PART II: SAVING AND INVESTMENT

Tax Policy and Corporate Investment

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Introduction

The proposition that the level of business fixed investment in the United States should be increased commands almost universal support. Increasing the rate of investment is widely seen as a panacea for a variety of economic problems including inflation, declining productivity, and the fall of the dollar. While there is agreement as to the inadequacy of business fixed investment, there is little agreement as to the causes of the shortfall. For example, in a recent proceedings volume of the *American Economic Review*, Alan Blinder concludes with Robert Hall that "The principal source of inadequate capital formation has been our failure to do anything about recessions, not our active use of anti-investment stimulative policies," while Martin Feldstein (1980) argues that the interaction of inflation and taxation accounts for much of the decline in corporate capital accumulation that has taken place over the last decade.

This paper presents an overview of the issues connected with the relationship between tax policy and corporate investment. In the first section of the paper, post-war trends in capital formation and corporate sector profitability are examined. While the share of gross investment in GNP has remained almost constant, the rate of net productive investment expressed as either a fraction of GNP or of the capital stock has fallen sharply during the 1970s. This decline has been associated with a substantial fall in the market price of corporate capital, and in the after-tax rate of return to investors in the corporate sector. The reduction in after-tax returns to corporate investors, while partially related to a fall in the pre-tax rate of return on capital, is in large part due to the interactions of inflation and our non-indexed tax system.

The second section presents a cautious view of the social gains from increased corporate investment. Even a large increase in net

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business investment would not be sufficient to offset more than a small part of the productivity slowdown. Given a fixed path of monetary policy, tax reductions to spur investment are likely to increase rather than reduce the rate of inflation. The real payoff from increased investment, it is argued, comes from the very favorable terms of trade between consumption today and tomorrow. Foregoing a dollar today leads to an increase in potential consumption of two dollars only seven years hence. At these rates, most persons would find more investment attractive.

Traditional econometric studies of the relationship between tax policies and investment are reviewed in the third section. It is argued that the type of investment equations embodied in most large scale econometric models do not offer meaningful guidance as to the effects of tax policy on investment. Since output is traditionally held constant, the capacity effects of increased investment cannot be captured in these formulations. As fundamental, the usual approach yields results which are very inconsistent with the assumption that expectations are rational. As an example of the misleading nature of standard econometric investment equations, the role of general expansionary policy as a device for spurring investment is considered. It is argued that as long as one accepts the view that there is no long run Phillips curve tradeoff, it is not possible for the level of general stimulus to have any effect on the long-run growth of the capital stock. The accelerator does not offer a useful route to increasing corporate investment.

An alternative methodology for viewing corporate investment incentives is presented in the fourth section. It is shown that an asset price approach to evaluating investment incentives avoids the difficulties inherent in traditional investment equations and avoids the "Lucas critique" of being unstable across changes in policy regimes. The effects of various tax policies on investment are analyzed using this approach. It is argued that through judicious policy choices substantial stimulus to investment can be achieved without any large revenue cost to the government.

The fifth section examines the general equilibrium effects of a change in business taxation. It is argued that business tax incentives can only spur investment if the supply of savings flowing to the corporate sector is increased. This can occur in one of two ways. An increase in the after-tax rate of return may raise the savings rate. Alternatively, it may lead to an increase in the share of wealth allocated to the corporate sector. Each of these mechanisms is examined briefly. The paper concludes by discussing the appropriate macroeconomic policy mix to accompany business tax reductions.

INVESTMENT AND THE PERFORMANCE OF THE NON-FINANCIAL CORPORATE SECTOR

This section examines trends in the rate of non-financial corporate investment, and profitability during the post-war period. The focus here is on corporate capital formation because its alleged deficiencies have received the most attention and it is most plausibly influenced by tax policies. It is important to recognize, however, that corporate investment makes up only about 60 percent of the total. About 25 percent of investment is residential and the remainder is done by non-corporate business. The trends illustrated here hold for total business investment as well. There have been rather divergent movements in the rate of residential investment and the valuation of housing capital. These are examined in the paper's final section.

TRENDS IN THE RATE OF CORPORATE INVESTMENT

Various measures of the rate of non-financial corporate capital investment are displayed in Table 1. The type of measure most usually relied on, a comparison of gross investment with gross output, is shown in Table 1. It has been surprisingly constant throughout the 1951-79 period, and has been close to its long-term average during the last decade. However, focusing on gross investment may be very misleading. The key variable for economic performance is the rate of growth of the capital stock. This depends on net investment rather than gross investment. The rate of net investment as a fraction of gross corporate product has declined quite sharply in the last decade as shown in column 2.[1] While it averaged 0.036 over the entire 1951-79 period, it averaged only 0.024 during the 1975-79 recovery period. This corresponds to a 33 percent reduction in the rate of net capital formation.

There is a second important issue involved in assessing investment performance during the 1970s. Regulatory requirements imposed in order to protect the environment and workers' safety have forced

[1] These estimates are based on the assumptions of straight line depreciation and service lines of .85 Bulletin F. There is a strong argument to be made that both these assumptions are conservative and so these figures understate depreciation and overstate net investment.

TABLE 1
Alternative Measures of the Rate of Non-Financial Corporate Investment

Year	Gross I / Y	Net I / Y	Pollution Adjusted Net I / Y	Pollution Adjusted Net I / K
1951	0.138	0.045	0.045	0.043
1952	0.134	0.038	0.038	0.036
1953	0.138	0.042	0.042	0.041
1954	0.137	0.034	0.034	0.031
1955	0.136	0.039	0.039	0.038
1956	0.146	0.047	0.047	0.045
1957	0.146	0.044	0.044	0.041
1958	0.131	0.021	0.021	0.018
1959	0.124	0.022	0.022	0.021
1960	0.131	0.030	0.030	0.028
1961	0.128	0.025	0.025	0.024
1962	0.129	0.033	0.033	0.032
1963	0.125	0.031	0.031	0.032
1964	0.130	0.039	0.039	0.041
1965	0.141	0.053	0.053	0.057
1966	0.146	0.059	0.059	0.064
1967	0.139	0.049	0.047	0.050
1968	0.136	0.047	0.045	0.048
1969	0.138	0.048	0.046	0.048
1970	0.133	0.037	0.034	0.034
1971	0.129	0.032	0.027	0.027
1972	0.128	0.035	0.029	0.031
1973	0.135	0.043	0.036	0.039
1974	0.140	0.040	0.033	0.033
1975	0.123	0.016	0.009	0.008
1976	0.120	0.017	0.010	0.010
1977	0.127	0.027	0.021	0.021
1978	0.124	0.028	0.022	0.024
1979	0.127	0.032	0.025	0.027

TABLE 1 (continued)

51-54	0.137	0.040	0.040	0.038
55-59	0.137	0.035	0.035	0.032
60-64	0.129	0.037	0.031	0.031
65-69	0.140	0.051	0.050	0.053
70-74	0.133	0.037	0.032	0.032
75-79	0.124	0.024	0.017	0.018
T 51-79	0.133	0.036	0.034	0.034

Source: as described in text.

firms to engage in capital investment.[2] This investment does not add to the productive (in terms of measured output) capital stock. Hence, it should not be included in assessing changes in capacity expanding investment. Data is available from the Department of Commerce on the share of investment outlays devoted to pollution control but not for occupational safety. These outlays have risen sharply during the 1970s. In columns 3 and 4, net productive investment is expressed as a fraction of gross corporate output, and of the corporate capital stock. They show very pronounced declines during the 1970s. The rate of growth of the non-financial corporate sector's capital stock in column 4 averaged only 2.5 percent during the 1970s compared with 3.9 percent during the 1951-1969 period. A similar pattern is exhibited by the data in column 3. The evidence suggests that the rate of corporate capital formation has declined significantly during the 1970s. This conclusion would be strengthened if account were taken of occupational safety investment expenditures, and the more rapid depreciation of the capital stock, which has occurred due to rising energy prices.[3]

[2]It should be emphasized that pollution control expenditures are productive, in that they provide for clean air and water. These benefits are real even though they do not show up in measured GNP. However, there is no apparent reason why a social decision to increase environmental quality should lead to a decline in the rate of "normal" investment. Hence, the appropriate standard of comparison is investment net of pollution control expenditures.

[3]The impact of higher energy prices has been to reduce substantially the value of existing capital which is energy inefficient. If this extra component were added to depreciation, estimated net investment would decline even further. If one assumes that the energy shock rendered even 5 percent of the capital stock obsolete, the average net investment rate over the last seven years declines by .007, or over one-fourth of its average level.

TABLE 2
Cyclically Adjusted Rates of Investment

Year	Gross I / Y	Net I / Y	Pollution Adjusted Net I / Y	Pollution Adjusted Net I / K
1956	0.143	0.042	0.042	0.039
1957	0.144	0.041	0.041	0.037
1958	0.136	0.038	0.038	0.039
1959	0.132	0.032	0.031	0.030
1960	0.135	0.037	0.037	0.036
1961	0.134	0.041	0.041	0.041
1962	0.135	0.041	0.040	0.040
1963	0.127	0.034	0.034	0.035
1964	0.130	0.037	0.037	0.038
1965	0.138	0.046	0.046	0.049
1966	0.140	0.047	0.047	0.050
1967	0.131	0.035	0.033	0.034
1968	0.127	0.029	0.029	0.030
1969	0.129	0.031	0.029	0.029
1970	0.127	0.029	0.026	0.026
1971	0.128	0.032	0.027	0.027
1972	0.128	0.033	0.027	0.028
1973	0.131	0.036	0.028	0.030
1974	0.136	0.035	0.028	0.027
1975	0.128	0.033	0.027	0.030
1976	0.130	0.032	0.025	0.027
1977	0.132	0.034	0.028	0.029
1978	0.125	0.027	0.021	0.022
1979	0.125	0.028	0.021	0.022
56-59	0.139	0.038	0.038	0.036
60-64	0.132	0.038	0.038	0.038
65-69	0.133	0.038	0.037	0.038
70-74	0.130	0.033	0.027	0.028
75-79	0.128	0.031	0.024	0.026
T 56-79	0.132	0.036	0.033	0.033

Source: as described in text.

Even casual inspection of Table 1 shows that the state of the business cycle has a large impact on the rate of corporate investment. The rate of investment by any of the measures peaks in the boom years of the mid-60s, and reaches its low in 1975. In assessing the long-term trends which should guide tax policy, it is useful to abstract from cyclical factors. This is done by calculating the cyclically adjusted rates of investment shown in Table 2. The cyclical adjustments are based on regression equations of the form:

$$R_t = \alpha_0 + \alpha_1 RUMM_t + \alpha_2 RUMM_{t-1} + u_t$$

where R_t is the rate of investment, and $RUMM_t$ is the married-male unemployment rate which is used as a cyclical indicator.[4] The cyclically adjusted investment rate $\hat{R}_t$ is calculated as:

$$\hat{R}_t = R_t - \alpha_1 (RUMM_t - \overline{RUMM}) - \alpha_2 (RUMM_{t-1} - \overline{RUMM})$$

It corresponds to the rate of investment which would have taken place if the unemployment rate had been at its mean level.

The results show that the decline in net productive investment in the 1970s is not a cyclical artifact. The share of corporate product (column 3) going to this source on a cyclically adjusted basis has declined from 3.8 percent during the 1956-1959 period to 2.5 percent during the 1970s. Thus, the decline in investment is almost as great on a cyclically adjusted basis as on a cyclically unadjusted basis. This conclusion also holds for the other measures of the investment rate. The conclusion that the 1970s have witnessed a large reduction in investment, inexplicable on the basis of cyclical factors, appears almost inescapable. Below we examine some possible underlying causes including the rate of profit and the extent of capital taxation.

TRENDS IN CORPORATE PROFITABILITY

The data in Tables 1 and 2 illustrate the declines in investment. Table 3 shows how various indicators of corporate profitability have evolved over the last 25 years. The first column shows the pre-tax rate of profit of the corporate sector. While the rate of profit has declined somewhat in the 1970s, it appears to have been fairly constant at about 11 percent over the entire period. The second column shows the total tax rate on corporate capital arising from

[4] Similar results were obtained using other indicators of the cyclical conditions such as the unemployment rate of all men 25 and over, the GNP gap, and the rate of capacity utilization.

