax rate cut to 40 percent in 1987 and 34 percent from 1988 onward, from 46 percent previously.

1/ For example, in the case of an investment tax credit of 10 percent, the depreciable base of an asset became 95 percent of the purchase price.

Table 4. United States: Sources of Change in Business Fixed Investment

(As percent of investment in the first quarter of 1983)

Year	Actual Change	Normal Output Recovery 1/	Above Average Output Recovery 2/	Lower Cost of Funds 3/	Changes in Relative Prices 4/	Tax Policy 5/	Petroleum Drilling Collapse 6/	Residual 7/
			A. Nonresidential Fixed Investment					
1983:IV	14.3	8.6	0.8	1.8	0.3	0.6	--	1.7
1984:IV	30.1	17.1	4.8	4.2	1.1	1.6	--	-1.0
1985:IV	36.2	23.6	1.6	4.8	1.7	1.9	--	-0.1
1987:II	28.2	31.1	-8.9	5.1	2.5	1.3	-3.6	2.0
			B. Producers' Durables					
1983:IV	21.3	10.7	1.0	1.9	0.3	0.5	--	5.6
1984:IV	39.3	22.3	6.3	4.8	1.3	1.6	--	-0.7
1985:IV	49.0	31.2	2.1	5.5	2.3	2.0	--	1.0
1987:II	48.8	41.9	-11.5	6.2	3.6	1.5	--	6.1
			C. Nonresidential Structures					
1983:IV	2.6	5.0	0.4	1.6	0.3	0.7	--	-5.2
1984:IV	14.8	8.4	2.4	3.2	0.7	1.7	--	-2.1
1985:IV	14.8	9.0	0.8	3.5	0.8	1.9	--	-1.7
1987:II	-6.1	13.4	-4.6	3.3	0.6	1.0	-9.7	-8.4

1/ Normal growth was taken to be the average of output growth that took place in the economic expansions that began after troughs in real GNP in 1960:IV and 1975:I. The subsequent expansions were the only two of comparable length to the present one. The calculation was made by comparing results from a simulation with normal output growth thus defined, to one with real GNP held constant at its value of 1982:IV.

2/ Calculated by comparing a simulation with actual output growth to one with "normal" output growth.

3/ Calculated using a simulation in which the cost of funds was held at its 1982:III value.

4/ Calculated using a simulation in which the relative prices of investment goods were held at their 1982:III values.

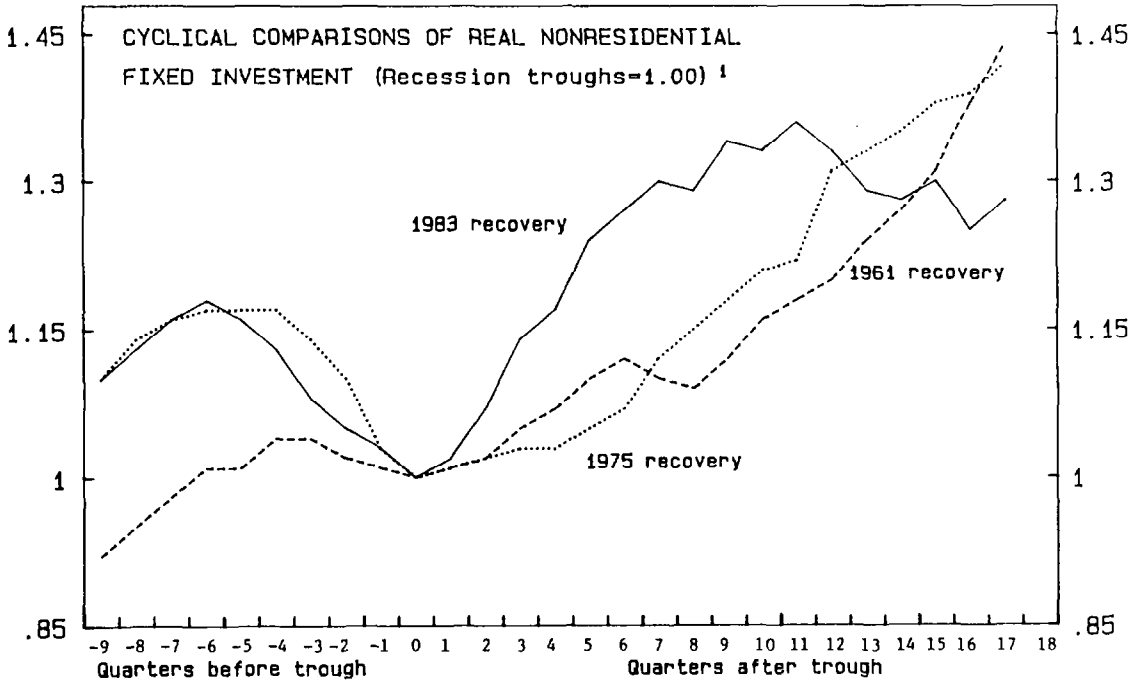
5/ Calculated by comparing simulation assuming that none of the changes in tax policy from 1981 onward took place to one in which all the changes took place.

