INFLATION AND TAXES: A GENERAL EQUILIBRIUM APPROACH

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NOTATION

a: real value of individual asset
b: debt-capital ratio
C: real net cost of one unit of capital
d: real per capita disposable income
e: real rate of return on equity
e_N: real net rate of return on equity
f': marginal product of capital
g: real per capita government spending
G: real per capita government deficit
h: fraction of real income consumed by the government
i: nominal rate of interest
i_N: real net rate of interest
J: ratio of inventories based on FIFO method of inventory accounting to the stock of fixed capital
K: capital stock
k: real per capita capital stock
m: real per capita money balances
M: nominal money balances
N: population
n: rate of growth of the population
p: price level
q: market price of capital in terms of output
$\overline{r}$: nominal rate of return on capital
r_N: nominal net rate of return on capital
s: per capita saving
T: real per capita taxes
u: gross marginal product of capital
X: true rate of physical decay when economic depreciation is allowed
y: real per capita output
Z: present value of all future tax savings as a result of depreciation allowances
α: tax rate on the real return on capital
β: tax rate on returns due to inflation
γ: proportion of corporate income paid out as dividends
σ: propensity to save
μ: tax rate on capital gains
ζ: physical depreciation rate of capital
δ: a measure of risk
Π: rate of inflation
τ: corporation tax rate
θ: personal tax rate

CHAPTER I

INTRODUCTION

General Introduction to the Combined Effects of Inflation and Taxes

One fundamental problem that has been attracting increasing attention in recent years is the combined effects of taxes and inflation on financial and economic decision-making. New studies, such as Hendershott (1981), Feldstein, Green and Sheshinski (1978), and Feldstein (1982a), show that the interaction of tax rules and inflation has resulted in intended and unintended effects on labor supply, business equipment, corporate financial structure, the prices of common stock, capital gains, housing investment and prices, and saving.[1] A recent study, edited by King and Fullerton (1984), shows that the interaction between inflation and the tax system goes beyond the lack of proper adjustment of depreciation for inflation. Their research shows that the combined effects of inflation and taxes affect the way investments are financed and produce different effective tax rates across different types of capital assets.[2]

The most direct effect of inflation is to raise the total effective tax rate on the capital income of non-financial corporations. The tax law and inflation have interacted to raise the effective tax rate on the profits earned on investment in plant and equipment and thereby to reduce the net-of-tax rate of return.[3] The total effective tax rate rose from 55.1% in 1965 to 74.5% in 1979.[4] At the same time, the real net rate of return declined from 6.5% in 1965 to 2.4% in 1979. Summers (1981a) claims that more than half of this decline in the after-tax rate of return can be attributed to increased inflationary induced taxes rather than to a decline in the pre-tax rate of return.[5]

The total effective tax rate rose because of the use of firms of historic cost method of depreciation of plant and equipment for tax purposes. This added over $25 billion to corporate tax liabilities in 1979.[6] The first-in-first-out method of calculating the value of inventories was another reason for the increase in the total effective tax rate. Taxation of nominal inventory profits raised corporate taxes by over $30 billion in 1979.[7]

The reduction in the rate of return on investment resulted in reducing investment in assets. The cyclically adjusted rate of net investment, i.e., net investment over GNP, was 4.6% in 1965 but only 2.8% in 1979.[8] This reduced rate of growth of the capital stock contributed to the substantial slow-down in productivity growth. In 1980 and 1981, policies to lower inflation caused temporary higher unemployment and lower economic growth. Although the economy has recovered from the recession since 1982, production is still below the economy's full potential.

The short-run costs of reducing inflation in the 1980s have been very high. However, based on the experience of the past few years, it seems that the economic benefits of reducing inflation outweigh the economic costs.

The sum of the economic costs of inflation can be high. The important point is, however, that these costs continue so long as inflation continues. They can be eliminated only by eliminating inflation and can definitely be reduced by changing the tax laws.

The analysis above suggests that the interaction of inflation and taxes has resulted in the decline in the rate of growth of the corporate capital formation through its effects on the rate of return on investment. In order to understand the way in which this interaction affects macroeconomic variables, a thorough study of the U.S. tax system and the distortionary effects of inflation is necessary.

Objectives of the Present Study

The principal objectives of this study are to examine the combined effects of inflation and taxes on capital formation, the rate of return on equity, and the rate of return on debt. In particular, an attempt is made to model the way in which inflation affects economic variables in the presence of corporation taxation.

Inflation has many adverse effects on the economic system. It distorts the measurement of profits, of interest payments, and of capital gains. Its effect on the tax system could be through increases in the effective tax rate on real income. Because interest expenses are deductible, inflation could lead to the expansion of consumer debt and the higher demand for owner-occupied housing.[9] Any way at which it is looked, inflation and taxes interact to lower the rate of growth of the capital formation in the private sector of the economy.

The purpose of this dissertation is to present an explicit and consistent analytical framework which clarifies some of the conditions under which the many frequently heard comments about inflation and taxes are legitimate. In doing so, the study is limited to analyzing the combined effects of inflation and taxes on capital formation, rate of return on equity, and the rate of return on debt.

In chapters II, III, and IV, a neoclassical monetary growth model is used to study the effect of inflation and some other important macroeconomic variables, such as the federal budget deficit, corporate and personal tax rates, and debt-equity ratio, on capital formation.

Higher rates of inflation cause people to shift their money balances into real capital, because money provides a negative or very low real rate of return. This shift from money into real capital is called The Tobin effect. Fischer (1979) shows that it holds in rational expectations models.[10] Meanwhile, higher rates of inflation drive up the replacement cost of capital, while the current tax laws provide for a depreciation allowance based on the historic cost of capital. These lower real return on capital investment and, therefore, reduce the rate of growth of capital accumulation. In chapters II, III, and IV, it is argued that the interaction of inflation and taxation reduces the rate of growth of capital stock which is crucial to the well being of the economy in the long run.

In chapter V, a disaggregated model of business activity is presented. The economy is assumed to be dominated by the corporate sector, and the corporate sector is assumed to consist of firms that differ only with respect to their sizes. Under these circumstances, the combined effect of inflation and taxes on the rate of return on debt capital and equity capital can be studied, and conclusions can be drawn with respect to this combined effect in the economy. If inflation decreases the real net rate of return, then the funds migrate to other less productive sectors of the economy, such as real estate. The analysis in chapter VI shows that under the current U.S. tax law, an increase in the rate of inflation leaves the interest rate on corporate debt virtually unchanged. However, the real net rate of return on corporate equity decreases substantially.[11] If the rate of saving is sensitive to the real net rate of return, as claimed by Boskin (1978), this leads to a lower rate of accumulation of capital. At the same time, the capital-labor ratio in the corporate sector is decreased, and the marginal productivity of capital is increased.

The real net cost of capital is affected by four major parts of the tax code. The ability to deduct interest payments as a business expense is one. The ability to deduct allowable depreciation at historic cost as a business expense is the second part of the tax code that affects the real net cost of capital. The opportunity to claim an investment tax credit is not dealt with in this paper. However, it is the third major part of the tax code that affects the real net cost of capital. The last major part is the inventory accounting method.

This paper shows that the subjects of capital formation and the rates of return are inter-related. If the problem of low rates of return is addressed, the problem of low rates of capital formation will be addressed automatically. It is shown that the real net cost of capital is the key to solving the problems associated with the effects of inflation and taxes.

An important aspect of capital formation which is emphasized in this paper is its explicitly financial side. Each decision to create more investment has a financial side. The current system of taxing corporate income influences corporate financial policies. The system encourages more debt instead of equity and promotes retention of earnings instead of payment of dividends. It is shown here, however, that the total debt-to-income ratio has been stable in the United States. With large budget deficits and increasing share of the government debt in total debt in the economy, the question is whether businesses can continue to undertake increased capital outlays.

ENDNOTES

[1]See Feldstein (1976) for the combined effects of inflation and taxes on the real rate of interest; Hendershott (1981) for the effects on stock prices; and Summer (1981a) for the effects on corporate investment and capital formation.

[2]See King and Fullerton (1984), pp. 45-90.

[3]See Bosworth (1985), pp. 14-15.

[4]See Summers (1981a), p. 122, table 3.

[5]Ibid., p. 123.

[6]Ibid.

[7]Ibid.

[8]Ibid., p. 120, table 2.

[9]See Feldstein (1982a).