TABLE 3
Corporate Sector Profitability

Year	[a]Total Rate of Return	[b]Total Effective Tax Rate	[b]Real Net Rate of Return	[c]Ratio of Market Value to Replacement Cost of Net Assets
1955	13.2	66.5	4.4	0.92
1956	11.4	72.4	3.2	0.92
1957	10.5	71.7	3.0	0.85
1958	9.0	70.7	2.6	0.87
1959	11.2	67.3	3.6	1.04
1960	10.4	66.5	3.5	1.02
1961	10.3	66.4	3.5	1.14
1962	11.7	61.5	4.5	1.09
1963	12.4	60.6	4.9	1.20
1964	13.4	56.2	5.9	1.29
1965	14.5	55.1	6.5	1.35
1966	14.5	56.0	6.4	1.20
1967	13.0	56.4	5.7	1.21
1968	13.0	62.6	4.9	1.25
1969	11.7	67.3	3.8	1.12
1970	9.6	70.5	2.8	0.91
1971	10.0	67.7	3.2	1.00
1972	10.8	62.5	4.1	1.07
1973	10.5	70.1	3.1	1.01
1974	8.2	90.1	0.8	0.75
1975	8.6	72.4	2.4	0.71
1976	9.5	68.1	3.0	0.80
1977	9.7	68.3	3.1	0.73
1978	9.7	72.2	2.7	0.68
1979	9.1	74.5	2.3	0.65

Sources:

[a]Feldstein and Poterba, "State and Local Taxes and the Rate of Return on Non-Financial Corporate Capital," NBER Working Paper #508R, p. 10.

[b]*Ibid.*, p. 23

[c]Economic Report of the President, 1980, Table B-85.

the combination of federal and state taxes at both the corporate and individual levels. A fuller discussion of the calculation of these effective tax rates is contained in Feldstein and Summers (1979) and Feldstein and Poterba (1980). These data clearly show a very pronounced increase in the taxation of corporate capital during the 1970s. The tax rate has risen from 55.1 percent in 1965 to 74.5 percent in 1979.

This increase in taxes has largely been the result of inflation. Inflation increases the taxation of corporate capital in three ways. The two most important are historical depreciation, which added over $25 billion to corporate tax liabilities in 1979, and the taxation of nominal inventory profits which raised corporate tax liabilities by over $30 billion in 1979.[5] In addition, the taxation of nominal capital gains is estimated to have imposed a tax burden of over $10 billion. It is frequently argued that these effects are offset by the fact that corporations can deduct nominal interest payments for tax purposes. This gain to corporations, however, is itself almost completely offset by the increase in individual taxes on nominal interest. Feldstein and Summers (1979) show that in assessing the total tax burden on corporate capital, the taxation of nominal interest nets out and can be neglected.

The after-tax rate of return on corporate capital is displayed in the third column. In the late 1970s it fell to only about one-half of its level during the late 1960s. From columns 1 and 2 it can be seen that over half of this fall can be attributed to increased taxes rather than to a decline in the pre-tax rate of return. This suggests that it may be taxation more than any decline in the return to capital which has accounted for the 1970s investment slowdown.

The values of Tobin's q ratio of the market value of the capital stock to its replacement cost are shown in column 4. The large decline in the value of q during the 1970s of course stands out. It is noteworthy that the 50 percent fall in q from the late 1960s almost exactly parallels the fall in the net return to corporate capital shown in Table 3. It appears that a significant portion of the fall in the total market valuation of corporate capital can be attributed to the extra tax burdens imposed by inflation. If one accepts a "q" theory of investment of the type discussed in the fourth section, this provides further support for the hypothesis that increased taxation

[5]This extra tax burden is in some sense voluntary since firms could avoid it by switching to LIFO inventory accounting. This does not make it less real. Firms presumably stay with FIFO because, rationally or irrationally, they perceive some intramarginal economic gain from doing so. Nonetheless inflation does penalize them by raising their tax burdens.

has been an important cause of the decline in investment which has taken place during the 1970s. Before examining the data bearing on this question, we turn in the next section to an analysis of the potential gains from increasing the rate of investment.

THE GAINS FROM INCREASED INVESTMENT

This section examines the potential social gains from tax policies designed to increase corporate investment. The arguments which have received the most popular attention, those linking investment to productivity, inflation and unemployment, are examined first. It is shown that none of these considerations provide a strong case for investment tax incentives. A case for reducing the tax burden on corporate capital is then developed in terms of micro- and macro-intertemporal economic efficiency.

INVESTMENT, PRODUCTIVITY AND GROWTH

The poor performance of productivity in recent years has often been attributed to the low rate of growth of the capital stock. It is argued that increasing the rate of investment could have a large effect on the rate of growth over the next decade. This prospect seems unlikely. Prominent studies of the productivity slowdown, Denison (1979), Norsworthy, Harper and Kunze (1979), show that even after full account is taken of the decline in capital accumulation, most of the productivity slowdown cannot be explained. The limited potency of increased investment in spurring productivity growth can be illustrated by a simple calculation.

Consider an economy which evolves according to the following model:

$$Y_t = K_t^{\alpha} L_t^{1-\alpha} \tag{1a}$$

$$K_t = (1-\delta)K_{t-1} + I_{t-1} \tag{1b}$$

$$I_{t-1} = \delta K_{t-1} + \gamma Y_t \tag{1c}$$

$$L_t = (1+g)L_{t-1} \tag{1d}$$

Equation (1a) is a standard Cobb-Douglas aggregate production function. Since the variable Y is to be interpreted as net output, it is plausible to take $\alpha = .15$ in using the model to interpret U.S. economic performance.[6] The second equation (1b) describes the

[6]The standard assumption that $\alpha = .25$ is simply wrong in an analysis of this type. The figure of interest is the share of *net* return to capital in *net* output. For the corporate sector, this has averaged .15 over the last quarter century.

TABLE 4
The Rate of Growth of Output
Under Alternative Investment Policies

Years	$\gamma = .045$	$\gamma = .060$	$\gamma = .075$	$\gamma = .090$
0-5	3.00	3.10	3.20	3.30
6-10	3.00	3.11	3.22	3.31
11-20	3.00	3.09	3.17	3.24
21-30	3.00	3.07	3.13	3.17

accumulation of capital in the standard way. In the calculations reported below, it is assumed that $\delta = .08$. Equation (1c) specifies that net investment is a constant fraction (γ) of net output. This figure has averaged about 4.5 percent[7] over the last two decades for the U.S. non-financial corporate sector. The final equation specifies that the effective labor force grows at rate g. In the calculations below g is taken to equal .03.

It is apparent the model has a steady state with a capital output ratio of 1.5, and a rate of return on capital of .10. This is quite realistic. As shown in Table 3, the pre-tax rate of return on corporate capital averaged 9.6 percent over the last decade. The 1979 capital-output ratio was 1.48. By simulating the model it is possible to examine the effects of an increase in the share of output devoted to net investment. This is done in Table 4 which shows the rate of growth of output under alternative investment policies.

The limited potency of increasing investment to spur growth emerges clearly. Even a doubling of the share of output devoted to net investment would increase the economy's rate of growth by only 0.3 percent per year over the next decade. The long-run gains are even smaller. In steady state the rate of growth is independent of the investment rate. The effects of more feasible increases in the rate of investment are much smaller. Increasing the share of net investment by one-third would only raise the growth rate of productivity by about 0.1 percent per year over the next decade.

This calculation has assumed that all technical change is disembodied—that is, independent of the accumulation of capital. It might be argued that instead technical progress is embodied in

[7]This figure is greater than those in Table 1, because it takes account of growth in land and inventories.

new capital goods, so that an increase in the rate of investment raises productivity by speeding the introduction of new technology. The model can easily be modified to take account of this possibility by allowing technical change to affect the growth of the effective capital stock rather than the effective labor force. That is, the model becomes:

(2a) $$Y_t = KEFF_t^{\alpha} L_t^{1-\alpha}$$

(2b) $$KEFF_t = (1+g)^{t-1} I_{t-1} + (1-\delta) KEFF_{t-1}$$

(2c) $$K_t = I_{t-1} + (1-\delta) K_{t-1}$$

(2d) $$I_t = \delta K_{t-1} + \gamma Y_{t-1}$$

(2e) $$L_t = (1+n) L_{t-1}$$

where g is now to be taken as the rate of embodied technical change and n the rate of population growth. For the U.S. economy it seems reasonable to take $n = g = .015$.

The results of simulating this model for alternative values of γ are displayed in Table 5. They indicate that assuming that technical change is embodied does somewhat increase the estimated potency of increased investment. Even so, a doubling of the share of output devoted to net investment only raises the productivity growth rate by .6 percent over the first decade. This calculation surely is an overstatement since at least some technical change is disembodied.

The conclusion of this analysis, that even a large increase in the rate of investment will have only a minor effect on productivity, may at first seem surprising. However, it is in line with most previous research. One of the striking discoveries of the "growth accounting" literature dating from Solow (1958) has been the unimportance of capital accumulation as a factor accounting for increasing affluence. Estimates of the sources of inter-temporal and international differences in productivity, Denison (1979), have consistently found that capital intensity plays only a minor role. The major factors appear to be human capital and technological progress. It is little wonder, therefore, that increasing capital accumulation is not likely to have major effects on productivity growth.

Proponents of the view that increased investment would yield large output gains frequently point to the apparently high correlation across countries between capital formation and growth. It is possible that this is because high rates of capital formation spur research, or give rise to "learning by doing" effects. If so,

TABLE 5
The Rate of Growth of Output
Under Alternative Investment Policies
with Embodied Technological Change

Years	$\gamma = .045$	$\gamma = .060$	$\gamma = .075$	$\gamma = .090$
0-5	3.00	3.21	3.40	3.59
6-10	3.00	3.14	3.25	3.36
11-20	3.00	3.10	3.16	3.23
21-30	3.00	3.06	3.11	3.15

conventional analyses may underestimate the gains from increased investment. However, it seems more plausible that causality runs the other way and high savings rates are caused by rapid technological progress. This implication flows naturally from the standard Life-Cycle Hypothesis.[8]

INVESTMENT AND INFLATION

It is difficult to know how to frame the question of the effects of policies to encourage investment on the rate of inflation. The outcome of such policies obviously depends on what other concurrent policy choices are made. We begin by considering the effects of measures to encourage investment holding the rate of growth of money constant.

Unless there is a change in the velocity of money, the effect of increased investment on the rate of inflation is just the negative of its impact on the growth rate of real output. The calculations in the preceding section suggest that this is likely to be only a small effect on the order of several tenths of a percentage point per year.

An investment oriented tax cut is likely to raise the returns available on stocks and bonds. This will reduce the demand for money, thereby increasing velocity and tending to raise the price level. Suppose, for example, that an investment stimulus raised the yield to bond holders by one percentage point. Assuming an initial

[8]Two other qualifications to the analysis in this subsection should be acknowledged. First, an increase in the rate of capital accumulation will tend to increase real wages, which may spur some labor supply response giving rise to extra growth. It is easy to show that this effect is likely to be negligible even if a very high labor supply elasticity is assumed. Second, the gains from additional investment may be slightly underestimated because no account is taken of the advantage from replacing energy intensive with energy conserving capital. Preliminary analysis suggests that this effect could not possibly raise the estimates reported above by more than .1 percent.

interest rate of 10 percent, and an interest elasticity of money demand of only .25, the price level would have to rise by 2.5 percent beyond normal inflation to restore asset market equilibrium. This inflationary pressure is much greater than the deflationary force from increased productivity growth. Hence, the net effect of an investment oriented tax cut is likely to be an increase in the rate of inflation unless the rate of money growth is reduced at the same time.

Depending on the exact formulation of wage-price dynamics it is possible to argue that increases in productivity may make it possible to bring down the rate of money growth and inflation without causing unemployment. Essentially the argument is that productivity growth is like a favorable supply shock. A one-time shock, by reducing past inflation, may moderate wage demands leading to further reductions in inflation. This argument depends on the implausible premise that workers are not able to obtain higher real wages when increased capital intensity raises their productivity. It also suggests that any measure (e.g., cutting sales taxes) which reduces prices will reduce long-run inflation. Hence, it does not single out increased investment incentives as the way to fight inflation.

In sum, it does not appear that tax policies to spur investment are likely to reduce the rate of inflation. This proposition is true *a fortiori* if account is taken of their effects on aggregate demand and the government deficit.

INVESTMENT AND EMPLOYMENT

There is no reason to favor investment oriented policies as a vehicle for encouraging employment. As long as labor and capital are substitutable, either within individual production activities or through shifts in the mix of production activities, it will be possible to achieve full employment with any level of capital intensity. Fears that insufficient capital accumulation must cause unemployment are as groundless as earlier concern about unemployment due to automation. Indeed, since capital and labor are substitutes in production, unless output also expands increased capital accumulation will actually reduce the level of employment.