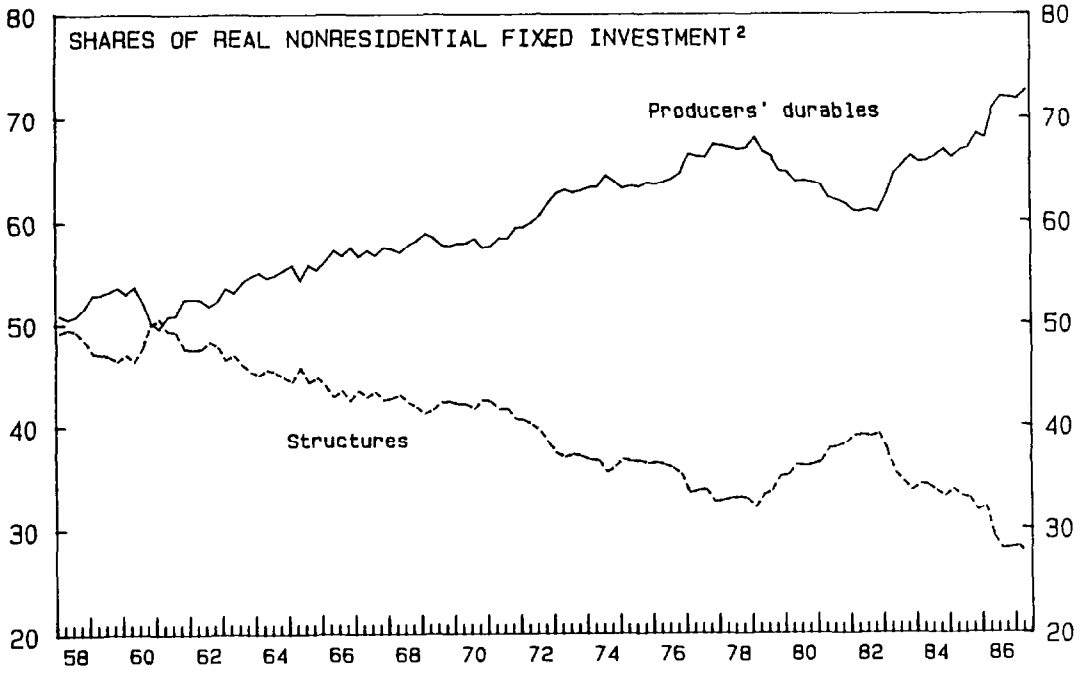
6/ Calculated multiplicatively. A positive residual indicates growth in investment in excess of that explained by the contributing factors.