[10]See Fischer (1979), pp. 225-252.

[11]This result is consistent with the findings of Ballentine and McLure (1980), pp. 351-372. They used a two sector model, but obtained the same results.

CHAPTER II

INFLATION AND CAPITAL FORMATION

Introduction

The slow growth of U.S. productivity in recent years has attracted increasing attention. The slowing in capital formation is said to play a major role in the stagnation of productivity growth since 1973.[1] Some analysts, however, claim that the apparent productivity slowdown in the last decade is only an illustion.[2]

Beebe and Haltmaier (1980) show that reduced capital deepening--slower growth of capital-labor ratios within different sectors in the economy--is an important factor in productivity slowdown, accounting for one-third to one-half of the deceleration. The rate of growth of the capital-labor ratio was 2.8% during 1948-1965, 2.5% during 1965-1973, and 1.8% during the 1973-1978 period.[3] They also show that the slowdown is evident in total productivity (involving both capital and labor inputs).

Economic uncertainty, inflation, reduced output growth, tax laws, government regulations, and lack of labor participation and job security contributed to the slowdown in capital investment and hence in productivity, according to Beebe and Haltmaier. They conclude that "an appropriate policy response would call for a reexamination of governmental policies and other factors that affect capital formation."[4]

Probably the best indicator of capital intensity is the capital-labor ratio. As mentioned earlier, while the capital-labor ratio rose at an annual rate of almost 3% during 1948-1973, it rose at the rate of only 1.8% during the 1973-1978 period. This may have accounted for one-third to one-half of the decline in productivity growth, with a major part of the slowdown due to other factors.[5] These include changes in the composition of the labor force, in the mix of output, and in the composition of capital formation. At least some of these changes are of a temporary sort and some reflect a change in consumer preferences towards the output of the industries (such as services and health care) with lower productivity. Summers (1981a) rules out any substantial effect of cyclical factors on the level of investment, and studying the changes in consumer behavior is beyond the scope of the present analysis.[6]

There is a need to look at the factors that keep capital intensity and, therefore, the rate of capital accumulation from being higher. The question here is whether (1) the unavailability of saving and investable funds, or (2) inadequate willingness to invest is the limiting factor.

Looking at the saving function, a shortage of saving relative to investment demand should be signalled by a high and rising real rate of interest. The combination of high nominal interest rates and the slowing in inflation has resulted to real interest rates well above their historical averages through the past few years.[7] Although nominal interest rates have declined since mid-1982, they are still high relative to inflation.[8] Throughout 1983, the interest rate on 90-day Treasury bills exceeded the actual inflation rate by 4.5

percentage points--a simple real interest rate which, before 1981, had not been attained since the Great Depression.[9]

A long-run analysis shows, however, that though interest rates have risen sharply in nominal terms, they have remained relatively low in real terms throughout the years.[10] On the other hand, while the cost of equity capital has been high due to lagging stock prices in recent years, financing by new issues has never been a major factor, and major reliance of the corporations has been on internal sources.

Summers (1981a) suggests that policy measures directed at increasing national saving would not affect investment significantly. He argues that to increase investment, the policy should be directed at corporate capital.[11]

A second question with respect to capital formation is whether investment has been retarded by inadequate rates of return. Until recently, it was generally believed that the rate of saving is independent of the rate of return. Boskin (1978) uses the real after-tax interest rate in his study of the interest elasticity of saving, and finds it to be significant and equal to .4. The rise in the demand for investment requires financing through a rise in the quantity of saving. Therefore, a higher real return to saving is the incentive needed, and higher capital spending must accompany higher real rates.[12] Maybe this could explain the recent high real interest rates as a result of recent corporate tax cuts and accelerated depreciation allowances adopted to stimulate capital spending.

Chapters II and III deal with the second question and the way in which inflation affects the capital formation through its effect on the rate of return. In chapter II, the effect of inflation on capital formation is studied. The same thing is done again in chapter III, this time in the presence of corporate taxation.

To study the effect of inflation on capital formation, a neoclassical one-sector monetary growth model similar to the one presented by Feldstein (1982a) is utilized.[13]

Neoclassical Monetary Growth Model[14]

The economy is described by a simple neoclassical one-sector monetary growth model in which the population grows exogenously at a constant rate of n, and the labor force is a fixed fraction of the population. There is only one good, which can be used either for consumption or production. A unit of the good when consumed disappears from the scene; when used in production, it is called capital. Capital is thus used here to mean the quantity of the good currently used in the production process. There are constant returns to scale and no technical progress. The technology can be described by a production function that relates output per capita, y, to the capital stock per capita, k:

$$y = f(k), \; f' > 0, \; f'' < 0 \tag{2.1}$$

This production function is assumed to be homogenous of degree one.

Money enters the model as an asset held by individuals. The demand for real money balances per capita, m, is assumed to be a function of the nominal rate of return on real assets, $\bar{r}$, and capital stock per capita, k, with the latter being the constraint variable.

$$m = L(\bar{r})k, \; L' < 0 \tag{2.2}$$

An increase in inflation, by increasing the real cost of holding money balances, encourages individuals to economize on real money balances and, therefore, to devote a larger share of their wealth to real assets.

The real value of individual asset or wealth holdings, a, is the sum of the values of outside money per capita, $m = (M/p)/N$, and the per capita capital stock, k.[15]

$$a = m + k \tag{2.3}$$

Here, p represents the price level, and N is the population.

The importance of the substitution between k and m depends on the size of the stock of outside money relative to total wealth of the individual. (m/a) is about 3% in the United States, suggesting that even major changes in nominal rates of return on capital have a small effect on the portion of saving that contributes to real capital formation.[16]

In the model of one-sector monetary equilibrium growth, if the rate of growth of the nominal money stock is given, the rate of inflation can be determined. The reason is that the growth rate of m, like any other real stock, must remain constant in equilibrium growth. In steady state, $(m/k) = (M/pK)$ must remain constant; therefore, the rate of growth of the nominal money stock is equal to the rate of growth of prices plus the rate of growth of the population.[17]

$$(\dot{M}/M) = \Pi + n, \tag{2.4}$$

where $\dot{M} = (dM/dt)$, $(\dot{M}/M)$ is the rate of growth of the nominal money stock, and Π is the rate of inflation.

Economic agents hold a part of the real assets in the form of real cash balances. It is through the transmission mechanism of the relative rates of return of both assets (real cash balances and capital goods) that monetary policy can influence the real variables in the neoclassical monetary growth model. As specified by equation (2.2), real cash balances are negatively related to the opportunity costs attached to the holding of cash balances. Under the assumption of no taxation, these opportunity costs can be represented as the difference between the real rate of return of capital goods, f', and the real rate of return of the cash balances, $-\Pi$. The opportunity costs can consequently be rendered as $(f' + \Pi)$.

$$\bar{r} = f' + \Pi \tag{2.5}$$

In the U.S. economy capital is financed by a mixture of debt and equity. Suppose $0 \leq b \leq 1$ is the proportion of capital that is financed by debt, i is the nominal rate of interest, and e is the real rate of return on equity. Then the nominal rate of return on capital, $\bar{r}$, can be defined as

$$\bar{r} = bi + (1-b)(e+\Pi) \tag{2.6}$$

Therefore, in an economy with mixed debt and equity finance, from equations (2.5) and (2.6),

$$\bar{r} = bi + (1-b)(e+\Pi) = f' + \Pi \tag{2.7}$$

Equation (2.5) or (2.7) gives the optimal condition for capital stock, or the investment equilibrium condition. Accordingly, equation

(2.2) specifies the demand for money as a function of the nominal return to capital, $f' + \Pi$.

Consider the model of Feldstein (1976) in which firms finance all capital investment through the sale of bonds to individuals. Here, $b=1$, and from equation (2.7), $\bar{r} = i = f' + \Pi$.[18] Now consider an all equity world. In this case, firms finance all capital investment through equity financing. Here, $b=0$, and from equation (2.7), $\bar{r} = e + \Pi = f' + \Pi$, or $e = f'$. In the short run $e = f'/q$, where q is the market price of capital in terms of output.[19] Since the analysis here is concerned with the steady state long-term relationship, q is equal to unity and, therefore, $\bar{r} = e + \Pi = f' + \Pi$.[20]

The analysis above shows that no matter how capital is financed, equation (2.5) holds and the opportunity cost of capital is given by $f' + \Pi$. In section (3.2.2), it is shown that in a world with taxation of capital, this conclusion does not hold.