INVESTMENT AND INTERTEMPORAL ECONOMIC EFFICIENCY

The justification for measures to increase the rate of economic growth, if such a justification exists, must lie in the area of intertemporal economic efficiency. There are two types of issues involved here which I will refer to as macro- and micro-intertemporal efficiency. Macro-efficiency here refers to society's decision about the allocation of consumption between those alive today and future generations. The huge literature on the Ramsey optimal economic growth problem is concerned with this issue. Micro-efficiency here refers to the distortion of individual consumption plans by capital income taxation. This is the subject addressed by traditional welfare analyses of the effects of capital income taxes.

INVESTMENT AND MACRO-EFFICIENCY

The allocation of consumption between current and future generations inherently involves ethical choices. Even a policy of consuming the entire capital stock and leaving nothing to future generations is Pareto optimal. Hence traditional welfare economics can offer little guidance. The problem is normally formulated on choosing a growth path to maximize the discounted value of utility subject to the constraints imposed by the production technology. That is:

$$\text{Max} \int_0^\infty U(c_t)e^{-(\delta+n)t}dt \qquad \text{s.t.} \tag{3}$$

$$c = f(k) - (n+g)k - \dot{k}$$

$$k_0 = \overline{k}$$

where c is consumption, δ the discount rate, n the rate of population growth, and g is the rate of Harrod-neutral technical change. It is not difficult to show (see Solow (1970) for an intuitive exposition) that an economy which is moving along a path which solves the maximization problem given in (3) approaches a steady state path with the property that:

$$f'(k) = \delta + \varepsilon g \tag{4}$$

where ε is the elasticity of the marginal utility function. A value of $\varepsilon = -1$ implies that as consumption doubles, the value of a small increase in its rate halves. With $\varepsilon = -2$, the value falls by 75 percent and so forth.

Equation (4) can be used to make a judgment about the efficiency of the path currently followed by the U.S. economy. The data in Table 1 suggest that the marginal product of corporate capital, $f'(k)$, approximately equals .10. The value of g is very optimistically assumed to be .02. The parameters ε and δ describing how the social marginal utility of consumption changes with the level of consumption and time cannot be estimated empirically. A value of $\varepsilon = -2$ implying that society is willing to take a dollar from someone with a \$30,000 income in order to transfer 12 cents to someone with an income of \$10,000 seems very egalitarian. This implies that current levels of investment are insufficient unless $\delta \geqslant .06$.

There is little that an economist can say about the value of δ.[9] However, it is difficult to see a rationale for discounting the utility of future generations at a rate nearly as high as six percent. Ramsey himself saw no argument for any discounting at all. Thus, there is an ethical argument pointing to the desirability of more capital accumulation.

It might be argued that this hardly provides a warrant for government policies to spur investment. The future will be provided for by bequests from parents to their children. The level of capital intensity ground out by the free market is almost bound to be the optimal rate. Careful consideration of this line of argument suggests that there is a presumption that private capital formation will be insufficient. First, the private return to capital is far less than the social return to investment. The data in Table 2 indicate the average return to corporate capital was about 10 percent during the 1970s. The after-tax return to investors is only about one-fourth as great, creating a presumption that insufficient provision will be made for investment. Second, as long as individuals' concern for posterity extends to the children of others, there is a benefit externality from increased capital formation. Third, there is no more reason to rely on private provision for the future than there is to rely on private charity to meet current social needs. The *existence* of a transfer motive is hardly sufficient to establish the sufficiency of the resulting transfers.

While no definitive statement can be made, the foregoing arguments suggest that macro-efficiency considerations dictate the desirability of increased corporate investment. The amount of the increase is of course more difficult to judge.

INVESTMENT AND MICRO-EFFICIENCY

Even if taxation has no effect on the amount of capital accumulation, it may lead to substantial welfare costs due to the distortion of individual consumption profiles. This will be true even

[9]Note the term g in (4) already takes account of the fact that future generations will be richer than those alive today.

if the overall level of capital intensity is constant at its optimal level. Feldstein (1978), Boskin (1978) and Summers (1980) all estimate annual welfare costs of capital income taxes at current levels which exceed $100 billion annually. Below, I illustrate how capital taxes can give rise to large welfare costs, without having an effect on capital intensity.

Consider the following model. Consumers live two periods supplying labor inelastically in the first period and consuming in both periods. That is, consumers maximize:

$$(5) \qquad U(C_1,C_2) \quad \text{s.t.} \quad C_1 + \frac{C_2}{1+(1-t)r} = W\overline{L}$$

where C_1 and C_2 refer to first and second period consumption, t is the tax rate on capital income, and $W\overline{L}$ is first period income. If the utility function is Cobb-Douglas, $U = C_1^{\alpha}C_2^{1-\alpha}$, it is easy to show that $C_1 = \alpha W\overline{L}$ independent of the capital income tax rate. Thus the tax has no effect on the level of capital formation which is given by:

$$(6) \qquad K = W\overline{L} - C_1$$

The welfare cost of the tax can easily be measured. Solving the maximization problem (5) it can be shown that the indirect function is given by:

$$(7) \qquad V(t,r,WL) = W\overline{L}\alpha^{\alpha}(1-\alpha)^{\alpha}(1+(1-t)r)^{(1-\alpha)}$$

This expression can be solved to find the change in labor income necessary to compensate the representative consumer for any given change in his tax rate on capital income. The revenue yield of the tax can then be subtracted from this expression to calculate the deadweight loss.

This model is highly stylized. Nonetheless, it can provide some insight into the orders of magnitude of the welfare losses from capital income taxation. It is assumed that each period in the model corresponds to a generation, or 25 years. Hence, the value of α is taken to equal .5, and the pre-tax rate of return is taken to be $e^{.10(25)} = 12.18$.

These parameters imply that relative to lump sum taxation, the welfare loss from a 75 percent tax rate on capital income is 8 percent of labor income, compared to 4 percent of labor income for a 50 percent capital tax rate, and 1 percent with a 25 percent tax rate. These welfare losses are very large—a 50 percent capital income tax has a welfare loss of over $50 billion annually at current levels of national income. As is to be expected, the welfare loss rises much more than proportionally with the tax rate. Cutting the tax rate by one-third from 75 percent to 50 percent reduces the deadweight loss by one-half. A further halving of the tax rate to 20 percent reduces the loss by three-quarters. Thus the marginal gains in intertemporal efficiency from cutting high capital tax rates are large. The reduction in deadweight loss equals half the revenue loss in the case of reduction in the tax rate from 75 to 50 percent.

This calculation omits two important features of reality. The result may be overstated because of the assumption that lump sum taxes are available. If the alternative is the taxation of labor income, then deadweight losses may also result from this source. However, it is not at all clear that consideration of variable labor supply would reduce rather than increase the estimated welfare losses from capital taxation. Capital taxes, by raising the price of future consumption, reduce real wages as defined by an appropriate intertemporal cost of living index.[10] Hence, they also distort the labor-leisure choice. Moreover, they distort the intertemporal allocation of labor, which is not affected by a labor income tax.[11] Feldstein (1978), without considering the latter effect, found that there are substantial net gains which can be realized from a shift towards labor taxes. Considering the intertemporal labor supply effects would strengthen this conclusion.

The calculation also is carried on as if all capital were located in the corporate sector. This means the final losses from the misallocation of capital are not included. Available evidence, Fullerton, *et al.* (1976), suggests that these losses may not be too great.

Any reduction in the tax burden on corporate capital would tend to reduce the wedge between the social return to capital and investors' private return, and so would reduce the deadweight loss. The calculation presented here suggests that even if the policy did not increase capital formation there would be substantial gains in intertemporal economic efficiency. If parameter values consistent

[10]This crucial point is overlooked by many authors who hold that with variable labor supply, optimal tax rules are completely indeterminable. In the plausible case of separable utility, it is optimal to place no taxes on labor income regardless of the elasticity of labor supply. It is easy to construct examples in which a subsidy to capital income is optimal.

[11]A long tradition in labor economics dating from the work of Mincer has recognized that the intertemporal elasticity of labor supply far exceeds the static elasticity.

with a positive effect of investment incentives on saving had been assumed the estimated welfare gains would have been much greater.

These results imply that there is a substantial scope for improving economic welfare through increased incentives for investment. The next sections discuss the empirical estimation of the extent to which tax policy can increase investment.

Traditional Approaches to Evaluating Corporate Investment Incentives

This section examines previous empirical evidence on the relationship between corporate investment and tax policy. The large literature on this subject is based almost entirely on single equation econometric models of the demand for equipment and structures. A detailed survey and criticism of some prominent models may be found in Chirinko and Eisner (1980). There have been relatively few efforts to examine the effects of investment stimuli within plausible general equilibrium frameworks. The efforts of this type which have taken place have been carried out using large scale econometric models which are ill-suited to questions of long-run capacity growth.

The standard method of evaluating the effects of tax policy on investment follows the seminal work of Hall and Jorgenson (1967). They begin by postulating that the desired capital stock, K*, depends on the level of output, Y, and the cost of capital, c. The cost of capital is a complex function of the interest rate and tax parameters. A general expression for it is given by

$$c = \frac{q\left[(1-u)\varrho - \frac{\dot{q}}{q} + \delta\right]\left[1 - k - uz\right]}{(1-u)} \tag{8}$$

where q is the supply price of capital goods, u is the corporate income tax rate, ϱ is the opportunity cost of capital, δ is the rate of economic depreciation, k is the investment tax credit, and z is the present value of the tax depreciation expected from a dollar of investment.

From this point, empirical implementations differ across studies. It is usually assumed that the rate of investment depends on some distributed lag on K.* The distributed lag is usually justified as deriving from lags in the delivery of investment goods or in the formation of expectations. The equation is then estimated econometrically.

Changes in tax policy are studied by examining the effects of a tax change on the cost of capital and then of the cost of capital on investment. Chirinko and Eisner (1980) present a detailed description of how this is done in the major large scale econometric models.

While there is room for substantial disagreement about the proper way to carry out this procedure, these issues are ignored here. There are several fundamental problems which make this approach an undesirable way of evaluating investment incentives.

First, by holding the level of output fixed, the investment equation approach makes it impossible to capture the effects which are at the root of the case for tax policies to encourage investment. If one believed that the level of output was in fact independent of the path of investment, it is difficult to see why investment stimuli should be advocated. The essence of the way in which investment stimuli are supposed to work is by reducing the cost of capital and encouraging firms to increase investment in order to supply more output.

The second fundamental difficulty with these investment functions is that they are susceptible to the "Lucas critique." There is no reason to suppose that their parameters would remain constant if policy rules were changed. Hence they cannot provide useful policy guidance. A trivial example is provided by considering the difference between a variable and a permanent tax credit. It is easy to see that a temporary credit will provoke a much greater investment response since firms will all schedule their investment to coincide with it. Hence the estimated effect of the investment tax credit (ITC) will depend on what policy rule has been followed. A related point is that conventional investment equations offer no way of considering the effects of policy announcements. Taken literally, the investment equations in all the major macro-econometric models would imply that an announcement today that six months hence the corporate income tax would be abolished would have no effect at all on current investment decisions. Nor does anything in the equations suggest how they might be modified to meet this objection.

The third difficulty with traditional investment equations is that they are really adjustment equations without a theory of adjustment. The question of ultimate interest is the effect of changes in tax policy on the long run capital stock. This question can be answered simply from the production function requirement, $F_K = c$, holding that the marginal product of capital is equated to its rental cost. The investment equation is essentially irrelevant. Seen in this light, it is clear that the focus of efforts to examine the effects of tax policy should be on the aggregate production function rather than the investment equation. Worse, the production functions which are implied by the results of fitting investment equations are typically wildly implausible.

The only role for an investment equation is in explaining the economy's adjustment path in response to a policy shock. Yet existing econometric investment equations proxy adjustment without any explicit treatment of adjustment costs. They can hardly be interpreted as offering useful guidance on the process of convergence to equilibrium because the equilibria they imply are typically so far wide of the mark.

THE ROLE OF DEMAND

Previous studies all suggest that the state of business activity is a prime determinant of the level of investment. It is this evidence that has led many observers to conclude that more vigorous anti-recession policies offer the greatest hope for raising the level of investment. This conclusion typically emerges from both single equation studies (e.g., Clark (1979)) and full model simulations. This finding can be traced directly to the flaws in these studies noted above. In fact, economic theories which command almost universal support among Keynesians as well as classical macroeconomists indicate that reliance on the accelerator offers no route to increased capital formation in the long run.

The high correlation between output and investment which is observed in the data does not imply that a permanent increase in the level of output will permanently increase the rate of investment. As emphasized above, output and investment are simultaneously determined and in the past have moved in tandem because of common causes. Indeed the apparent potency of the accelerator reflects, in large part, the impact of investment on total output. It does not follow that the correlation would be the same if general expansionary policy was regularly used to spur investment.