CHART 1

UNITED STATES

BUSINESS FIXED INVESTMENT



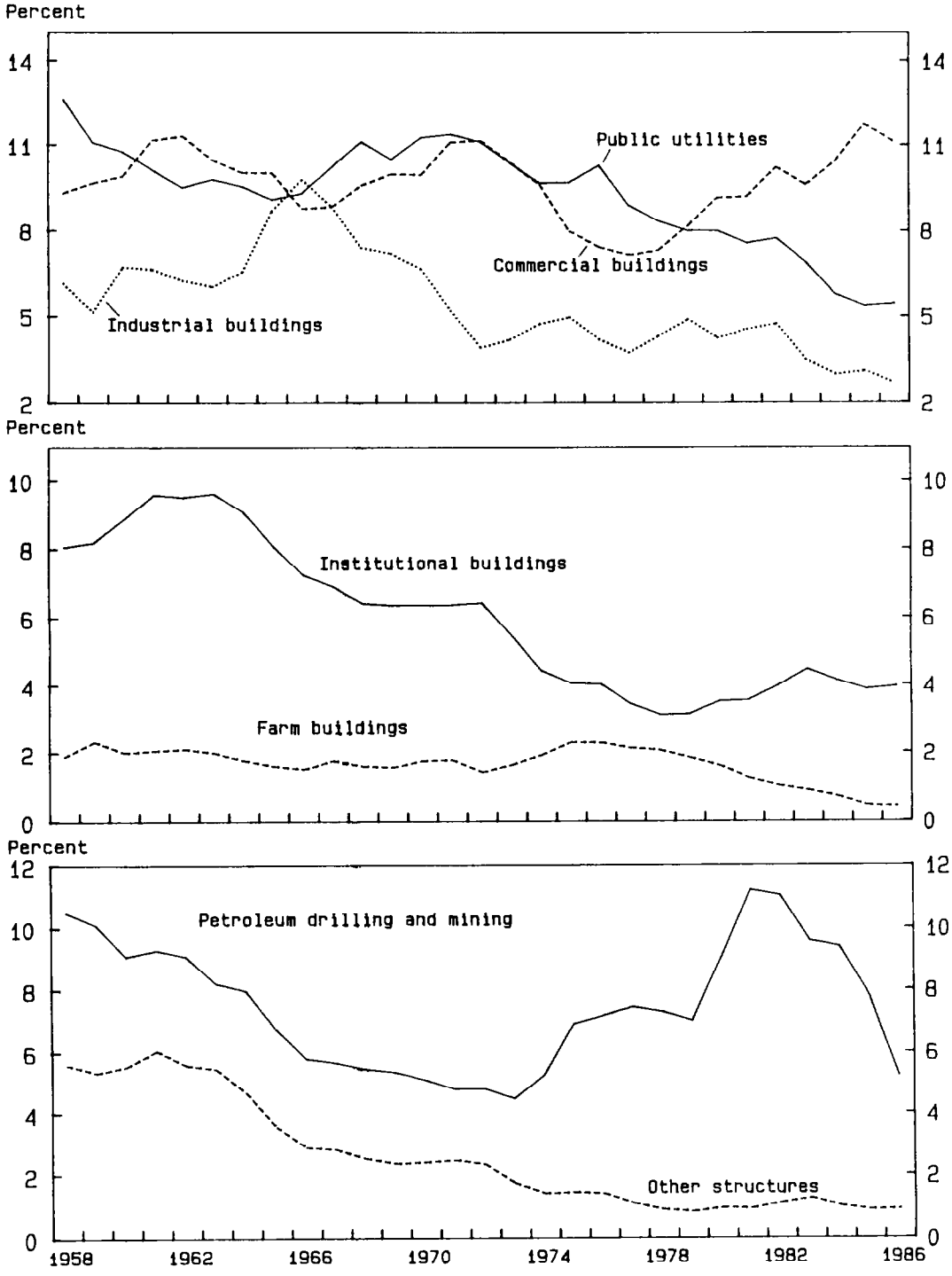


[1]The troughs in business fixed investment employed were 1961, first quarter; 1975, second quarter; and 1983, first quarter.