The government consumes a constant fraction, h, of real national income per capita, y. Real per capita government spending, g, is, therefore,

$$g = hy \tag{2.8}$$

Disposable income, d, is defined as national income minus taxes, T, and the reduction in real money balances (or tax on real balances) caused by inflation, Πm.[21]

$$d = y - T - \Pi m \tag{2.9}$$

The government deficit, $g-T$, is financed as the increase in the stock of real money balances, $(\Pi + n)m$.[22]

$$g - T = (\Pi + n)m = \frac{\dot{M}}{pN}, \tag{2.10}$$

where $\underline{N}$ is population. Therefore, the government deficit is financed by increasing the money supply.

Substitute equations (2.8) and (2.10) into equation (2.9) to obtain

$$d = y - hy + nm = y(1 - h) + nm \tag{2.11}$$

The most important influence that government money can have on the operation of the economy is through disposable income, which determines the saving of the economic agents. The supply of saving is proportional to the households' disposable income, $\underline{d}$. Therefore,

$$s = \sigma d, \tag{2.12}$$

where $\underline{0 < \sigma < 1}$, is the saving propensity, assumed to be constant. Saving is divided between capital and real money balances. The composition but not the size of the portfolio is dependent on the real rates of return on both assets. The introduction of taxes on capital income is assumed to affect the allocation of saving but not the savings rate out of real disposable income. In steady state equilibrium, all real assets grow at the same rate as the population. Therefore, from equation (2.3),

$$s = na = n(k + m) \tag{2.13}$$

Combining equations (2.12) and (2.13) gives the growth equilibrium equation:

$$\sigma d = n(k + m) = n(1 + L)k \tag{2.14}$$

Substitute equations (2.1), (2.2), and (2.11) into equation (2.14) to find

$$\sigma(1 - h)y - (1 - \sigma)nLk - nk = 0 \tag{2.15}$$

This is the growth equilibrium condition.

To study the steady state behavior of the economy, it is useful to collect the six equations that jointly determine $\underline{y}$, $\underline{m}$, $\underline{\Pi}$, $\underline{\bar{r}}$, $\underline{d}$, and $\underline{k}$.

$$y = f(k) \tag{2.1}$$

$$m = L(\bar{r})k \tag{2.2}$$

$$(\dot{M}/M) = \Pi + n \tag{2.4}$$

$$\bar{r} = f' + \Pi \tag{2.5}$$

$$d = y - hy + nm = y(1 - h) + nm \tag{2.11}$$

$$\sigma d = n(k + m) \tag{2.14}$$

The exogenous variables are the rate of population growth, $\underline{n}$, and the propensity to save, $\underline{\sigma}$.[23] The policy instruments controlled by the government are the share of government spending in national income, $\underline{h}$, and the rate of growth of the nominal money stock, $\underline{(\dot{M}/M)}$.

To illustrate the model, figure 1 can be used.[24] Real per capita income, $\underline{y}$, is presented on the vertical axis and per capita capital-labor ratio, or capital intensity, $\underline{k}$, on the horizontal axis. The slope of the production function 0y is the marginal product of capital at the corresponding value of capital intensity. 0nk is the capital requirement line and represents the rate of growth of capital goods required to maintain the equilibrium value of capital intensity.[25]

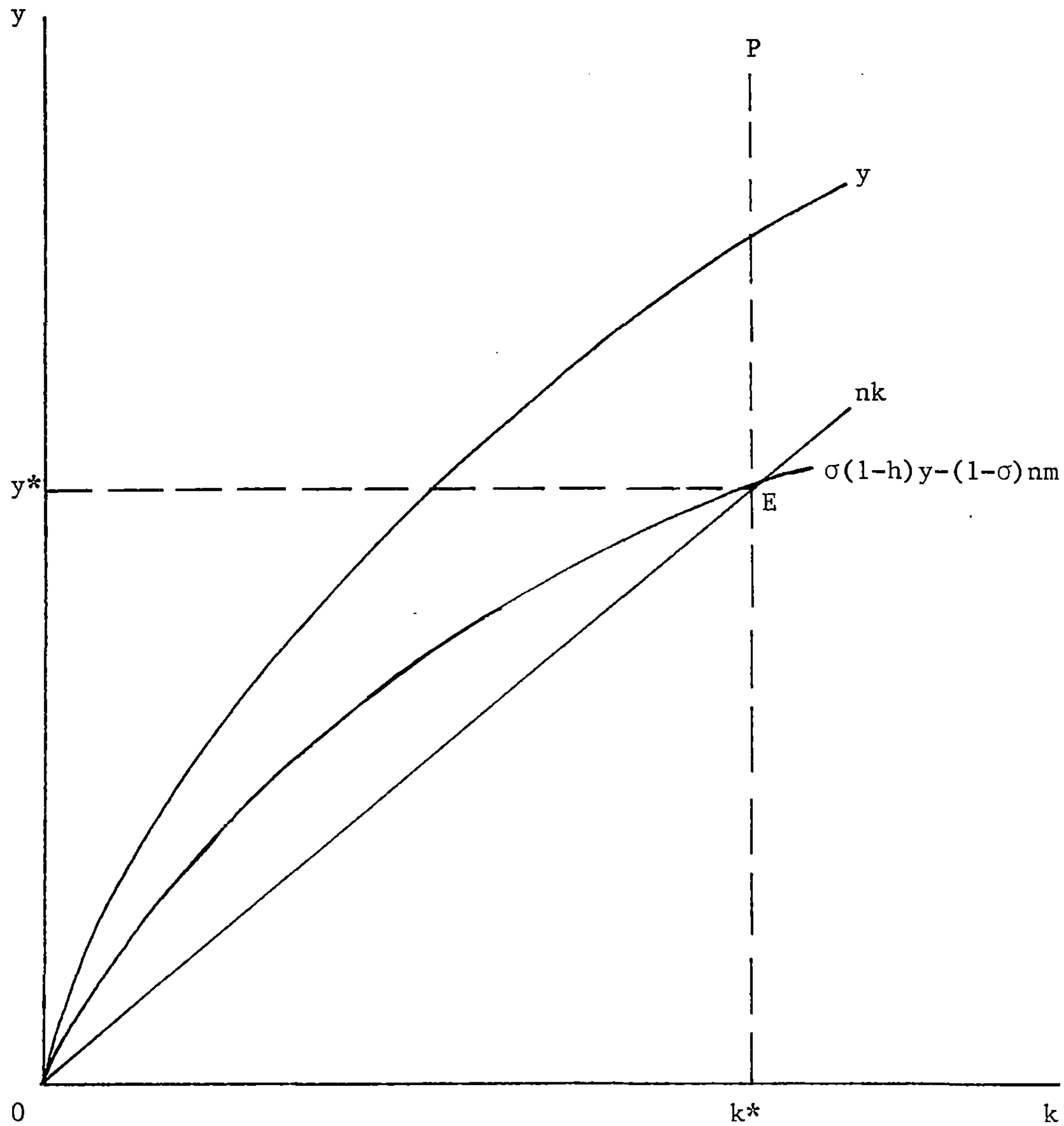

Figure 1. The Neoclassical Growth Diagram

The vertical distance between the 0y curve and the $0\sigma(1-h)y-(1-\sigma)nm$ curve represents per capita consumption at the relevant value of capital intensity. Equilibrium occurs in point E where the curve of the available savings for expansion of real capital goods, i.e., $0\sigma(1-h)y-(1-\sigma)nm$ curve, intersects the 0nk curve.[26] The equilibrium value of capital intensity and accordingly income per employee are $0k^*$ and $0y^*$, respectively. Now output per head and capital stock per head are constant. The economy is in steady state and current saving and additions to the capital stock would be just enough to equip new labor with the same amount of capital as the average worker uses.

If the saving rate increases, then the long-run level of per capita real income and per capita capital intensity rises. However, the growth rate of per capita real income is not affected in the long-run. Here, at point E, the rate of economic growth is equal to a term determined by the saving ratio and the money-capital ratio divided by the capital output ratio.[27] In the short-run, the increase in saving rate does raise the growth rate of per capita real income according to the neoclassical monetary growth model.[28]

Johnson (1967) points out that in a model such as this, money is not neutral, in the sense that the degree of convergence to the equilibrium growth path depends on the rate of monetary expansion.[29] Consumption per head can be raised by capital accumulation, if the marginal product of capital, $\underline{f'}$, is larger than the rate of growth, $\underline{n}$.[30] Per capita consumption is maximized in point P, where the marginal product of capital is equal to the growth rate $\underline{(f'=n)}$. The corresponding equilibrium value of capital intensity is k^* and per capita consumption is PE. Points on the production function to the right of point P correspond to per capita capital intensity larger than k^*, and represent situations which are dynamically inefficient ($f' < n$). Per capita consumption can be increased by reducing savings.