There is a second important argument supporting this conclusion. Many, though not all, previous investment studies fail to impose the restriction that investment depends only on the growth in output not its level. Since high output has in the past been correlated with high output growth it appears that expansion is a potent policy to stimulate investment. A policy of permanent expansion would eliminate this correlation and so would be much less effective than conventional econometric specifications suggest.

The analysis so far has been partial equilibrium in character. It has suggested that there is reason to doubt that a permanent increase in GNP would have a large impact on investment. There is, however, a much more fundamental flaw in the argument for expansionary policy to spur investment. Stated baldly, the natural rate hypothesis implies that there is no such thing as "permanent expansionary policy." Any attempt to keep the level of *economic output performance* above some "natural" level, will lead to accelerating inflation. If we rule out policy rules which will lead to steadily increasing rates of inflation, we are confined to policies which on average keep the economy at its natural rate. Permanent expansion or contraction is not possible.

What about a policy of systematically more vigorous response to recessions than has been observed in the past? While this would increase investment, it would also lead to permanently accelerating inflation, unless an equal offset was applied in boom times. Such an offset would negate any gains which might be realized in terms of investment.

EVALUATING INVESTMENT INCENTIVES

This section summarizes the methodology for evaluating investment incentives developed in Summers (1980), and presents some estimates of the effects of alternative tax policies on investment. The method described here is an application of Tobin's q theory of investment. It yields estimates of the effects of tax policies on the valuation of the stock market as well as on rate of investment. Below I present a heuristic account of the method. For a fuller treatment, the reader is referred to my earlier paper.

METHODOLOGY

For simplicity, the dynamics of investment and market valuation are examined in a simplified model where all investment is financed through retained earnings and the only tax is a proportional levy on corporate income. In this setting it is reasonable to assume that investment depends on the ratio of the market value of existing capital to its replacement cost. Unless the market value of the firm will be increased by more than one dollar by a one dollar investment, there is no reason for it to be undertaken. Given costs of adjustments and lags in recognition and implementation, there is no reason to expect that all investments which will raise market value by more than their cost will be made immediately. As Tobin

(1969) has argued, these considerations lead to an investment equation of the form:[12]

$$(9) \qquad I = I\left(\frac{V}{K}\right) K$$

$$I(1) = 0 \qquad I' > 0$$

where I represents gross investment and V/K is the "q" ratio of market value to replacement cost. The assumption that it is I/K which depends on q insures that the growth rate of the capital stock does not depend upon the scale of the economy.

It is assumed that equity owners require a fixed real rate of return to induce them to hold the existing stock of equity. This return comes in the form of dividends, equal to after-tax profits less retentions for new investment, and capital gains. Hence we have the condition:

$$(10) \qquad \varrho = \frac{Div}{V} + \frac{\dot{V}}{V}$$

which implies:

$$(11) \qquad \dot{V} = \varrho V - (1-\tau)\, F'(K)K + I\left(\frac{V}{K}\right)K - \delta K$$

where τ is the corporate tax rate, and F(K) is the production function for net output.

It will be most convenient to examine the dynamics in terms of K and $q \equiv \frac{V}{K}$. Equations (9) and (11) imply that the system's equations of motion are:

$$(12) \qquad \dot{K} = I(q)K - \delta K$$

$$(13) \qquad \dot{q} = \varrho q - I(q)q + \delta q + I(q) - (1-\tau)F'(K) - \delta$$

where δ is the rate of depreciation.

The steady state properties of the model are easily found by imposing the conditions $\dot{K} = 0$ and $\dot{q} = 0$. These imply:

$$(14) \qquad q = I^{-1}(\delta)$$

$$(15) \qquad (1-\tau)F'(K) = \varrho q$$

[12]A rigorous foundation for an investment equation of this type is provided in Abel (1979) and Hayashi (1980). An important implicit assumption of this approach is the homogeneity of capital. If capital is heterogeneous, shocks may reduce the market value of existing capital but raise the return on new investment. The recent energy shock illustrates this phenomenon.

The former equation indicates that the steady state value of q must be greater than 1 by an amount just large enough to induce sufficient investment to cover depreciation. The latter equation holds that firms equate their net marginal product of capital to the cost of capital. Inspection of (14) and (15) makes it clear that a change in the corporate tax rate affects the steady state capital stock but has no effect on steady state q. This is a consequence of the assumption that it is investment relative to the capital stock which varies with q.

The phase diagram of the system (12) and (13) is displayed in Figure 1. It is readily verified that the pair of equations is saddle point stable[13]. The arrows indicate the direction of motion and the heavy line represents the saddle point path along which the system will converge. A change in the corporate tax rate is depicted in Figure 2[14]. If the expectations about pre-tax profits were static, the value of q would jump from E to A when the tax change took place. This expectations assumption has been used in previous works on the effects of taxation on the stock market, e.g., Feldstein (1979), Hendershott (1979). It neglects the effect of the induced changes in investment on the present value of future profits. With perfect foresight, as assumed here, the value of q will jump only to B. The magnitude of the jump will depend upon the speed of adjustment of the capital stock to the shock.

The system of equations (12) and (13) can be solved numerically to estimate the impact of any type of shock on the path of q and the capital stock. The effect of tax changes on the level of the stock market can be easily calculated. This can then provide a basis for estimating the effects of tax changes. The model actually used to calculate the effects of tax changes is considerably more complex. It takes account of the complexities of the tax code and of the fact that investment is partially financed through the issuance of debt. The results reported below are based on empirically estimated production functions and investment relations for the corporate sector.

RESULTS

We begin by considering the impact of the investment tax credit, since this issue has been a focus of previous work. Standard single equation approaches to the investment function have yielded

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[13]This is a common feature of models with asset prices.

[14]It is assumed that the market selects the unique stable perfect foresight path.

TABLE 6
Permanent and Temporary Removal of the Investment Tax Credit[a]

	Permanent			[b]Temporary		
Year	V	I	K	V	I	K
1	−2.8%	−6.0%	0%	−2.0%	0%	0%
2	−3.0%	−4.8%	−0.4%	−0.5%	0%	−0.1%
3	−3.0%	−4.9%	−0.9%	−0.5%	0%	−0.1%
4	−3.3%	−6.1%	−1.3%	−0.6%	−4.9%	−0.1%
5	−3.5%	−6.2%	−1.7%	−0.6%	−3.7%	−0.4%
10	−4.0%	−6.4%	−3.5%	−0.3%	0%	−0.9%
15	−4.4%	−7.9%	−4.8%	−0.3%	0%	−0.7%
20	−4.7%	−8.1%	−6.0%	0%	0%	−0.6%
50	−5.6%	−8.8%	−8.9%	0%	0%	−0.1%
Steady State	−5.6%	−9.6%	−9.6%	0%	0%	0%

Notes: [a]The numbers shown in the table are the changes relative to the 8 percent inflation path in the absence of tax reform.
[b]The temporary investment tax credit is imposed in year 4 for three years.

divergent results. In perhaps the most widely cited study, Hall and Jorgenson (1971) conclude that the investment tax credit has a potent impact, which reaches its peak after about three years. They estimated that the 7 percent credit on equipment enacted in 1962 raised the 1970 capital stock by about 4 percent above the level it would have reached in the absence of the credit. Other estimates typically suggest much smaller estimates of the effect of the credit. None of the estimates takes explicit account of the possibly temporary nature of changes in the level of the credit.

In Table 6 the effects of alternative tax credit policies are considered. The first column considers the effects of a correctly perceived permanent removal of the credit. The results indicate that the credit has potent effects on investment, even though it has only a small impact on market valuation in the short run. Its immediate effect is to reduce investment by about 6 percent, and it decreases the capital stock by 8.9 percent in the long run. The estimated response is much more gradual than that predicted by standard investment equations. The effect on investment declines between the first and second years and then rises steadily as the reduced capital stock requires less replacement investment. Since the change considered here is the removal of a 9 percent investment credit, these results indicate a slightly larger effect than those of Hall and Jorgenson, and a much larger effect than that found in most other studies.

The right half of the table considers the impact of a temporary removal of the ITC. Such a measure leads to a sharp decrease in investment during the suspension period. This leads to an increase in net investment after the suspension is removed. Gross investment does not increase because the lower capital stock requires less replacement investment. Note that the catch-up following the restoration of the credit is very slow. Two-thirds of the gap caused by the suspension in the capital stock remains 15 years later. These results show the importance of the adjustment costs, which explain investment's sluggish response to q. In the absence of any adjustment costs, one would expect to see substantial disinvestment during the period of the suspension. Because the adjustment costs of returning to the steady state capital stock would be high, this does not take place. These findings illustrate the importance of considering expected future policy. If the credit suspension were permanent its effects on net investment in the short run would be far less pronounced.

The effects of reductions in the corporate tax rate are examined in Table 7. An immediate rate reduction from .48 to .40 is constrasted with an announcement that in year 4, such a tax cut will take place. Both measures are equivalent in the long run, and raise the steady state capital stock by 15.7 percent. They increase the long-run value of the stock market significantly more because the reduced corporate tax raises the effective price of new capital goods by diminishing the value of accelerated depreciation and the expanding of adjustment costs.

The simulations show that the announcement policy has a significantly greater short-run impact on investment than the immediate implementation policy. The former raises the capital stock by 3 percent after three years compared with 2 percent for the latter. This occurs even though the immediate implementation policy has a greater immediate impact on the capital stock. The reason again is the effects of accelerated depreciation and the expanding of adjustment costs. Firms find it optimal to accelerate their investment plans to take account of the lower effective price

TABLE 7
Unanticipated and Anticipated Permanent Corporate Tax Cut[a]

	Unanticipated			[b]Anticipated		
Year	V	I	K	V	I	K
1	+18.6%	+ 7.1%	0%	+15.1%	+ 9.5%	0%
2	+19.4%	+ 7.2%	+ 0.5%	+16.9%	+10.8%	+ 0.8%
3	+20.0%	+ 8.5%	+ 1.1%	+19.0%	+12.2%	+ 1.6%
4	+20.4%	+ 7.3%	+ 1.6%	+20.9%	+ 8.5%	+ 2.5%
5	+20.7%	+ 8.6%	+ 2.0%	+21.2%	+ 8.6%	+ 3.0%
10	+22.3%	+ 9.0%	+ 4.5%	+22.7%	+10.3%	+ 5.1%
15	+23.2%	+10.5%	+ 6.5%	+23.5%	+10.5%	+ 7.0%
20	+24.1%	+10.8%	+ 8.1%	+24.3%	+10.8%	+ 8.6%
50	+25.9%	+14.7%	+13.5%	+25.9%	+14.7%	+13.8%
Steady State	+26.7%	+15.3%	+15.3%	+26.9%	+15.3%	+15.3%

Notes: [a]See footnote (a) in Table 6
[b]Tax cut takes place in year 4

of capital goods which prevails before the tax reduction actually takes place. This implies that if the goal of the corporate rate reduction is to increase capital formation, the measure should be announced well in advance of its enactment. Similar considerations suggest that a temporary increase in the corporate tax rate would actually spur investment.

These findings have important policy implications. They indicate that a policy of announcing a future reduction in corporate taxes will spur investment with no current revenue loss. Indeed, the effect on investment would actually be enhanced if corporate taxes were raised immediately and then cut. By combining temporary corporate rate increases with temporary increases in the investment tax credit or accelerated depreciation it would be possible to provide substantial investment stimulus at no budgetary cost.

Most previous analyses of the effects of investment incentives have neglected the role of individual tax measures. The effects of reforms in the individual tax system are considered in Table 8. Eliminating capital gains taxes would raise the stock market by 7.3

TABLE 8
Reforms in Individual Taxes[a]

	Capital Gains Tax Eliminated			[b]Anticipated Dividend Relief		
Year	V	I	K	V	I	K
1	+ 7.3%	+11.9%	0%	+60.3%	+40.5%	0%
2	+ 8.1%	+12.0%	+ 0.9%	+68.5%	+47.0%	+ 3.2%
3	+ 8.5%	+13.4%	+ 1.8%	+77.3%	+53.7%	+ 6.7%
4	+ 8.9%	+12.2%	+ 2.7%	+86.3%	+ 6.1%	+10.7%
5	+ 9.3%	+13.6%	+ 3.6%	+85.7%	+ 6.2%	+10.2%
10	+10.8%	+16.7%	+ 7.5%	+83.7%	+ 5.1%	+ 8.5%
15	+12.1%	+17.1%	+11.1%	+82.5%	+ 4.0%	+ 7.0%
20	+13.2%	+20.3%	+14.0%	+82.0%	+ 2.7%	+ 5.7%
50	+16.1%	+26.5%	+24.0%	+79.3%	+ 1.5%	+ 1.7%
Steady State	+17.3%	+27.7%	+27.7%	+78.6%	0%	0%

Notes: [a]See footnote (a) in Table 6
[b]Expected abolition of the dividend tax in year 4

percent in the short run. Because it would increase the advantages to the firm of retaining earnings, the impact on investment is substantially greater. Its long-run effect would be to raise the capital stock by 29.5 percent. The transition is however very gradual with only half the adjustment occurring within the first decade.