[2]In real terms.

CHART 2

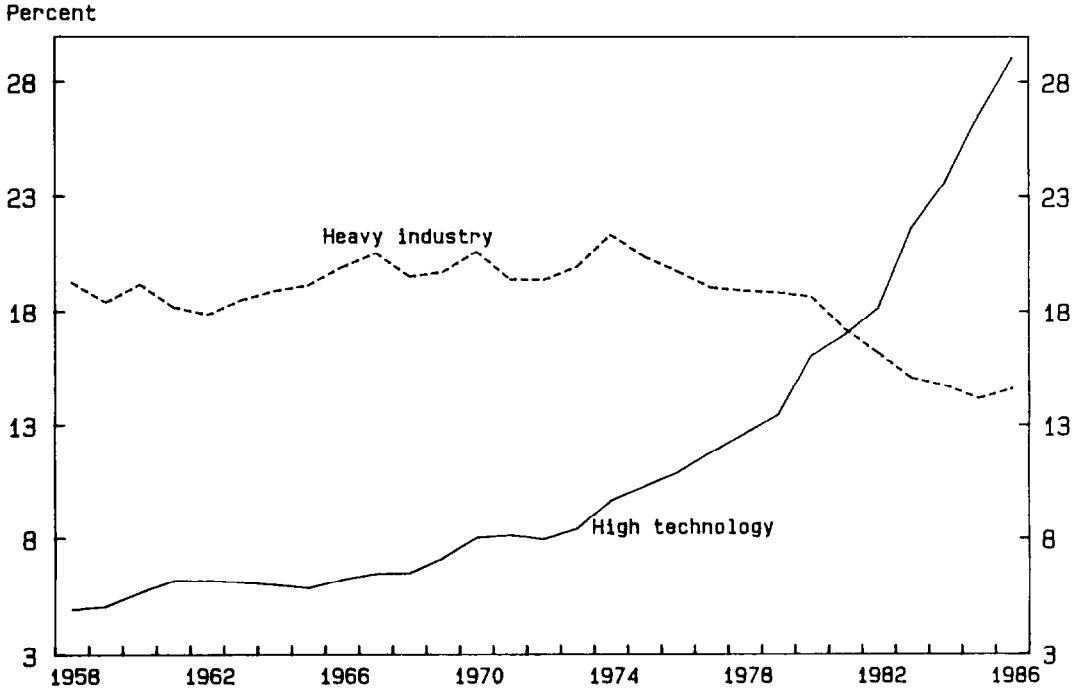
UNITED STATES
SHARES OF REAL NONRESIDENTIAL FIXED INVESTMENT[1]