The economy can always be moved to the maximum per capita consumption (i.e., golden rule) point P, with monetary policy. From equation (2.2),

$$L(\overline{r}) = \frac{m}{k} \tag{2.16}$$

Differentiate with respect to time to find[31]

$$\left(\frac{dL}{dt}\right) = \left(\frac{M}{pK}\right) \left[\left(\frac{\dot{M}}{M}\right) - \Pi - n\right]. \tag{2.17}$$

As the rate of growth of money supply is increased, the expected (and actual) rate of inflation, Π, is higher according to equation (2.4). Equation (2.17) suggests that expansionary monetary policy leads to a lower value of money-capital ratio which would eventually increase real saving and the equilibrium capital-labor ratio.

Therefore, if the saving behavior in the economy is such that the money-capital ratio is low and the capital intensity is to the right of k^*, this saving surplus can be eliminated by bringing about a contraction in the money supply, producing a deflationary price development. On the other hand, an inflationary policy is needed when L is "too high" and capital intensity is lower than k^*. Therefore, money is not neutral in this model.[32]

Equation (2.17) shows that monetary policy along with the demand for money affects the equilibrium growth path. In the extreme, as a result of monetary expansion, the rate of inflation may become so high that the real cash-balances are reduced to a negligible amount so that saving in the economy is totally devoted to real capital goods. It is possible that the resulting capital intensity does not satisfy the condition of the golden rule which maximizes consumption per head.[33]

In the next section, the effect of inflation on capital formation is calculated.

The Effect of Inflation on Capital Formation

As mentioned earlier, the rate of growth of the nominal money stock, $(\dot{M}/M)$, is one of the policy instruments of the government. This makes the model block recursive. From equation (2.4), $d(\dot{M}/M) = d\Pi$. If the rate of growth of the nominal money stock is given, the rate of inflation can be determined. In other words, even though the rate of inflation is an endogenous variable in the model, its value is determined and set by the government. Total differentiation of the six equations of the model yields:[34]

$$(dk/d\Pi) = \{(1-\sigma)nL'k\}/\{\sigma(1-h)f' - (1-\sigma)n(L'f''k+L)-n\} \tag{2.18}$$

The denominator is unambiguously negative. Since $-(1-\sigma)nL'f''k$ is negative, the denominator will be negative if $\sigma(1-h)f'-(1-\sigma)nL-n < 0$. Multiply this inequality by k and substitute $m = kL$ to obtain $k\sigma(1-h)f' < (1-\alpha)nm + k$. From equation (2.14), $\sigma d = \sigma\{(1-h)f+nm\} = nm + nk$, or $\sigma(1-h)f = (1-\sigma)nm + nk$. Therefore, the inequality can be written as $k\sigma(1-h)f' < \sigma(1-h)f$, or $kf' < f$. This inequality is the condition for the stability of the simpler real growth model with no money and it clearly holds.[35]

The numerator is negative because the demand for money is inversely related to the nominal rate of return on capital. That is, $L' < 0$. Therefore, under the assumption of no taxation of capital income, an increase in the rate of inflation raises steady state capital intensity, i.e., $(dk/d\Pi) > 0$.

Since money and capital holdings present alternative portfolio assets, they move in opposite directions according to:[36]

$$(dk/dm) = \{((1-\sigma)n)/(1-h)f'-n)\} \tag{2.19}$$

The relationship between m and k is negative if $\sigma(1-h)f'-n$ is negative. This is an element for checking the stability of neoclassical monetary growth model and is satisfied by most plausible combinations of parameter values. Assuming $\sigma = .1$, $f' = .11$, and $n = .03$, and given the fact that h was equal to .2 in 1983, it is found that $\sigma(1-h)f' < n$.[37]

It is possible to arrive at a numerical evaluation of how inflation affects capital formation. Equation (2.18) suggests that in a world with no taxation of capital income, given the parameters prevailing in the economy and assuming $f''=0$, $(dk/d\Pi)$ was about \$1,975,595 in the long run. Therefore, if inflation in that year was one percentage point higher, capital stock, K, would have been \$221,267 billion higher.[39] This is obviously a very rough estimate at best, since the model used here is very simple and capital income is taxes in the real world.

This two-asset model of economic growth which was originally developed by Tobin (1965) is subject to a number of criticisms. The best known criticism is called the "Tobin-paradox." Tobin argues that saving formed from disposable income will be transformed into capital goods (physical capital) as well as real cash balances (monetary wealth). This division (portfolio balance) depends on the real rate of return on both types of assets. Tobin argues that the introduction of pure money as an asset leads to a lower saving ratio than in the pure, real model of economic growth. This rather strange conclusion that introducing money as a wealth component would reduce the equilibrium value of capital intensity, is due to the fact that money is functioning only as an asset and not as a producer or consumer good.

A higher rate of monetary growth, which results to a higher equilibrium value of the rate of inflation according to equation (2.4), will reduce real cash balances as a wealth component on the basis of Tobin's views regarding the portfolio behavior. The difference which arises between the real rates of return on both assets is expressed by more physical capital as shown by equation (2.18). This substitution of physical capital for cash balances is called the portfolio effect of Tobin. Therefore, in a model such as this, the monetary authorities can influence savings by regulating the growth rate of the money supply. This suggests that they should look for an optimal rate of inflation.

Johnson (1966) and Levhari and Patinkin (1968) showed that under a different set of assumptions regarding the saving propensity, the influence of a change in the rate of monetary expansion on the equilibrium values of the real variables, or capital intensity is ambiguous. However, if the saving ratio is constant, a higher rate of monetary growth, or a higher rate of inflation, reduces the desired cash holdings and more saving is directed towards physical capital goods. The same results are found when a positive relation exists between a change in the rate of inflation and a change in the ratio of saving to disposable income.[40]

ENDNOTES

[1]This claim was made, among the others, by Clark (1978), pp. 965-975; and Kendrick (1980).

[2]See Morris (1984), pp. 3-15.

[3]See Beebe and Haltmaier (1980), p. 13, table 5.

[4]Ibid., p. 8.

[5]Ibid., p. 13.

[6]See Summers (1981a), pp. 117-121.

[7]See Berson (1983), pp. 23-28.

[8]See Miller (1983), p. 9.

[9]Friedman (1981), p. 39, examines some of the explanations for high interest rates and finds that none of them is satisfactory.

[10]See Boskin (1978).

[11]See Summers (1981a), pp. 143-146.

[12]See Feldstein (1980b), pp. 636-650.

[13]This model is also used in some other papers such as Feldstein (1976).

[14]Feldstein (1980b) uses a three-asset model of monetary economic growth. In his model, government deficit is financed by increasing the money supply and issuing interest-bearing government debt.

[15]Monetary growth theory was originally developed by Tobin (1965).

[16]Outside money is based on the debt of a unit (government) exogenous to the economic system itself. Therefore, it is not the creation of a private banking system. It is a completely liquid financial asset that is considered as an addition to the net-wealth by private economic agents.

[17]See Feldstein (1982a), p. 301.

[18]Feldstein (1976), p. 810, offers an alternative explanation for equation (2.5). Firm's profit will be maximized when the marginal product of capital, f', is equal to the real rate of interest, $i - \Pi$; or stated differently, when the marginal product of capital plus the appreciation in the value of a unit of capital (i.e., $f' + \Pi$) is equal to the nominal rate of interest, the firm's capital stock will be optimal.

[19]q is also called Tobin's q. According to Tobin, in a world with no taxes, firms invest as long as each dollar spent on capital raises the market value of the firm by more than one dollar. If q, the market value of an additional unit of capital is defined as the market value of the capital stock to its replacement cost, investment will increase if q is larger than unity, and it will decrease if q is less than unity. If q is equal to unity, then investment consists of only the replacement component plus an expected growth component in a growing economy. q may be less than unity because of the differences in taxes on dividends and capital gains. However, in the long-run and the steady state, when desired and actual levels of capital are equal, q is unity.