The second reform considered is an announcement that in year 4, the dividend tax will be eliminated. This corresponds to an extreme form of partial integration of the corporate income tax. As explained in Summers (1980), changes in the dividend tax rate have no effect on steady state capital intensity. The announcement that a dividend tax reduction will occur however gives firms a very large incentive to defer paying of dividends. This is done by accelerating investment. The simulations suggest that the announcement effect raises investment by 40.5 percent.

The estimates of the potential gains from reductions in taxes on capital income described here are quite robust. As explained in the previous section, the long-run results depend almost entirely on the production function. The Cobb-Douglas form which provides the basis for the estimates reported here is widely accepted as a reasonable aggregate approximation. The propositions that the stock market's level reflects the present value of future profits, or that investment responds positively to q are also uncontroversial. This is all that is necessary to accept these results.

Taken together the results indicate the large scope for tax policy to affect capital accumulation in the long run. Politically conceivable measures, such as the abolition of capital gains taxes or the allowing of replacement cost depreciation would have a very substantial impact on long-run capital intensity. Measures can be designed which have a large impact on investment with a relatively low cost in foregone government revenue. A final conclusion which emerges from these simulations is the dangers of indiscriminate tax cutting. The incentive effects of announced and unannounced cuts vary greatly across tax measures so that careful policy design can increase the investment stimulus per dollar of lost government revenue.

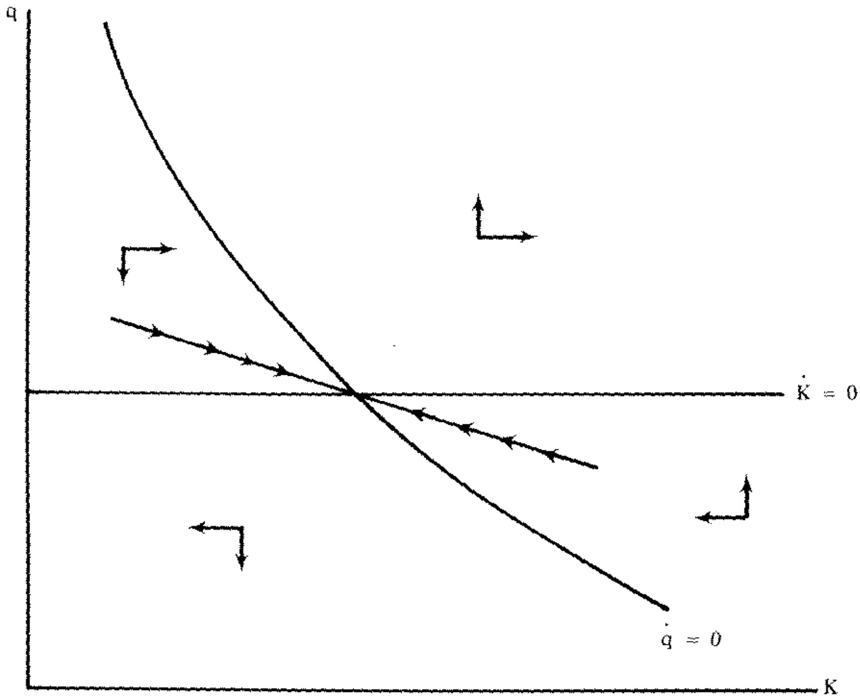
THE SUPPLY OF FUNDS FOR CORPORATE INVESTMENT

The analysis in this paper so far has assumed that the rate of return required by investors in the corporate sector is fixed, independent of tax policy or the level of corporate investment. As Figure 2 illustrates, this is equivalent to assuming that the supply of funds to the corporate sector is perfectly elastic. Unless this condition is met, investment incentives will lead to increases in the rate of return required by corporate investors. In the limiting case where the supply of funds to the corporate sector is completely inelastic, and the KS curve in Figure 1 is vertical, investment stimuli will have no effect on capital accumulation.

It is therefore crucial to assess the elasticity of the supply of capital to the corporate sector. A full discussion of this issue is outside the scope of this paper, but a few remarks are sufficient to establish that the elasticity is likely to be quite high. The elasticity of the supply of savings to the corporate sector depends on both the elasticity of total savings with respect to the rate of return and the substitutability of corporate and non-corporate assets in wealth portfolios. These issues are considered in turn.

Until recently, it was widely believed that the rate of saving was largely independent of the rate of return. This notion was supported by verbal reference to conflicting income and substitution effects, and to the near constancy of the saving rate. Recently, both

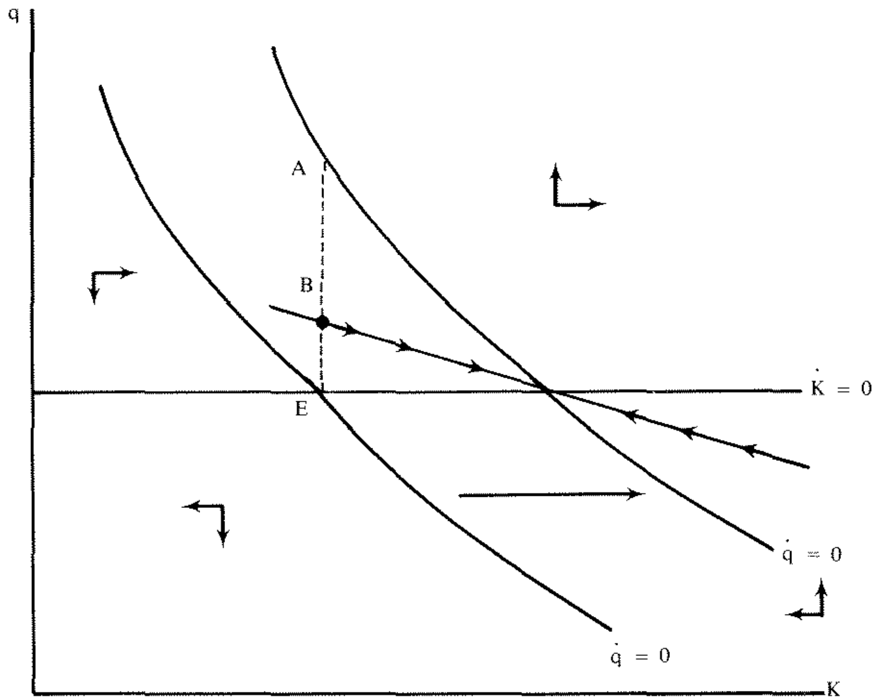
FIGURE 1



theoretical and empirical evidence have accumulated suggesting that the elasticity is quite high. The "infinite horizon" model of intertemporal consumption decisions implies that saving is perfectly elastic with respect to the interest rate. Summers (1980) shows that plausible life cycle formulations almost inevitably imply a high interest elasticity of saving. It also demonstrates that the two period model which provided the basis for most previous theoretical studies of the interest elasticity of saving is likely to be very misleading.

At the same time, recent empirical evidence tends to support a positive interest elasticity of saving. Boskin (1978) was the first study to use a measure of the proper variable, the real after-tax interest rate, in a study of the interest elasticity of saving. His study found an interest elasticity of about .4. There are strong reasons to believe that this is an underestimate of the elasticity of response to a permanent change in tax policy. The variations in real after-tax interest rates during Boskin's sample period are almost all transitory. As Summers (1980) shows, the response of policy to a

FIGURE 2



transitory shock in interest rates is likely to be much less than the response to a permanent shock. Of greater importance, Boskin, in calculating the interest elasticity of saving, takes no account of the wealth effects of interest rate changes. Part of the saving response to increases in interest rates occurs because of induced changes in wealth. Taking account of these effects can easily raise the estimated elasticity from .4 to 2.

These considerations suggest that there are strong reasons to believe that the supply of capital to the corporate sector is highly elastic. This conclusion is strengthened by considering the allocation of capital between sectors. The U.S. corporate sector accounts for only about one-fifth of American physical wealth and a much smaller fraction of world capital. Hence even if the total supply of capital were fixed, the supply of capital to the corporate sector might be quite elastic. There is no direct evidence bearing on the extent of these effects. Summers (1981) shows how the relative valuation and accumulation of corporate and housing capital over the last decade has been affected by increased taxation.

In Feldstein and Summers (1978) an attempt is made to gauge the elasticity of the supply of capital to the corporate sector. This is done by examining the effects of changes in the MPIR—the Maximum Potential Interest Rates firms can afford to pay on a given investment project—on actual interest rates. The results indicate that a one percentage point increase in the MPIR raises interest rates by .25 points. Loosely speaking, this means that 25 percent of the stimulus afforded by investment tax incentives is offset by rising asset prices. This is further evidence that investment incentives are unlikely to be crowded out by rising costs of capital.

If crowding out due to a limited supply of capital appeared to be a significant factor impeding corporate investment, government policy could easily increase the supply of funds to the corporate sector. This could be done through measures to encourage saving or more plausibly through increased public saving. The latter action could be achieved by reducing budget deficits and limiting commitments to future expenditures.

The analysis here of the supply of funds to the corporate sector has important implications for policy towards investment. In particular it implies that measures directed at increasing national saving will have little effect on investment. In the limiting case where saving is infinitely elastic, such measures would have no effect at all. Policies to spur investment, if they are to be effective, must be specifically directed at corporate capital. Our analysis suggests that such measures are likely to have potent effects.

REFERENCES

Abel, Andrew. "Investment Theory: An Integrative Approach." mimeo, 1979.

Blinder, Alan. Discussion of Martin Feldstein. "Tax Rules and the Mismanagement of Monetary Policy." *American Economic Review*, 70 (May 1980), 189-190.

Boskin, Michael. "Taxation, Saving and the Rate of Interest." *Journal of Political Economy*, (April, 1978).

Chirinko, Robert and Robert Eisner. "The Effects of Tax Policies on Investment in Large Scale Econometric Models." Paper presented at the 4th World Congress of The Econometric Society, August 28, 1980.

Denison, Edward. *Accounting for Slower Economic Growth: The United States in the 1970s*. Brookings Institution, 1979.

Feldstein, Martin. "Investment, Inflation, and Taxes." mimeo, 1980.

____________ and James Poterba. "State and Local Taxes and the Rate of Return on Nonfinancial Corporate Capital." NBER Working Paper #508R, July 1980.

____________ and Lawrence H. Summers. "Inflation, Tax Rules, and the Long Term Interest Rate." *Brookings Papers on Economic Activity*, 1978:1.

________________________. "Inflation and the Taxation of Capital Income in the Corporate Sector." *National Tax Journal*, 32 (December 1979), 445-470.

Fullerton, Don, *et al*. "Static and Dynamic Resource Allocation Effects of Corporate and Personal Tax Integration in the U.S.: A General Equilibrium Approach." NBER Working Paper #337, April 1979.

Hall, Robert and Dale Jorgenson. "Tax Policy and Investment Behavior." *American Economic Review*, 57 (June 1967), 391-414.

Hayashi, Fumio. "The q Theory of Investment: A Neo-Classical Interpretation." *Econometrica*.

Norsworthy, J.R., Michael Harper, and Kent Kunze. "The Slowdown in Productivity Growth: Analysis of Some Contributing Factors." *Brookings Papers on Economic Activity*, 1979:2, 387-421.

Solow, R.M. *Growth Theory*, Oxford University Press, 1970.

Summers, Lawrence H. "Taxation and Capital Accumulation in a Life Cycle Growth Model." *American Economic Review,* forthcoming. (1981).

____________. "Inflation, Taxation and Corporate Investment." mimeo, 1980.

Tobin, James. "A General Equilibrium Approach to Monetary Theory." *Journal of Money Credit and Banking*, 1 (1969), 15-29.

Estimates of Investment Functions and Some Implications for Productivity Growth

PATRIC H. HENDERSHOTT

My original assignment was first to evaluate Larry Summers' paper as a description of the current state of the art regarding investment behavior and second to determine the adequacy of the investment sector of Michael Evans' econometric model (Evans, 1980) in light of Summers' paper. The late arrival of Larry's paper forced me to alter my strategy, and it is just as well. Summers' investment function is a very long-run relationship that does not purport to explain cyclical movements in business investment outlays, while Evans' relationship is a more traditional analysis of quarterly expenditures.[1] Moreover, Summers is concerned with only corporate investment, while Evans deals with all of domestic fixed investment. My revised strategy was to employ two papers recently presented at Brookings Conferences (Hendershott, 1980, and Hendershott and Hu, 1981) as the standard with which to contrast Evans' work.