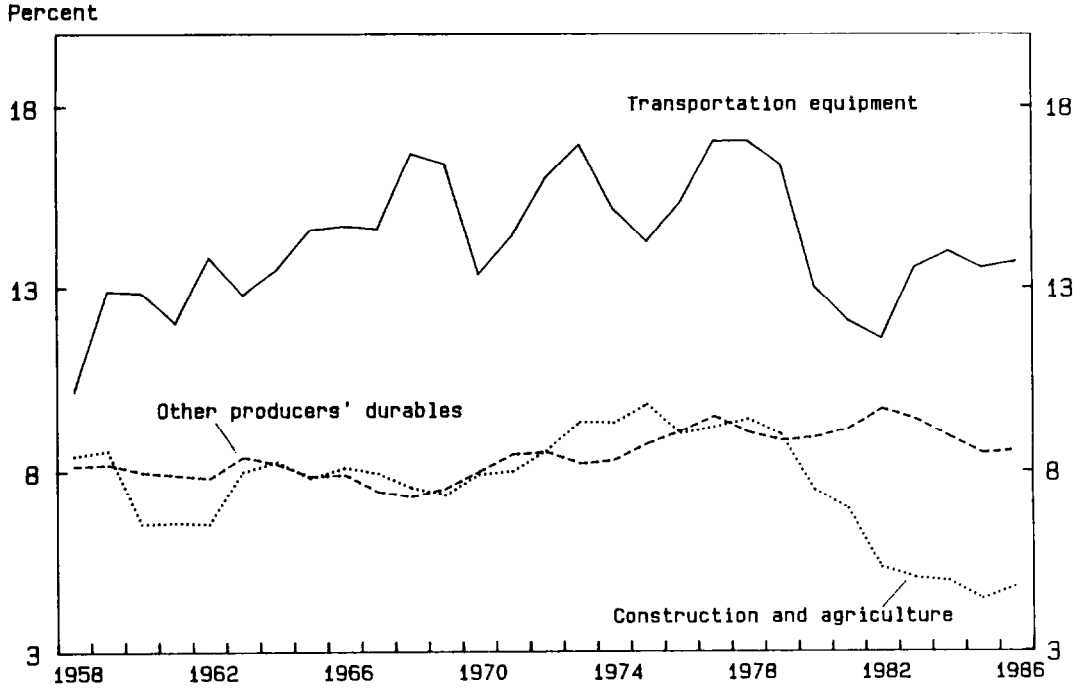


[1]In real terms.

CHART 3

UNITED STATES
SHARES OF REAL NONRESIDENTIAL FIXED INVESTMENT[1]



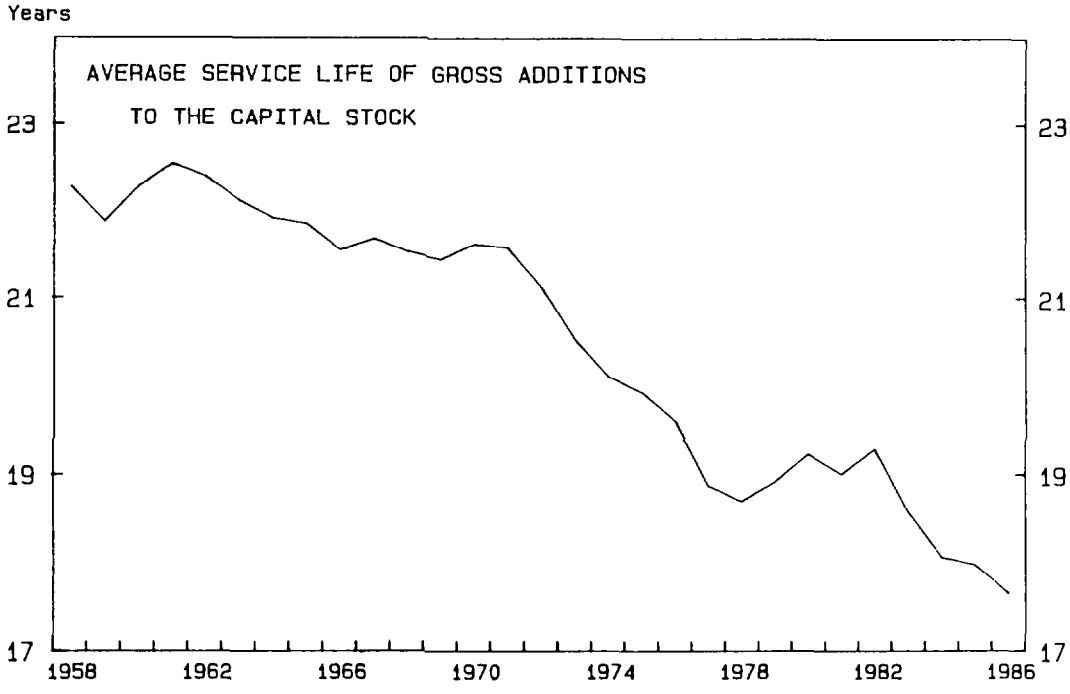


[1] In real terms.