[20]See footnote 19.

[21]See Feldstein (1982a), p. 302.

[22]Since $m = (M/p)/N$, or $M = mNp$, the increase in the stock of real money balances, $(\Pi + n)m$, can be written as

$$\left(\frac{\dot{p}}{p}\, m + \frac{\dot{m}}{m}\, m\right) = \frac{N(m\dot{p} + \dot{m}p)}{Np} = \frac{\frac{d(mNp)}{dt}}{pN} = \frac{\frac{dM}{dt}}{pN} = \frac{\dot{M}}{pN}\,.$$

[23]The constancy of the saving rate has been demonstrated by David and Scadding (1974).

[24]See Johnson (1977), p. 166.

[25]This required rate of growth is the population growth rate, n, which is also the slope of the Onk line.

[26]Saving is fully transformed into real capital goods and real cash balances.

[27]From equation (2.15), $n = \sigma\{(1-h)/[(1-\sigma)L+1]\}/(k/y)$.

[28]See Ott, Ott and Yoo (1975), pp. 300-306.

[29]See Johnson (1961), p. 167.

[30]See Phelps (1961), pp. 638-643.

[31]See Ott, Ott and Yoo (1975), p. 305.

$$\left(\frac{dL}{dt}\right) = d\left(\frac{M/p}{K}\right) = \frac{K\,\frac{d(M/p)}{dt} - \frac{dK}{dt}\,\frac{M}{p}}{K^2} = \frac{\frac{K\left(p\,\frac{dM}{dt} - M\,\frac{dp}{dt}\right)}{p^2} - \frac{dK}{dt}\,\frac{M}{p}}{K^2} =$$

$$\frac{\dot{M}}{pK} - \frac{M\dot{p}}{Kp^2} - \frac{\dot{K}}{K^2}\,\frac{M}{p} = \frac{M}{pK}\left[\frac{\dot{M}}{M} - \Pi - n\right] .$$

[32]See Beare (1978), pp. 456-458.

[33]See Tobin (1968), pp. 838-839.

[34]Totally differentiate equation (2.15) after substituting equations (2.1), (2.2), and (2.5) to obtain equation (2.18).

[35]See Feldstein (1980b), p. 642. $kf' < f$ implies that $f' < y/k$. In other words, the marginal product of capital, f', which is the slope of f(k), is less than income-capital ratio. Income-capital ratio in the U.S. is about .33, while f' is about .11, according to most studies, such as the ones mentioned in footnote 37.

[36]Equation (2.19) can be found by substituting equations (2.1), (2.2), and (2.5) into equation (2.15) and then totally differentiating this equation.

[37]See Summers (1981c), p. 182, for $\sigma = .1$ and $n = .03$. See Feldstein (1980a), p. 316, for $f' = .11$. Hendershott (1981) also assumes $f' = .1$. See Survey of Current Business, or any other publication that reports the national income accounts for $h = .2$ in 1983.

[38]The interest elasticity of demand for money in the United States is estimated to be about -.019 in the short-run (see Goldfeld (1973), p. 602). Treasury bills rate was 8.63% in 1983, and the stock of outside money was equal to $(M_1/3) = \$175.1$ billion. These imply that $L' = -.019(175.1/.0863) = -38.6$. The ratio of net fixed nonresidential capital stock to output in the United States is about 3 (see Summers (1981b), p. 73). This suggests that $k = 3(y/\text{labor force}) = 3(1{,}534{,}700/112) = \$41{,}108$, in 1983, and

$$L = \frac{(M_1/3)}{kN} = \frac{(175.1)}{(41{,}108)(234.3)} = .018 .$$

Therefore, from equation (2.18),

$$\left(\frac{dk}{d\Pi}\right) = \frac{(1-.1)(.03)(-38.6)(41{,}108)}{.1(1-.2)(.11) - (.9)(.03)(.018) - .03} = \$1{,}975{,}595$$

in the long run.

[39](1,975,595)(112) = \$221,267 billion, where 112 million is the labor force of the United States in 1983.

[40]Feldstein (1976) assumes that this relationship is negative. Still he finds that in two important special cases; (1) when there is full indexing of the taxation of interest income, and (2) when the rate of corporation tax is the same as the rate of personal income tax, $(dk/d\Pi)$ is unambiguously positive.

CHAPTER III

INFLATION, TAXATION, AND CAPITAL FORMATION

Introduction

A tax on corporate income affects economic decision-making concerning the allocation of resources within the private sector of the economy. Unfortunately, one cannot determine the full effects of the tax within the framework of an analytical model. As a result, the corporate tax has generally been viewed as a tax on capital in the corporate sector.[1]

While economists disagree about the causes of the shortfalls in capital spending, there seems to be a general view that certain changes in the structure of business taxation--the corporate income tax rate, the investment tax credit, and the nature of depreciation allowances--could stimulate business spending on new plant and equipment.

Feldstein (1980b) argues that the interaction of taxes and inflation reduces incentives for capital accumulation, while taxation on interest income, through the deductibility of interest payments, tends to offset the inflation tax on money balances.[2]

As mentioned earlier, a full analysis of the impact of taxation on capital is not as yet available. Almost half of the capital stock in the United States is non-corporate. A large portion of non-corporate capital consists of non-residential capital, with its tax treatment different from that of the corporation capital.

There is no doubt that inflation acts as a means of taxation. That is, it offers an alternative way to transfer resources from the private to the public sector of the economy. It is the effects of the inflation on the tax system itself and the way it alters the aims of corporate taxation that creates most of the distortions.

Since taxes are based on nominal values, inflationary effects on the tax base become more important in cases in which longer periods of time are considered for calculating the tax base. Therefore, inflationary distortions may be small for current income, but they are of considerable importance for depreciation and changes in asset value.

In an inflationary period, depreciation based on historical costs is lower than depreciation based on replacement costs. Therefore, profits are inflated above their economic level, and profit taxes are accordingly higher. Also, increases in the value of assets are partly due to inflation. Therefore, nominal capital gains exceed real changes in asset value. Because nominal capital gains are taxed, the combined effects of inflation and taxes create distortions in individual income taxes. On the other hand, creation of real gains or losses to debtors and creditors as a result of inflation is ignored by the present tax system.

Feldstein and Slemrod (1978) show that the taxation of capital income is more severely distorted in the presence of inflation than is the taxation of labor.[3] The interaction of inflation and the tax laws tends to lower the real rate of interest through historic cost depreciation. On the other hand, the tax deductibility of interest payments tends to raise the real rate of interest. Feldstein and Summers (1978) show that in a model that includes debt and equity capital, the nominal long-term interest rate rises by the same rate as the rate of inflation, implying that the real interest rate net of tax is reduced substantially by inflation.[4]

While profits are artificially inflated as a result of inflation and historic cost depreciation, the decline in the real value of corporate debt due to inflation helps the corporations. Feldstein and Summers (1979) show that the increase in inflation-induced tax outweighs the tax saving debt effects.[5]

To analyze the effects of inflation on the taxation of capital in the corporate sector, it is necessary to consider not only the taxes paid by the corporations, but to consider also the tax effects on the suppliers of capital. Inflation may raise not only the nominal, but also the real market rate of return demanded by the individuals. Therefore, personal income taxes must also be taken into consideration. In particular, if the interest elasticity of saving is significant, the adverse effects on capital formation as a result of the reduction in the real net rate of return may be substantial.[6] On the other hand, the role of the real after-tax rates of return as indicators of the effects of (expected) inflation on the performance of the economy should not be over emphasized. Steindl (1985) extends Feldstein's (1976) model and shows that capital intensity increases in a model similar to the one presented here regardless of the behavior of the real net rate of return.

The primary concern of this chapter is to analyze the effect of inflation and taxes on capital intensity. It is also of interest to study the effect of an increase in the government deficit, the corporate tax rate, and the personal tax rate on capital formation.

Chapter III is devoted to this task. In the last section of this chapter, the use of inflation as an alternative to taxation is studied.

To study the combined effects of inflation and taxation, an expanded version of the neoclassical monetary growth model is utilized in the next section.

Study of the Model

The logical approach to study the model is to present a list of the variables in the model first. This is followed by the description of the equations and the solution of the model.