The first two sections of the present paper are concerned with nonresidential and residential fixed capital outlays, respectively. In each of these I first summarize my earlier work and then critique Evans' treatment of the same investment component. A general discussion of the relationship between the form of investment and productivity growth is the subject of the third section, and a

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[1]Summers' equations explaining the annual ratio of gross real investment to the beginning period capital stock over the 1932-78 period have $\bar{R}^2$ that range from 0.05 (no autocorrelation correction) to 0.75 (Summers, 1980, Table 2, p. 34). Of course, investment equations must have plausible long-run properties if they are to be useful in examining the long-run impacts of tax changes, but this does not rule out relationships that also explain cyclical behavior.

summary concludes the paper. Summers' imaginative work is referred to periodically when it bears on the issue at hand, but time and space constraints prevent me from discussing his analysis at length.

NONRESIDENTIAL INVESTMENT

GENERAL DETERMINANTS

Investment outlays (or orders) can be thought of as the sum of four components: Those due to normal growth, to disequilibrium, to replacement, and to mandates of governments. The general determinants of each of these parts are the following:[2]

Normal Growth (I_n): Normal growth in the economy requires greater production capacity. How capital intensive this is should depend on the real user cost of capital (c). Thus one can write

$$I_n = I_n(\overset{+}{\dot{y}}, \overset{-}{c}),$$

where $\dot{y}$ represents any of a variety of variables that proxy for the expected growth rate in real output, and the expected signs of the partial derivatives are indicated above the arguments in the function. I emphasize here that the relationship is between net investment and the rate of change in output, not the level of output. As Summers (1981) and others have noted, the latter is a major misspecification of an investment function and has nonsensical macroeconomic policy implications.

Disequilibrium (I_d): Disequilibrium investment (positive or negative) arises when factor prices or aggregate demand change unexpectedly. Proxies often employed to represent disequilibrium are deviations between current and long run or "normal" values of Tobin's Q (the ratio of the market value of corporate debt and equity to the replacement cost of nonfinancial assets) and capacity utilization (CU). Thus

$$I_d = I_d(\overset{+}{Q\text{-}Q^*}, \overset{+}{CU\text{-}CU^*}),$$

where * denotes normal or long-run values (assumed to be constant).

[2]This analysis assumes a CES production function. The use of a variable elasticity function, such as the translog (see Berndt and Christensen, 1973), requires inclusion of either the user costs or quantities of other factors in the estimation equation.

Replacement (I_r): In a pure putty-putty world where changes in the capital/labor ratio can occur both before and after the installation of capital, replacement investment is reasonably approximated by the product of the depreciation rate and the existing capital stock. But in a putty-clay world, where variable factor portions exist only for net investment and upon replacement of old capital, replacement investment also depends on changes in the real user cost since the capital being replaced was initially installed. More specifically, one can write

$$I_r = K_{-1}\delta \sum_{\tau=0}^{\infty} Y_\tau(c_{-\tau}/c) = K_{-1}\delta^f.$$

where Y_τ equals 1.0 for $\tau = 0$ and 0.0 otherwise, if technology is putty-putty, or equals the fraction of each vintage of capital in the total existing stock, if technology is putty-clay, and the symbol δ^f denotes the optimal feasible replacement investment fraction.[3]

Mandated investment (I_m): This investment is mandated by law and is thus reasonably treated as exogeneous.

Combining the four investment (orders) components into a single function,

$$\text{(1)} \qquad I = \phi(\overset{+}{\dot{y}}, \overset{-}{c}, \overset{+}{Q}, \overset{+}{CU}) + \delta^f K_{-1} + I_m.$$

Our empirical results suggest the following. First, the user cost variable, which affects both ϕ and δ^f, is a fundamental factor affecting investment.[4] Second, the accelerator variable, $\dot{y}$, works as expected. And third, the capacity utilization rate, but not Q, is an important determinant of disequilibrium investment.

REAL USER COST OF CAPITAL

Consider the following assumptions/definitions:

i) all prices are expected to rise at rate π forever,

ii) the productivity of an investment declines at rate δ over an infinite holding period,

[3]Putty-clay technology is a possible source of long lags in investment functions, but it is still difficult to explain Summers' 16 year adjustment period to obtain half of the impact of an inflation shock (1980, Table 4, p. 45).

[4]With $\delta = 0.13$, δ^f varies from a low of 0.115 in 1957:1 to a high of 0.156 in 1971:4. Replacement of δK_{-1} with $\delta^f K_{-1}$ in the estimated equation significantly raised the explanatory power.

iii) the statuatory income tax rate is μ,
iv) the rate of investment tax credit is k,
v) the present value of depreciation allowed for tax purposes on a dollar of capital is z,
vi) pollution control outlays of ψ dollars are required for every dollar of capital investment,
vii) the ratio of inventories based on FIFO accounting to the stock of capital is ν, and
viii) the real after-tax financing rate is r.

With these assumptions, one can derive the real user cost of capital as

$$c = \frac{(1+\psi)q}{(1-\mu)p}[(1-k-\mu z)(r+\delta) + \mu\nu\pi], \tag{2}$$

where $z = \sum_{t=1}^{\infty} \frac{dx_t}{(1+r+\pi)^t}$,

dx_t = the fraction of the capital price allowed to be treated as tax depreciation in period t,

q = the price of capital goods, and

p = the general price of output.

This equation is identical, in appearance, to equation (4.2), p. 4.15 of Evans except for the addition of the inventory term to allow for the taxation of FIFO-based inventory profits. Assuming that a portion α of investment $[(1-k)q]$ is debt financed, the debt and equity portions are expected to remain constant forever, and debt finance charges are deductible from the income tax base,

$$r = \alpha(1-\mu)i + (1-\alpha)e_a - \pi, \tag{3}$$

where i is the nominal debt yield and e_a is the nominal after-tax cost of equity funds. A plausible proxy for e_a is the sum of the after-tax earnings-price ratio (E/P) and $\pi/(1-\alpha)$. The division by $1-\alpha$ reflects the fact that all inflation gains accrue to shareholders (except those indirectly built into i). Substitution into (3),[5]

$$r = \alpha(1-\mu)i + (1-\alpha)E/P. \tag{3'}$$

[5] This equation looks like an analogue to the Modigliani-Cohn stock market error; it appears that a nominal debt yield is being averaged with a real equity yield. In fact, the expression is an average of two real yields $(1-\mu)i-\pi$ and $E/P + [\alpha/(1-\alpha)]\pi$. The π terms cancel when the expression is simplified.

EVANS' ANALYSIS

The aggregate investment equations reported account for the normal growth and disequilibrium investment components in a reasonable fashion. A variety of sectoral income variables drive investment; the user cost variable generally performs as expected (more on this below); and the capacity utilization rate, the unemployment rate and stock prices all appear as disequilibrium proxies. The putty-clay optimal feasible replacement investment fraction does not appear, but the establishment of its relevance is of recent "vintage." However, I cannot even find the lagged capital stock in the equations, although it is referred to in the text. Even more disconcerting is the absence of mandated investment outlays. The importance of these outlays is emphasized by Evans and these outlays are incorporated in the calculation of the user cost, but the actual outlays are ignored in the estimation. To put these outlays in perspective, during the 1972-78 period they were roughly 4 percent of total new orders for equipment and 12 percent of net new orders (roughly two-thirds of orders were for replacement).

One final point on these equations. An undefined index of credit rationing appears in the equipment equation with rationing (supposedly a slowdown in deposit flows) reducing equipment outlays. While outlays on trucks and autos (p. 4.67) may be reduced, as are housing starts (see below), it would seem to me that outlays somewhere in the economy should be stimulated. That is, if accelerated flows into open market paper, defined broadly to include large CDs and money market funds, are detrimental to outlays financed by regular deposits, then these flows ought to be favorable to the outlays financed by open market paper; rationing ought to have an allocative, zero-sum impact rather than a cumulative negative impact. Finally, if rationing matters for business investment, then business cash flows obviously matter to investment, a fact Evans denies on p. 4.10.

Evans spends a great deal of time and effort in the construction of user costs of capital for business investments. For this he is to be commended. Unfortunately, there appears to be a number of errors in the calculations. First, consider the measurement of the real after-tax financing rate. In the aggregate investment equations (pp. 4.70 and 4.76), the yield is

$$r = 0.4\,i + 0.6\,E/P.$$

Note that the interest rate is before-tax when it should be after-tax.[6]

[6] In the industry studies (pp. 4.19 and 4.42), the dividend-price ratio replaces E/P, and the 0.4 and 0.6 weights may have been switched.

Also, there does not appear to have been any attempt to adjust earnings for the overstatement due to historic cost depreciation. Thus the real after-tax financing rate is clearly overstated by a significant amount. Second, depreciation rates of 0.095 (structures) and 0.181 (equipment) have been employed. These, too, are far too high (by about 0.05). Third, the effective (average) rather than statuatory (marginal) corporate tax rate is utilized. To the extent that the vagaries of the tax code are already accounted for—the investment tax credit, tax depreciation, and FIFO accounting—the statuatory rate is clearly the appropriate variable. Just as important, the average tax rate moves cyclically, being high when profits are great and low when profits are small, but the expected tax rate over the life of the investment, the relevant rate in the user cost calculation, is unlikely to move in this manner. This illustrates an important point about the user cost expression (2). All values in it denote expected values over the life of the investment asset. If these values are expected to change in the short run, then such expectations could have a large impact on the *timing* of orders or investments, even if only the long-run expected values affect long-run capital accumulation. To illustrate, a temporary increase in the investment tax credit would have a far larger short-run stimulative impact on investment (Lucas, 1976, pp. 30-35) than would a "permanent" increase.[7] Further, as Summers illustrates (1981) anticipations of tax changes can have major, and even surprising, effects.

In summary, the Evans model has not advanced econometric modeling of nonresidential investment. Replacement and mandated investment are not accounted for, and there are significant errors in the calculation of the important user cost variable. Moreover, the measurement and inclusion of z in the user cost is hardly innovative, as is suggested on p. 4.16. This variable was included in early Jorgensonian formulations and has been part of the data bank for the various versions of the Federal Reserve econometric model for at least a decade.

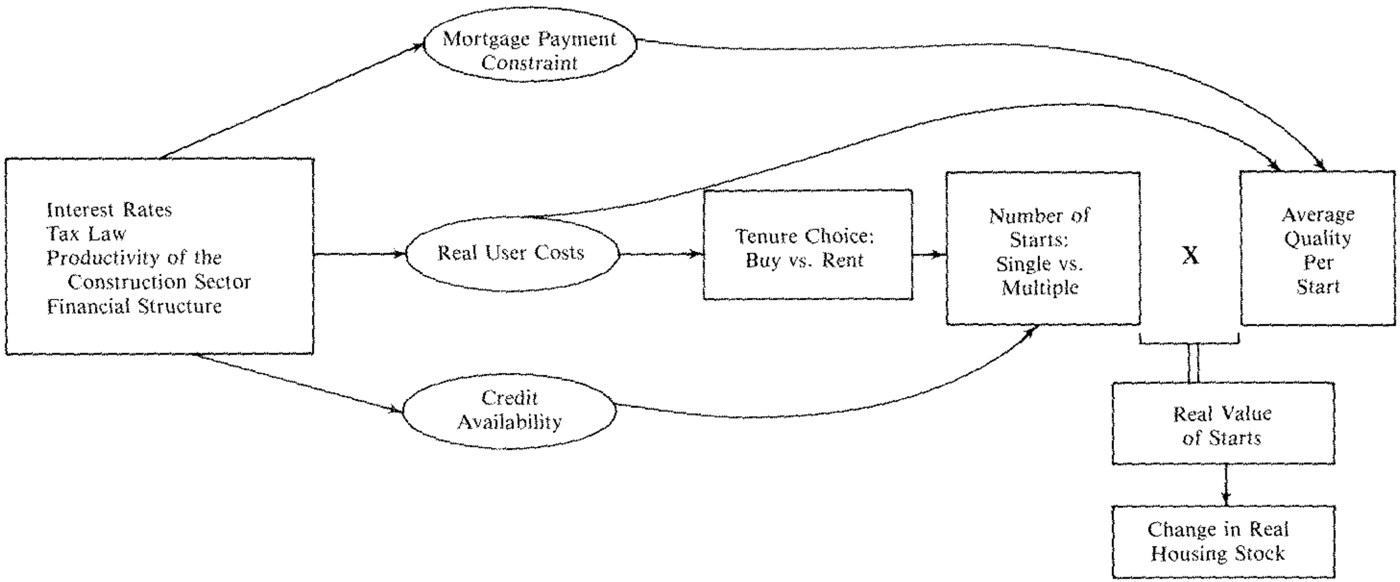
Residential Investment

An Overview of the Housing Market

My view of the determination of increments to the real housing stock is depicted in Figure 1. The major financial variables are circled: the mortgage payment constraint (roughly the product of the *nominal* after-tax mortgage rate and the real price of

[7]Evans states the opposite on p. 4.13.