CHART 4

UNITED STATES

NONRESIDENTIAL FIXED INVESTMENT



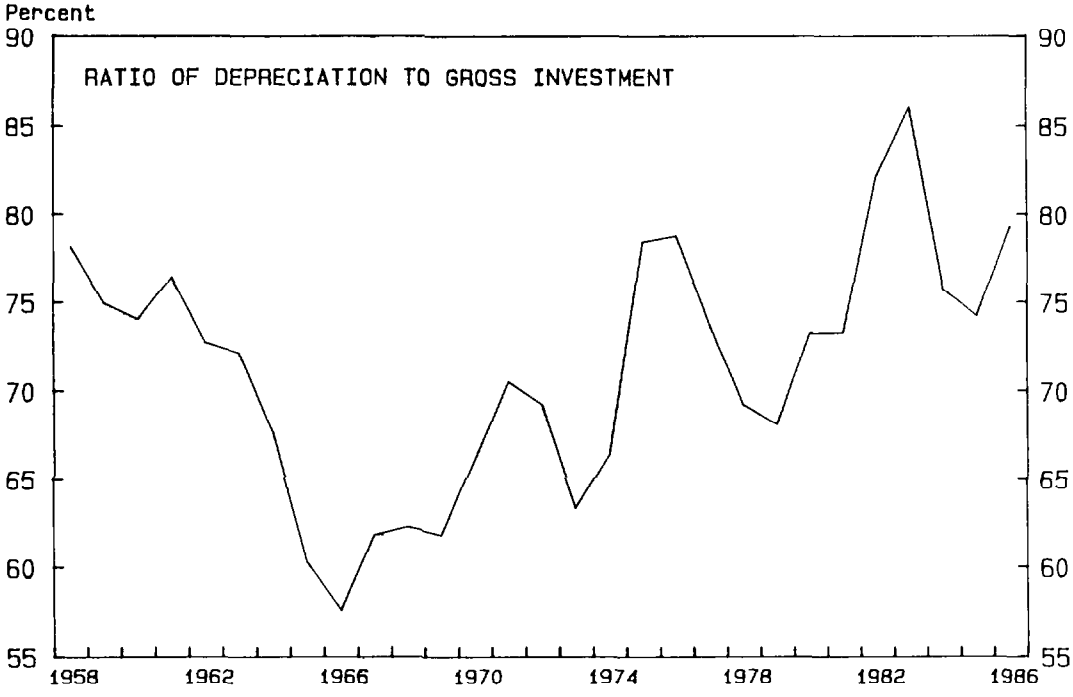
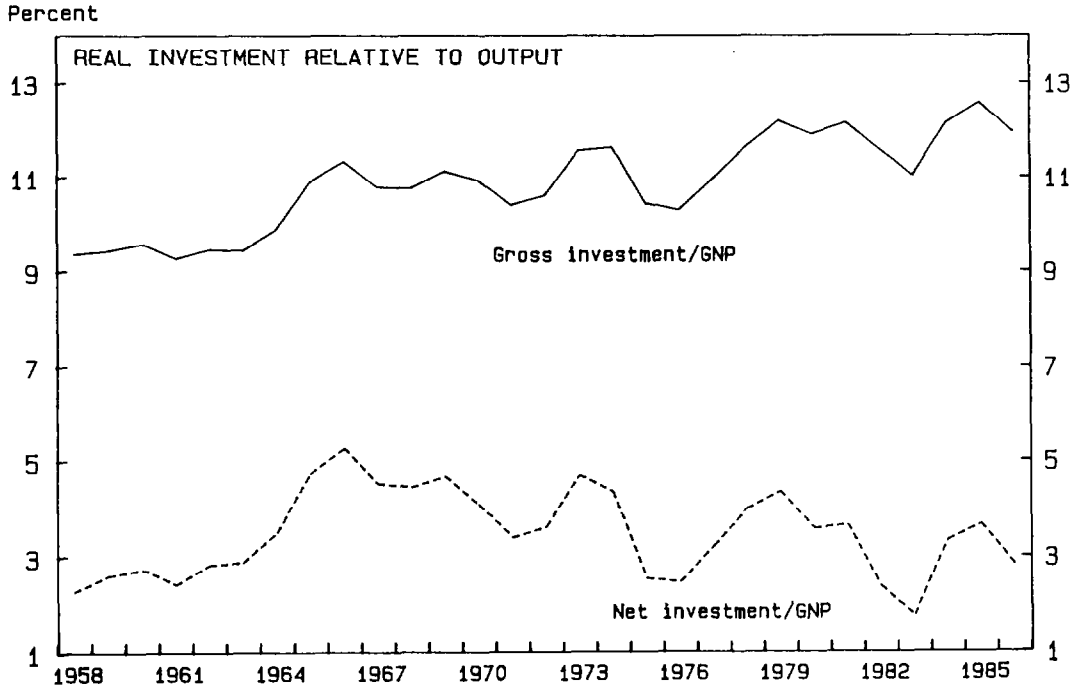