Notation[7]

It is useful to present a list of the variables that have been introduced so far in the paper.

a: real value of individual asset

d: real per capita disposable income

e: real rate of return on equity

f': marginal product of capital

g: real per capita government spending

h: fraction of real income consumed by the government

i: nominal rate of interest

k: real per capita capital stock

m: real per capita money balances

M: nominal money balances

n: rate of growth of the population

N: population

p: price level

q: market price of capital in terms of output

$\bar{r}$: nominal rate of return on capital

s: per capita saving

T: real per capita taxes

y: real per capita output

σ: propensity to save

Π: rate of inflation

The Model

If it is assumed that the tax system taxes the real return on capital, f', at a rate α, and the return due to inflation, Π, at a rate β, then the nominal after-tax return on capital is:[8]

$$r_N = (1 - \alpha)f' + (1 - \beta)\Pi \tag{3.1}$$

In the U.S. economy with mixed debt and equity finance, debt financing has an important advantage under the corporation income tax system. The interest that companies pay is a tax deductible expense. But dividends and retained earnings are not tax deductible. Thus, the return to bondholders escapes taxation at the corporate level. The present value of the tax shield provided by the debt of the firm is equal to the corporate tax rate times the amount of debt issued, and is contributed to the value of stockholders' equity.

Let θ be the marginal rate of personal tax. The cash flow due to the corporate income tax shield is θ percent less when personal taxes are recognized, but so is the opportunity cost of capital. If investors are willing to lend on a prospective return before personal taxes at i, then they must also be willing to accept a return after personal taxes of $i(1 - \theta)$. Inflation produces a capital loss at a rate of Π. Therefore, the real net rate of return to bondholders is given by:[9]

Interest net
$$i_N = (1 - \theta)i - \Pi, \tag{3.2}$$

where i is the nominal rate of interest.

Equity income comes in the form of capital gains and dividends. Dividends are taxed more heavily than capital gains. Also, the capital gains tax is deferred until the shares are sold and the gains are realized. Suppose that dividends are fully taxed at the personal tax rate θ. Inflation, by raising the nominal value of the firm's capital stock, generates a nominal capital gain that must be taxed at the capital gains tax rate, μ. This rate is the accrual rate of capital gains taxation equivalent to the tax that will be paid in the future when the stock is sold. The extra burden caused by taxing nominal capital gains is thus $\mu\Pi$. The real net return on corporate equity is therefore given by:[10]

Equity net
$$e_N = (1 - t')e - \mu\Pi, \tag{3.3}$$

where e is the real rate of return on equity. t' is the rate at which real equity income is taxes at the personal level. t' is equal to $\gamma\theta + \mu(1 - \gamma)$, where, γ is the proportion of the real before personal tax return that is paid out as dividends.[11]

In the presence of taxation, depreciation allowances at historic cost underestimate the needed capital requirements. If u is the gross marginal product of capital, then $u = f' + X$, where f' is the net marginal product of capital, and X is a parameter that is equal to the true rate of physical decay when economic depreciation is allowed, and is greater than the true rate of physical decay when the capital is assumed to depreciate faster than the rate of physical decay. This latter case is termed accelerated depreciation.

In steady-state equilibrium, the capital intensity is assumed to be constant at $\bar{K}$. If it is assumed this capital stock undergoes expotential depreciation at a rate X, then to keep the capital stock constant, gross investment in every period must equal $X\bar{K}$. The current capital stock is $\int_t^\infty I(t-s)e^{X(t-s)}ds$, where $I(t-s)$ is the amount of capital replaced $(t-s)$ periods ago, and $I(t-s)e^{X(t-s)}$ is the amount of that particular investment still in existence today. Since gross investment in every period is $X\bar{K}$, therefore, $\int_t^\infty I(t-s)e^{X(t-s)}ds = \int_t^\infty \bar{K}Xe^{X(t-s)}ds = K$. Here, $Xe^{X(t-s)}$ is the real tax depreciation allowed on a machine of age $(t-s)$.

Suppose $1 investment was made at time s. If it is assumed that the real net cost of investment of $1 of capital at time s is C, then Z, the discounted sum of all future tax savings as of the time that one dollar of investment is made is given by $Z = \int_t^\infty e^{C(t-s)}Xe^{(t-s)}ds = \{X/(X+C)\}$.[12] When the economy is in steady-state equilibrium, all nominal variables must be growing at the same rate. If prices, including the price of capital, are rising at a constant rate, Π, over time, then the real value of depreciation falls below economic depreciation by a factor that grows with time at the rate Π, and the real tax depreciation allowed on a machine of age $(t-s)$ becomes $Xe^{X(t-s)}e^{\Pi(t-s)}$. Therefore, $Z = \int_t^\infty e^{C(t-s)}Xe^{X(t-s)}e^{\Pi(t-s)} = \{X/(C+x+\Pi)\}$.

Suppose τ is the corporate tax rate. If ζ is defined as τZ, then in the steady state, the real return per unit of capital prior to income and capital gains taxes, when only the historic cost of depreciation is exempt from the corporate profits is $(1-\tau)f' - \zeta\Pi$, where the term $\zeta\Pi$ $(\equiv\tau Z\Pi)$ captures the fact that when historic or original cost methods of depreciation valuation are used, the real value of depreciation is understated when inflation is positive, and thus real taxable profits are overstated. If economic depreciation is allowed, $\zeta = 0$ and $Z = \{X/(C+X)\}$. When historic cost method of depreciation is allowed, $\zeta > 0$ and $Z = \{X/(C+X+\Pi)\}$. To keep the analysis simple, ζ is assumed to be exogenous.

Given equations (3.2) and (3.3) and depreciation allowances at historic cost, and assuming that all earnings are paid out as dividends, i.e., $\gamma = 1$, the optimal condition for capital stock, or the investment equilibrium condition can be written as:[13]

debt share

$$(1 - \theta)(1 - \tau)f' = b(1 - \tau)i_N + (1 - b)e_N + \Pi\{b(\theta - \tau) + \mu(1 - b) + \zeta(1 - \theta)\}, \qquad (3.4)$$

where τ is the corporate tax rate, and b is the proportion of capital financed by debt.[14]

1 Consider first the model of Feldstein (1976) in which firms finance all capital investment through the sale of bonds to individuals. Here, $b = 1$, and the nominal after-tax return on capital as a portfolio asset is found from equation (3.4) to be:

$$r_N = i_N + \Pi = (1 - \theta)f' + \{1 - (\theta - \tau + \zeta(1 - \theta)/(1 - \tau)\}\Pi \qquad (3.5)$$

Compare equation (3.5) to equation (3.1) to find that the real return on capital, f', is taxed at a rate of the individual income tax, i.e., $\alpha = \theta$. The return due to inflation, Π, is taxed at a rate of $\beta = \{\theta - \tau - \zeta(1 - \tau)\}/(1 - \tau)$, which is negative so long as the corporate tax rate exceeds the individual tax rate and economic depreciation is allowed. In this case, the tax treatment of debt financed corporate capital is very similar to the tax treatment of home-owners. The nominal after-tax return increases by more than the rate of inflation due to the fact that the tax system subsidizes the borrowers.

The steady state condition which is given by equation (2.15), or

$$\sigma(1 - h)f - (1 - \sigma)nL(\bar{r})k - nk = 0, \tag{3.6}$$

now becomes:

$$\sigma(1 - h)f - (1 - \sigma)nL(r_N)k - nk = 0. \tag{3.7}$$

As mentioned earlier, inflation is controlled by the government's monetary policy. Therefore, even though Π is assumed to be endogenous, its value is assumed to be pre-determined.

Differentiate equation (3.7) with respect to k and Π, after substituting for r_N from equation (3.5) to obtain

$$\begin{aligned}(dk/d\Pi) = \{&(1 - \sigma)nL'\{1 - (\theta - \tau + \zeta(1 - \theta))/ (1 - \tau)\}k \;/\\ &\{\sigma(1 - h)f' - (1 - \sigma)n\,\{L+L'f''(1 - \theta)k\} - n\}\end{aligned} \tag{3.8}$$

The denominator is negative if $\sigma(1 - h)f' - (1 - \sigma)nL - n < 0$. It was shown in chapter II that this condition holds. Since $(\theta - \tau + \zeta(1 - \theta)) = \beta$, given the values that prevail in the economy

for tax rates, i.e., $\tau = .46$ and $\theta = .3$, it can be shown that $\beta = -.03$.[15] Therefore, the numerator in equation (3.8) is negative. Thus, $(dk/d\Pi)$ is positive in a world in which the real return on capital, f', is taxed, capital depreciates at its historic cost, and all capital is financed through the sale of bonds to individuals. However, the steady state capital intensity increases by more than it would in an inflationary world with no taxation of capital income. The reason is that the return to bondholders escapes taxation at the corporate level.
nom, after-tax return on K
As mentioned earlier, β is negative. In this world, the cost of capital becomes cheaper as the rate of inflation is increased.