FIGURE 1
Determination of Changes in the Housing Stock



structures), the user costs of capital for owner-occupied and rental housing (the former is approximately the product of the *real* after-tax mortgage rate and the real price of structures), and credit availability. (An inflation-induced increase in the mortgage payment constraint will limit the size of house purchases if imperfections in the capital market prevent households from borrowing against future housing capital gains.) These variables depend on those in the box on the left: the level of interest rates, tax law, the financial structure, and the relative productivity of the construction sector (which determines the real price of structures). The three double-lined boxes represent the important economic decisions. Tenure choice depends on the rental price (user cost) of housing services generated by an owner-occupied dwelling versus that of services produced by a rental unit. This choice, along with total household formations and credit availability, determines the numbers of single and multifamily starts. The average quality (square feet, number of fireplaces, etc., valued in constant dollars) per start, in turn, is a function of real income per household and "prices," both the real user cost (user cost divided by the price of non-housing goods) and the real mortgage payment constraint. The product of the number of starts and their average quality is the real value of starts, and this is converted to real housing outlays or the change in the real housing stock with a short production lag.

Implicit equations for single (SST) and multifamily (MST) starts and explicit equations for the average real qualities of single (SQ) and multifamily (MQ) starts are

$$\mathrm{SST} = \phi_s(\overset{+}{\Delta \mathrm{HH}}, \overset{-}{\Delta(c/r)}, \overset{+}{\mathrm{AVAIL}})$$

$$\mathrm{MST} = \phi_m(\overset{+}{\Delta \mathrm{HH}}, \overset{+}{\Delta(c/r)}, \overset{+}{\mathrm{AVAIL}})$$

$$\mathrm{SQ} = \psi_s(\overset{+}{y}, \overset{-}{c}, \overset{-}{m})$$

$$\mathrm{MQ} = \psi_m(\overset{+}{y}, \overset{-}{r}),$$

where HH is the number of households, c and r are the real user costs for owning and renting, AVAIL represents credit availability, y is real income per household, m is the mortgage payment variable, and the signs of the partial derivatives are indicated above the variables. Significant lags exist, particularly with regard to the tenure decision.

The above starts equations are consistent with a world in which prices of new housing units are a mark-up on costs and builders determine starts so as to equate the expected future supply and demand for incremental units. An alternative view, which I label the pure supply view, has the price of new units determined by the supply and demand for existing units and has builders responding to profit opportunities, as well as the availability of credit:

$$ST = \phi_p(\overset{+}{Ph/p}, \overset{-}{Cost/p}, \overset{+}{AVAIL}),$$

where Ph/p is the real price of housing and Cost/p is the real cost of production.

THE EVANS MODEL

Starts equations appear in the Evans investment chapter, but average quality equations do not. Multiplication of starts by a housing price translates starts into nominal dollars, and a production lag converts these into nominal outlays on housing. How or whether real outlays are determined is unclear. Thus, my discussion relates only to the behavior of starts.[8]

It is difficult to fit the Evans starts equations into either of the above frameworks. The equations are of the forms

$$SST = \phi_{es}(\overset{+}{y}, \overset{-}{m}, \overset{+}{\pi_h}, \overset{+}{AVAIL})$$

$$MST = \phi_{em}(\overset{+}{y}, \overset{+}{\frac{RENT}{COST}}, \overset{-}{\frac{INT + RENT}{WAGES}}, \overset{+}{AVAIL}, \overset{-}{OVER}),$$

where the signs over the variables are the signs of the estimated coefficients, π_h is the housing inflation rate, RENT/COST is a profitability measure, (INT + RENT)/WAGES is the ratio of NIA interest and rent income to wage income, and OVER is a measure of overbuilding (the cumulated difference since 1970 between 600 thousand and actual annual starts). The first equation has no cost variables and looks more like an average quality rather than number of starts equation. The inflation and mortgage payment

[8]One exception. It is stated that "most recent estimates indicate that the (income) elasticity (of housing) is now closer to 1.5 [than unity]" (p. 4.94). My estimate is 0.68 and those of the micro studies I have seen are only slightly higher. Possibly the studies referred to (not cited) intermingle the income and price effects. The price (user cost) is lower for households with higher incomes (in higher tax brackets). If the income variable captures this price effect, then a higher elasticity would be estimated.

variables could be reflecting tenure choice, and the rise in income over time, too, likely reflects the shift towards home ownership, although there is no reason why higher income *per se* should increase ownership. Unfortunately, this would suggest that income should enter the multifamily equation with a negative sign. The multifamily equation also includes a profit variable, a factor share variable, and a measure of overbuilding consistent with desired starts over time being a constant 600 thousand and thus independent of any economic considerations. That is, the equation appears to include most any variable that "worked."

Because Evans' credit availability index is undefined, discussion of its plausibility is impossible. However, the impact of the change in FHLB advances, another availability proxy employed, is subject to interpretation. This variable reflects what appears to be a common problem with econometric models of housing: availability of funds variables work far *too* well. During the 1976-79 period, only 23 percent of savings and loan loans closed, net of refinancings, were used to finance new construction of dwelling units. Yet the coefficients on the advances variables in the starts equations suggest that a billion dollars of advances would generate $2 billion in new construction.[9] A quite careful specification of starts equations is needed to prevent a vast overstatement of availability effects. My own estimates are that a billion dollars of deposits generates only $0.31 billion of 1-4 family housing, and even this seems to be too large an effect.

Regrettably, the residential investment sector of the Evans model is no improvement on poorly formulated existing models.

Supply-Side Economics and the Productivity of Capital

Supply-side economics is concerned with increasing economic growth and thus the size of the economic pie. This can be achieved by increasing either the level of effort (more manhours worked) or the quality of a given level (more output per manhour). One way of increasing productivity is to increase capital per worker, and this is most directly achieved by raising the saving rate. Thus the most important supply-side economic issues are the sensitivities of labor supply to real after-tax wage rates and of saving to real after-tax interest rates. Because neither of these topics relates to investment, it is fortunate that other means of raising productivity exist. In

[9]Somewhat similarly, Jaffee and Rosen, 1979, and Poterba, 1980, report that an additional billion dollars of thrift deposits would lead to $1.5 billion in construction.

order to focus on such means, I assume in what follows that labor supply and saving, respectively, are independent of wage and interest rates.

Economic policy can affect economic growth in such a world via two routes. First, an increase in government saving that is not accompanied by an equal decrease in government investment or private saving will increase the capital stock. A reduction in government "consumption" outlays would reduce government borrowing and thus real interest rates, thereby stimulating investment. Alternatively, an increase in taxes on private consumption outlays would accomplish the same objective. Second, a reallocation of investment from less to more productive uses will raise the productivity of a given total stock of capital.

There are two general means of channeling investment into more productive uses. There has been a surge in explicitly mandated investments in the last decade, some of which have been of questionable value. The massive retrofitting of transportation networks to allow access of the handicapped comes to mind. Similarly, government regulations implicitly require overinvestment in some areas. For example, our trucking fleet is larger than it need be owing to "gateway" requirements whereby trucks are forced to make empty return trips on suboptimal routes. A reduction in explicit and implicit mandated investments would free resources for more productive uses.

A second means of improving the productivity of capital is to reduce the relative subsidy extended to owner-occupied housing. The user cost of capital for owner occupied housing tends to be low because neither the implicit rents from the unit nor the capital gain earned is taxed. Moreover, this user cost has declined in response to increases in anticipated inflation because real after-tax debt yields have fallen. Estimates of real user costs for owner-occupied housing and corporate structures in 1964 and 1978 are listed in Table 1. The 1964 data illustrate the relationships among user costs in a noninflationary period. The costs for housing are lower because of its preferred tax treatment, and the costs are lowest for those in the highest tax brackets. The 1978 data reflect the decline in real after-tax debt yields; the decline is largest for those in the highest tax brackets. The fall in the user costs for owner-occupied housing would have been greater but for a sharp rise in the real price of structures. Referring back to equation (2), the near doubling of the user cost for corporate structures reflects: 1) a decline in z, the present value of tax depreciation, owing to the use of historic cost

TABLE 1
Real User Costs of Capital, 1964 and 1978
(Percent)

	1964	1978
Owner-Occupied Housing:		
15 Percent Tax Bracket	9	5
30 Percent Tax Bracket	8	2
45 Percent Tax Bracket	7	0
Corporate Structures	15	27

Sources: Owner-occupied Housing, Hendershott and Hu, 1981a. Corporate Structures, Hendershott and Hu, 1981b.

depreciation, 2) an increase in taxes paid on inventory profits, and 3) a rise in the real price of structures (q/p). Also, the real after-tax financing rate for structures has not fallen because the heavily-weighted equity yield component has risen by enough to offset the decline in the real after-tax debt yield. Given this movement in user costs, the surge in the levels of sales and production of single-family housing in the second half of the 1970s and the sluggishness of investment in nonresidential structures are hardly surprising. America is now investing resources in housing that has a net (or depreciation) marginal product of near zero and foregoing the construction of corporate structures that have a net marginal product of over 20 percent.

The relative subsidy for owner-occupied housing and the resultant misallocation of capital can be reduced through a variety of methods. Most obviously, implicit rents and housing capital gains could be taxed. Not only does this appear politically infeasible, but the taxation of largely nominal capital gains has little appeal on equity grounds. Alternatively, a wide range of business tax cuts could be employed to offset the subsidy to owner-occupied housing: these include a switch to replacement cost depreciation, expanded investment tax credits, a reduction in the double taxation of corporate dividends and a general cut in the corporate income tax rate. The investment stimulated by these cuts would drive up real interest rates, thereby rechannelling resources from housing to nonresidential investments.[10] Feldstein, 1980, has generalized this argument by calling for a switch from an easy-money/tight-fiscal

[10]See Hendershott and Hu, 1980, for an analysis of the impact of these tax cuts on the user costs for business investments and owner-occupied housing.

policy mix, in which real after-tax mortgage rates are negative and the taxation of capital income is great, to a tight-monetary/easy-fiscal policy mix, in which the reverse is true.

My own favorite method of reducing overinvestment in owner-occupied housing is a large, say $12,000, exemption of interest and dividends from taxation, subject to the netting of personal (largely mortgage) interest expense. To illustrate, consider two households, each with $12,000 in interest income but one with a mortgage entailing an annual interest expense of $9,000 and the other with no mortgage and thus no interest expense. The former household would pay taxes on $9,000 of interest income (only $3,000 = $12,000 − $9,000 would be exempt), while the latter would pay no tax on interest income. This would reduce both the relative tax advantage to owner-occupied housing and the inequitable current taxation of largely nominal interest income. In effect, a tax break (cessation of taxation of nominal interest) would be extended to those not leveraging investment in owner-occupied housing. Finally, we should discourage any further subsidies to housing such as the use of tax-exempt financing (mortgage revenue bonds).

Summary

It is not clear that the new emphasis on supply-side economics has implications for major revisions in the form of business investment equations. There is, of course, a need to account carefully for the interaction between inflation and taxes and to incorporate mandated investment outlays into the analysis. But existing models either already do this or can be easily adapted. Possibly as a result, the equations in Evans' model do not appear to be particularly innovative. Moreover, there seem to be some errors in the calculation of user costs, and replacement and mandated investment outlays are overlooked.

The residential construction equations in existing models are not in as good shape as the nonresidential investment equations. The major problems are a failure to measure user costs as carefully as is done for the business sector, and a tendency to attribute far greater impact to credit availability than is remotely plausible. Unfortunately, the equations in Evans' model do not appear to address these problems in a useful manner.

While the new supply-side emphasis should not be expected to alter greatly the form of investment equations, hopefully its emphasis on supply constraints will alter the type of policy simulations run with the models. Too often in the past, simulations of policy actions or legislation designed to encourage a specific type of capital outlay have been run in the context of a world with unlimited resources or infinite supplies. The result implied by such simulations is, not surprisingly, an increase in not only the targeted capital good but in all capital and consumption goods. In such a world, *any* capital-specific policy should be pursued. In the real world, resources are limited. Even in the intermediate run, the only policies that should be analyzed are those designed to have zero aggregate demand impact. For example, a specific tax cut should be accompanied by other tax increases, expenditure cuts, or higher real interest rates (a more restrictive monetary policy).[11] Of course, if the policies are well-designed, then productivity and thus the total size of the economic pie, will increase. As Summers emphasizes (1981), however, significant quantities of these aggregate benefits will not be achieved quickly.