CHART 5

UNITED STATES

NONRESIDENTIAL FIXED INVESTMENT



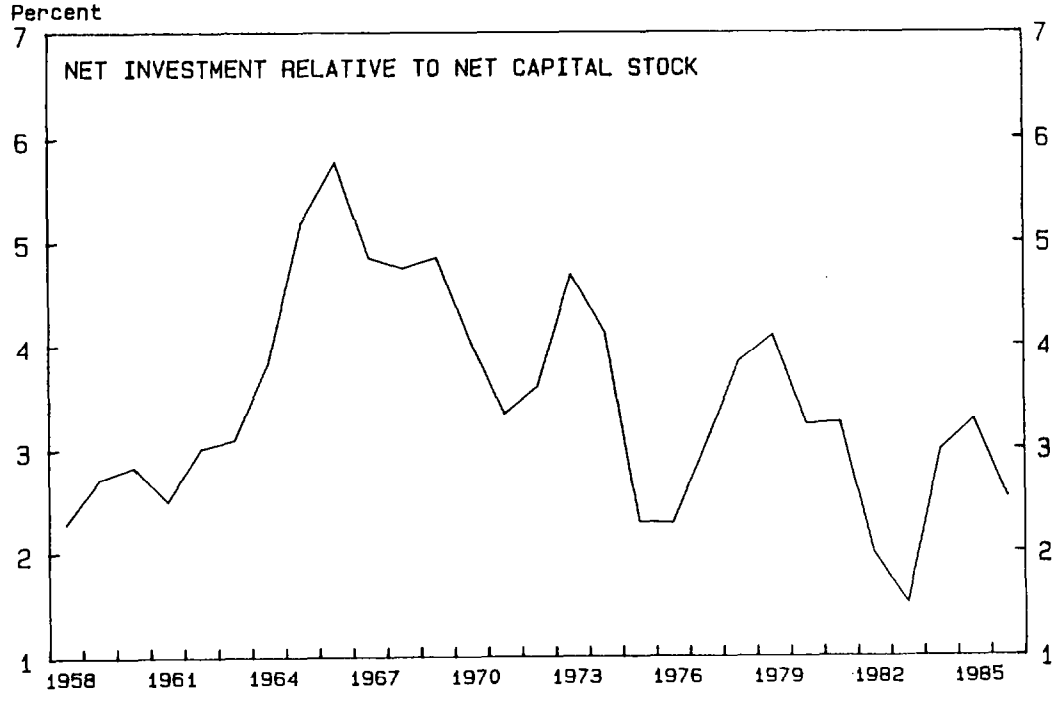


CHART 6

UNITED STATES

REAL USER COST OF CAPITAL