The relationship between per capita money holdings and per capita capital stock is given by equation (2.19) again, where h is the fraction of real income consumed by the government. An increase in per capita money holdings reduces per capita capital stock, k.

α

Now consider an all equity world. In this case, firms finance all capital investment through equity financing. Here, in equation (3.4), $b = 0$, and the nominal after-tax return on capital as a portfolio asset is

$$r_N = e_N + \Pi = \{1 - (\tau + \theta - \tau\theta)\}f' + \{1 - (\mu + \zeta(1 - \theta))\}\Pi \qquad (3.9)$$

Therefore, the real return on capital, f', is taxed at a rate of $\alpha = \tau + \theta - \tau\theta$, and the return due to inflation, Π, is taxed at a rate of $\beta = \mu + \zeta(1 - \theta)$, which is positive. Thus capital is taxed at both the corporate and individual level, and there would be no taxes on the return due to inflation if: (1) capital gains are not taxed, and (2) economic depreciation is allowed. Real gains, f', are taxed at a higher rate.

After substituting for r_N from equation (3.9) into the steady state equation (3.7) and differentiating with respect to Π and k,

$$(dk/d\Pi) = \{(1 - \sigma)nL' \{1 - (\mu + \zeta(1 - \theta))\}k\}/\{\sigma(1 - h)f' - (1 - \sigma)n\{L + L'f''(1 - (\tau + \theta - \tau\theta))k\} - n\} \quad (3.10)$$

The denominator is negative and so is the numerator.[16] Therefore, $(dk/d\Pi)$ is positive in a world in which the real return on capital is taxed, capital is assumed to depreciate at historic cost, and all capital investment is financed by equity. However, the steady state capital intensity increases by less than it would in an inflationary world with no taxation of capital income, or in a world in which capital is financed by issuing debt. The reason for this is the fact that the denominator is the same in both equations (3.8) and (3.10). However, β is positive in equation (3.10) and negative in equation (3.8). The reason for the smaller increase in capital intensity is the tax treatment of equity income compared to debt income.

3 In an economy with mixed debt and equity finance, the effective tax rates on real and inflationary capital income are weighted averages of the expressions derived in equations (3.5) and (3.9), with weights being the share of capital financed by debt and equity. Here, b is between zero and one. From equation (3.4),

$$r_N = b(1 - \tau)i_N + (1 - b)e_N + \Pi = (1 - \theta)(1 - \tau)f' + \Pi\{1 - b(\theta - \tau) - \mu(1 - b) - \zeta(1 - \theta)\} \quad (3.11)$$

Therefore, the real return on capital, f', is still taxed at a rate of $\alpha = \tau + \theta - \tau\theta$, and the return due to inflation is taxed at a rate of $\beta = b(\theta - \tau) + \mu(1 - b) + \zeta(1 - \theta)$. The tax rate on real capital is exactly like the previous case in which all capital is financed by equity. However, the tax rate on the return due to inflation is now much lower by $b(\theta - \tau) - b\mu$.

After substituting for r_N from equation (3.11) into the steady state equation (3.7) and differentiating with respect to Π and k,

$$(dk/d\Pi) = \{(1 - \sigma)nL' \{1 - b(\theta - \tau) - \mu(1 - b) - \zeta(1 - \theta)\}k\}/$$
$$\{\sigma(1 - h)f' - (1 - \sigma)n\{L +$$
$$L'f''(1 - (\tau + \theta - \tau\theta))k\} - n\} \quad (3.12)$$

The denominator is negative and so is the numerator.[17] Therefore, $(dk/d\Pi)$ is positive in a world in which the real return on capital is taxed, capital is assumed to depreciate at historic cost, and capital investment is financed by debt and equity. However, this increase in capital intensity is somewhere between the increases in k in: (1) all equity finance case, and (b) all debt finance case.

The effect of capital debt ratio, b, in equation (3.12) is given by $-b(\theta - \tau) + \mu b$ in the numerator. As equation (3.12) suggests, since $\theta < \tau$, under the current tax laws, a higher debt ratio increases the long-run steady state capital intensity in the presence of continued inflation. In this case, the shareholders prefer to see that firms are borrowing on their behalf, since interest expenses are deductible at a higher rate for businesses.

To analyze the case further, growth can be viewed as an outward movement of the production possibilities curve. The slope of the production possibilities frontier is given by the marginal rate of transformation, which is unity plus the rate of return on the investment projects, or the rate of profit. $F(C_1, C_2)$ in the following figure represents the production frontier. The economy grows as $F(C_1, C_2)$ moves farther from the origin (figure 2).[18]

The capital market constraint is represented by line JK and its slope is equal to unity plus the rate of return on capital. This line describes the opportunities for borrowing and lending.

Production is maximized subject to the capital market line, by equating the profit rate to the rate of return on capital. Given the production frontier and the capital market line, the optimal outcome is with production (C_1^*, C_2^*). Point E maximizes the present value of the stream of income. That is, it maximizes OK. At this point, the capital market constraint is satisfied and the production point on the production frontier is pushed as far to the right as possible.

In a taxless world, production and consumption frontiers are the same. The present savings are C_1^*K, and the economy grows at rate $\underline{n}$ on ray OE from the origin. If constant returns to scale is assumed, E travels along OE as the economy continues to grow and $F(C_1, C_2)$ moves to the right. If there is a productivity slowdown, then the economy grows along a ray drawn between OE and the 45 degree line.

If income taxes are introduced and after the payment of taxes, the production frontier, FG, shrinks towards the origin to give a new frontier, F'G', as shown in figure 3. This is the case if the government spends the tax revenue on consumption goods rather than capital. In the case of a consumption tax, FG would have shrunk proportionately towards the origin by a given factor. In the case of an income tax, FG does not move towards the origin by $\underline{(1 - \theta)}$. The reason is that taxing the present income leaves less for investment in the future. As a result the future stream of income will be taxed