[11]For discussion of the issues raised in this paragraph, see Hendershott, 1980.

REFERENCES

Berndt, Ernst R. and Laurits R. Christensen. "The Translog Function and the Substitution of Equipment, Structures, and Labor in U.S. Manufacturing, 1929-68." *Journal of Econometrics*, 1 (1973), pp. 81-114.

Evans, Michael K. "Supply-Side Model." Evans Economics, Inc., mimeo, 1980.

Feldstein, Martin. "Tax Rules and the Mismanagement of Monetary Policy." *American Economic Review*, 70 (May 1980), 182-86.

Hendershott, Patric H. "Analysis of the Impact of Capital Specific Policies or Legislation: Application to Reforms of the Tax-Exempt Market." *Journal of Money Credit and Banking*, (May 1980), 377-99.

________. "Real User Costs and the Demand for Single Family Housing." *Brookings Papers on Economic Activity*, 2:1980.

Hendershott, Patric H. and Sheng Hu. "Inflation and Extraordinary Returns on Owner-Occupied Housing: Some Implications for Capital Allocation and Productivity Growth." *Journal of Macroeconomics*, forthcoming (Spring 1981).

________. "Investment in Producer's Equipment." In Aaron and Pechman, eds., *How Taxes Affect Economic Behavior*. Washington: Brookings Institution, 1981.

________. "The Relative Impacts of Various Proposals to Stimulate Business Investment." In von Furstenberg, ed., *The Government and Capital Formation*, Ballinger Publishing Co., 1980, 321-36.

Jaffee, Dwight M. and Kenneth T. Rosen. "Mortgage Credit Availability and Residential Construction." *Brookings Papers on Economic Activity*, 2:1979, 333-76.

Lucas, Robert E., Jr. "Econometric Policy Evaluation: A Critique." *The Phillips Curve and Labor Markets*, North Holland, 1976.

Poterba, J. "Inflation, Income Taxes, and Owner-Occupied Housing." NBER Working Paper No. 553, September 1980.

Summers, Lawrence H. "Inflation, Taxation and Corporate Investment." mimeo, 1980.

________. "Tax Policy and Corporate Investment." In this volume.

Discussion of the Summers Paper

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I believe that the term "supply-side economics" is a misnomer. The analytical system going under this name really consists of nothing new or fancy but merely the application of price theory to public policies concerned with major economic aggregates. This analytical approach and the public policies developed therewith do not focus particularly on supply conditions to the exclusion of effects of policy on aggregate demand. The distinguishing attribute of "supply-side" economics, and the principal issue it casts up, rather, is that it identifies the initial impact of public policies and actions in terms of alterations in (implicit or explicit) relative prices instead of changes in income.

One of the principal consequences of this distinction is that if one wants to model economic responses to public policy actions in the supply-side context, one must make very certain that the behavioral functions in one's model preclude identification of first-order income effects of government actions. The mere addition of supply equations to a standard "aggregate demand" model does not convert that model into a supply-side model.

The implications for policy of assigning first-order price effects to government actions and of rejecting the possibility of first-order income effects of such actions are enormous, but not because public policies guided by supply-side economics focus exclusively or primarily on aggregate supply conditions or because such policies primarily affect supply conditions. Rather, it is because supply-side economics dictates different policy strategies and tactics from those which have long been pursued and looks to results which differ in character and magnitude from those urged by the Keynesian aggregate demand approach.

While Summers does not provide an explicit supply-side context

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for his discussion, his paper is very much in that spirit.

Summers' provocative paper presents a wide-ranging discussion, each of the topics of which itself deserves and would make an interesting paper. I shall comment briefly on several of these, reserving more extended comments for two of his topics.

Summers first turns his attention to the postwar trends in net capital formation in the nonfinancial corporate sector. He shows that the decline during the last half of the 1970s in the rate of net investment (other than for pollution control facilities) and in such investment in relation to gross corporate product is associated with a decline in the real net rate of return. This, in turn, more reflects increases in the effective rate of tax on corporate earnings than decreases in the pre-tax rate of return. The increase in the tax rate, in turn, is attributable to inflation. Accordingly, Summers concludes that the interaction of the tax system and inflation accounts for the 1970s investment showdown.

I take no issue with this conclusion or more generally with the proposition that tax factors materially influence the pace and volume of capital formation.

The question is why the acceleration of capital formation is important. Summers properly identifies the popular concern with the adequacy of investment in terms of effects on productivity, inflation, and unemployment. He finds, however, that changing the rate of investment is unlikely to have a significant effect on the rate of growth over the next decade, that increasing investment is likely to accentuate inflation, and that there is no reason to seek to promote investment as a means of encouraging employment. With each of these conclusions and Summers' means of arriving at them, strong issue is to be taken.

First, Summers' finding that increasing investment has an extremely limited potential for increasing growth in output is derived from a model the specification inadequacies of which include a labor supply function unrelated to anything but the passage of time and a capital supply function devoid of any behavioral arguments. Associated with this is an investment function specifying net investment as a constant function of net output. Summers' model is not useful for dealing with the question whether increasing investment implies significant gains in output and employment and decreases in the inflation rate. Nor can the model be treated as representing reality. Indeed, as specified, it serves no purpose other than to illustrate a proposition which needs no illustration, viz., if the elasticity of output with respect to a production input is very small, large increases in the amount of that input will result in relatively small increases in output. By the way, even in this unrealistically limited context, the effect on the growth rate of increasing the share of output allocated to investment is substantially more impressive than Summers' exposition would lead one to believe. He finds, for example, that doubling the share of output allocated to investment would increase the growth rate "by only 0.3 percent per year over the next decade." But this is more correctly read "0.3 *percentage* points" and amounts to a *10* percent gain in the growth rate.

A model correctly specified to analyze the effects of a change in the rate of capital formation on growth of output will show how the initial change in the capital: labor ratio increases the marginal value productivity, i.e., real wage rate, of labor, and the consequent increase in both the demand for and supply of labor services. These increases in labor inputs, along with the initial gain in capital inputs, result in gains in output of significantly larger magnitude than Summers estimates. Moreover, the second-order income effects of the output gains also generate an increase in the optimum stock of capital, hence a further expansion of capital inputs.

Summers' line of analysis leads him to conclude that "Fears that insufficient capital accumulation must cause unemployment are as groundless as earlier concern about unemployment due to automation." This conclusion is, of course, dead wrong. It is arrived at by way of a mechanistic observation that since production inputs are substitutable it is possible to have some given amount of labor employed with virtually any given amount of capital. All this statement amounts to is that one can conceive production functions with any combination of exponent values one wishes. It is this analytically useless observation that leads to Summers' next assertion that increasing capital will decrease labor unless there is an increase in output. This is, of course, precisely the fear about the consequences of automation which Summers dismisses as groundless. Aside from being inconsistent, Summers is wrong. Other things equal (i.e., the pertinent demographics, the state of technology, the basic conditions of factor supplies, etc.), the *only* way to increase employment is by increasing labor's productivity which requires, unless the laws of production have been repealed, an increase in the capital: labor ratio. Indeed, the basic criterion for assessing the sufficiency or insufficiency of capital accumulation is whether it affords an increase in the capital:

labor ratio sufficient to maintain an acceptable rate of gain in productivity, real wage rates, and employment.

One of Summer's most startling conclusions is that if the rate of growth of the money stock is held constant, investment-oriented tax changes which increase investment, hence, one must presume, increase total output above levels otherwise attained, will result in an increase in the inflation rate. This conclusion derives from misspecification of the direct effects of the tax change and of the responses thereto. The correct specification is that the tax change reduces the real supply price for any given amount of capital, the response to which is a shift in the use of current income from consumption toward saving. Insofar as the reduction in real capital supply price is reflected instantaneously in an increase in the returns on stocks and bonds, this entails no shift from money to securities, as Summers claims, but from purchase of consumption goods and services to purchases of claims on capital assets. Nothing in this response mechanism necessarily pertains to any change in velocity. All that is left as a source of effect on the price level, therefore, is the effect of larger stocks of capital and the consequent increases in labor inputs on total output. As Summers correctly notes—but denies—"...the effect of increased investment on the rate of inflation is just the negative of its impact on the growth rate of real output."

To summarize to this point, on the score of the effects of increasing the stock of capital on output, employment, and the price level, Summers negative conclusions are derived from misspecification. While certainly not dismissing the welfare gains which Summers believes are the real payoff from increased investment, I think he grossly underestimates the gains in output, hence employment, which would result from increased investment in response to reducing the existing tax bias against saving and capital formation.

Summers' discussion of how tax "incentives" affect investment behavior—the last three sections of his paper—are more useful. He is quite right in criticizing the treatment embodied in the standard large-scale econometric models. For the most part, these models depend on a capital stock adjustment formulation but take a no-think approach to the adjustment process. Yet as Summers himself points out, the lack of theory to explain the pace of adjustment from one optimum stock of capital to another is not, itself, a fatal flaw in analyzing the effects of tax changes on the economic aggregates. To be sure, it impairs the usefulness of these models for forecasting purposes but the social welfare is little diminished by any such model imperfections. More to the point is whether these or any other models are so specified as to capture correctly the effects of tax "incentives" on the desired stock of capital.

The relevant formulation for this purpose proceeds, as Summers notes, from the specification of the production function, from which the schedule of the marginal product of capital is derived. *This* is the capital "demand" function, obviously unaffected *initially* by any tax change, since it is not a behavioral function. The capital supply function is the schedule showing the amounts of capital individuals wish to hold at varying net, real rates of return, given the level of total income. With taxes of the character the U. S. relies upon, market or pre-tax rates of return required for each quantity of capital must, obviously, exceed the net or after-tax rates. It is the intersection of the downward sloping marginal product and upward sloping supply schedules which determine the optimum stock of capital. Clearly, changes in tax provisions affect this optimum by altering the capital supply schedule *in pre-tax terms*. A tax change per se can have no initial effect on the marginal product of capital. Nor has it any initial first-order income effect to alter the supply of capital. It affects only the pre-tax returns required to obtain the after-tax return at which a given amount of capital will be held.

I belabor you with this simple exposition only to emphasize that the effect of a tax change on investment derives solely from the way in which taxes affect the supply of capital, hence saving behavior. With no change in the tax regime and other things given (i.e., the rate of technical progress, the condition of labor supply, etc.), saving = investment will increase with the increase in total income, hence the increase in the desired stock of capital, through time. Given the level of income, however, a change in taxes affecting the rental cost of capital generates a new optimum stock of capital *at that total income level*. It consequently impels a change in the amount of saving out of that total income, hence a change in consumption, as people seek to shift to the new desired stock of capital. It is, therefore, *only* through its effects on saving that tax changes can alter the stock of capital.

For purpose of analyzing the ultimate effect of tax changes on the stock of capital, nothing more is needed. For purposes of estimating the effects of tax changes on saving = investing, i.e., the adjustment from one optimum stock to another, far more is needed, specifically theory and data to explain the pace of the adjustment.

The search for this explanation is complicated by virtue of the fact that few, if any, feasible tax changes will affect the desired stock of *each component of the total stock* of capital in the same proportion. Virtually all such tax changes will result in some change in the composition of the capital stock. The time required to effectuate that change will differ from one type of capital to another; it takes a good deal longer, ordinarily, to build a petroleum refinery than to manufacture a new machine tool. Searching the data for stable saving functions, therefore, is chasing a will o' the wisp.

But instability in the saving function does not imply instability or shifting parametric values in the desired stock of a capital function. Accordingly, there is no real problem rising from changes in policy rules, of the sort Summers suggests, in the use of a properly specified cost of capital formulation. Set in the correct model context, this specification entails no difficulty whatever in differentiating the effects of temporary or permanent investment tax credit changes. Moreover, it generates the carefully differentiated, with respect to both magnitude and timing, estimates of the effects of different types of tax changes of the sort Summers illustrates without resort to the exotic sort of explanation Summers offers.

I find myself mostly in agreement with Summers' conclusions about the relative magnitude of the effects of capital-favoring tax changes, despite the fact that I largely disagree with the way he arrives thereat. What this proves is that even when marching to different drummers, people can arrive at the same destination. It is heartening to discover that despite quite different perceptions of what supply-side economics is about, it is possible to come quite close together on tax policy prescriptions aimed at regeneration of economic progress.