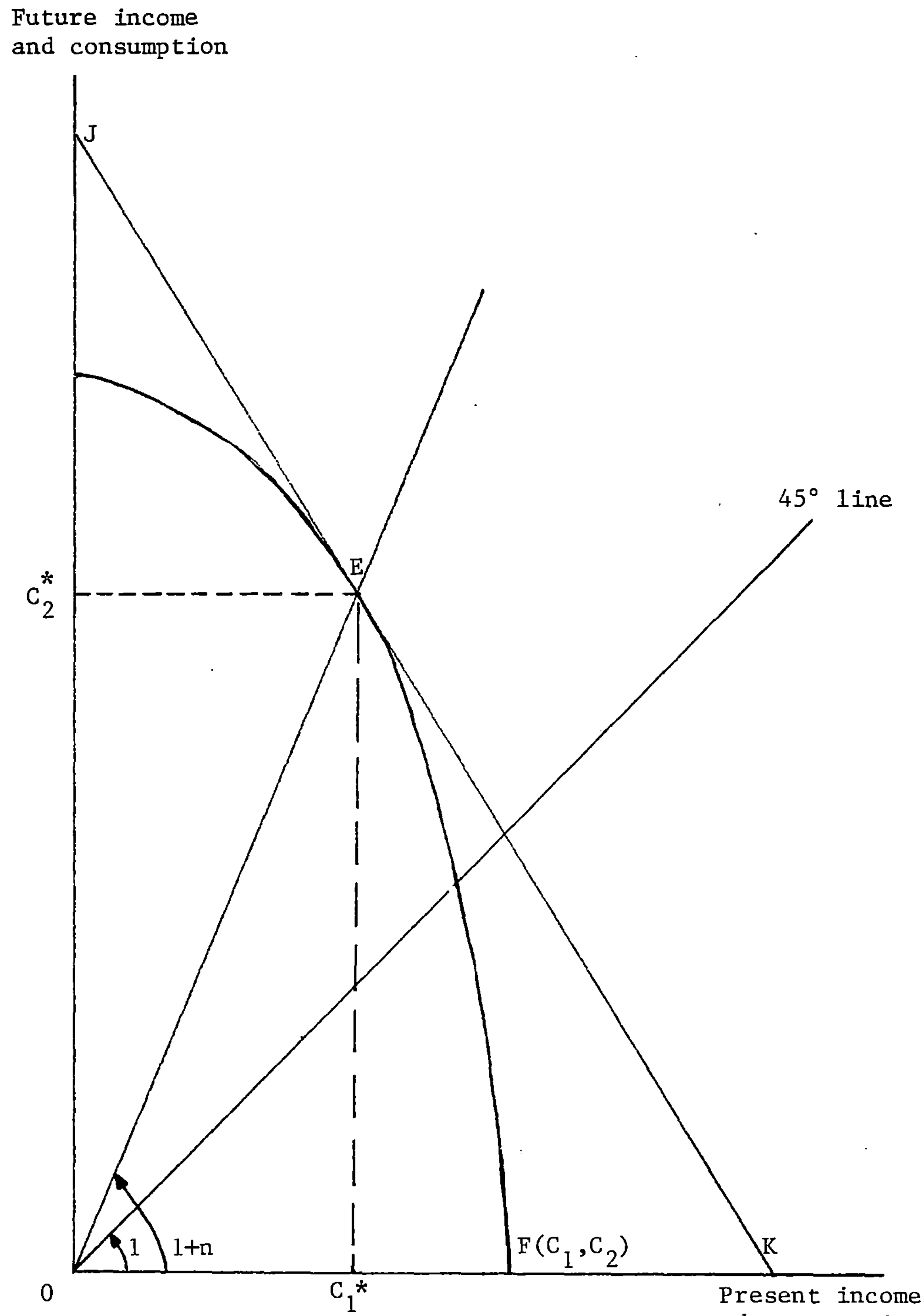

Figure 2. The Production Frontier

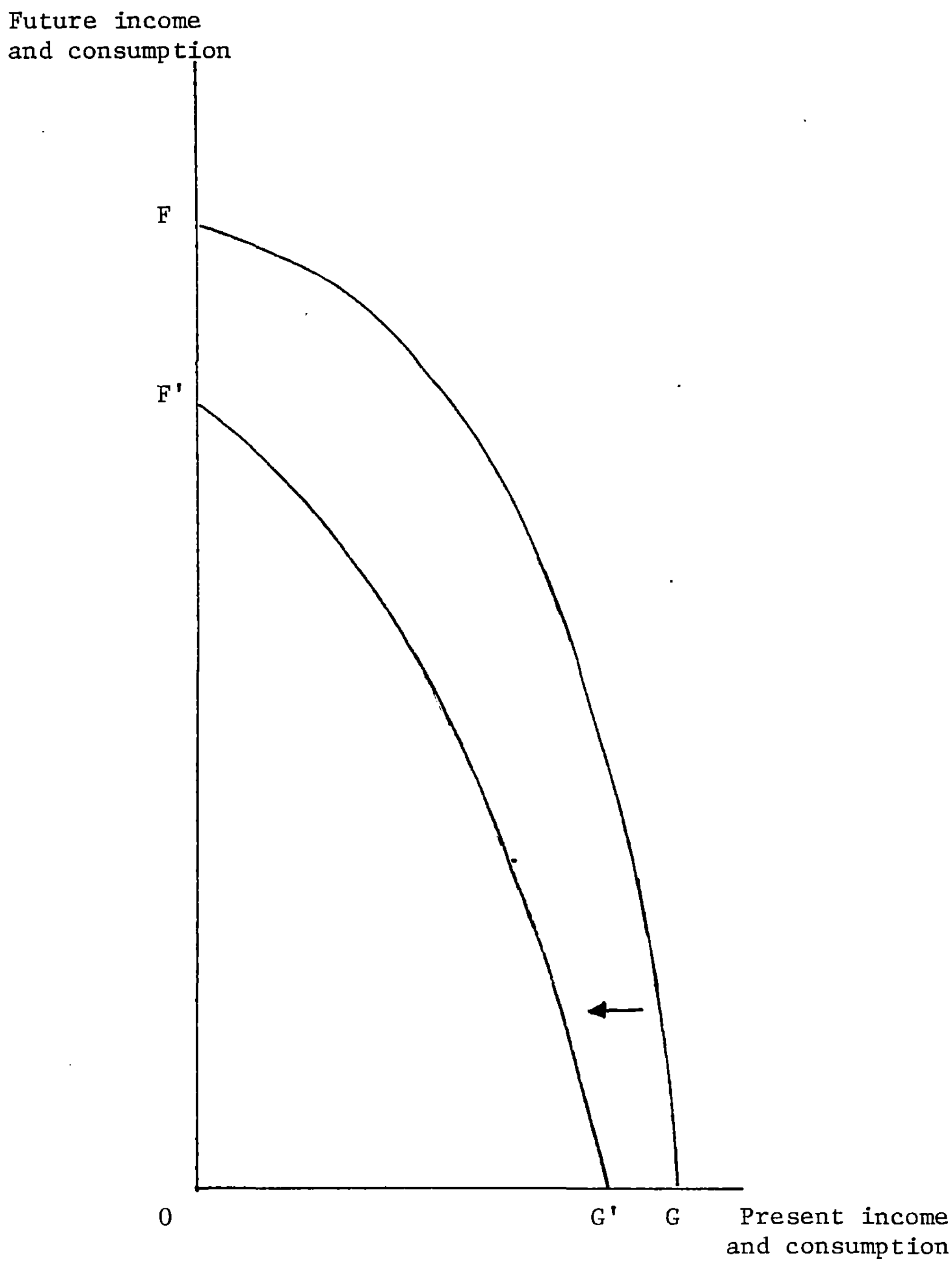

Figure 3. The Effect of Income Taxes

more heavily compared to the present, even though the income tax rate is the same for both periods.[19]

If it is assumed that all revenues are spent, F'G' shifts to the right. However, due to lower productivity of government expenditures, F'G' does not shift back as far as FG. Suppose F'G' is the production frontier after all shifts have taken place. Then F'G' is flatter than FG, implying a shift from future consumption to present consumption. The post-tax rate of return is now lower than the pre-tax rate of return. In equilibrium the rate of time preference for the society and the post-tax rate of profit should be equal to the post-tax rate of return on capital.[20]

The pre-tax rate of profit and the pre-tax rate of return on capital are now about the same. However, the income tax creates a wedge between the rate of time preference and the pre-tax rate of profit, and, therefore, it produces misallocation of resources. Present consumption is now preferred to future consumption. This would restrict the outward movement of the production frontier.

If it is assumed that only economic depreciation may be offset against profits for tax purposes, and if FG is the production frontier before corporate taxation, then F'G' is the production frontier after the payment of corporation tax. F'G' is flatter than FG for the reasons mentioned earlier.

Dividends are subject to personal income tax at rate $\underline{\theta}$. The dividend streams of the individuals after the payment of corporation and personal taxes are now to the left of F'G'. Inflation, by creating an extra burden caused by taxing nominal capital gains, will push the frontier further towards the origin.

Suppose firms are able to borrow and lend. Interest payments are deductible from profits for tax purposes. Interest received is subject to corporation tax. If the position of FG is determined by gross profits before tax and interest payments, it is not solely determined by the supply of equity by shareholders. More borrowing will lead the FG curve to lie further from the origin.

In figure 4, for any given level of borrowing and a particular position of FG, point P on the corresponding F'G' curve, where the post-tax rate of profit is equal to the post-tax rate of return on capital, will give the optimal production activity.

More borrowing will lead to a move by P away from the origin on a ray OP. There is a limit to how much firms can borrow, however. The demand for corporate financial obligations (or the supply of capital) is highly correlated with the rate of inflation and tax structure. The supply of saving is a constant fraction of disposable income according to equation (2.12). The mixture of debt and equity acceptable to the market is determined by the real net rates of return on both debt and equity.

If accelerated depreciation allowances are assued, then some of the distortions created by the tax system are removed. However, the triple equality between the pre-tax rate of profit, the rate of time preference, and the pre-tax rate of return on capital still is not satisfied. Stiglitz (1976) shows that introduction of a corporation tax with expensing (i.e., with immediate write off of costs) is non-distortionary.[21]

The analysis above suggests that the combined effects of inflation and taxes would create distortions in economic growth.

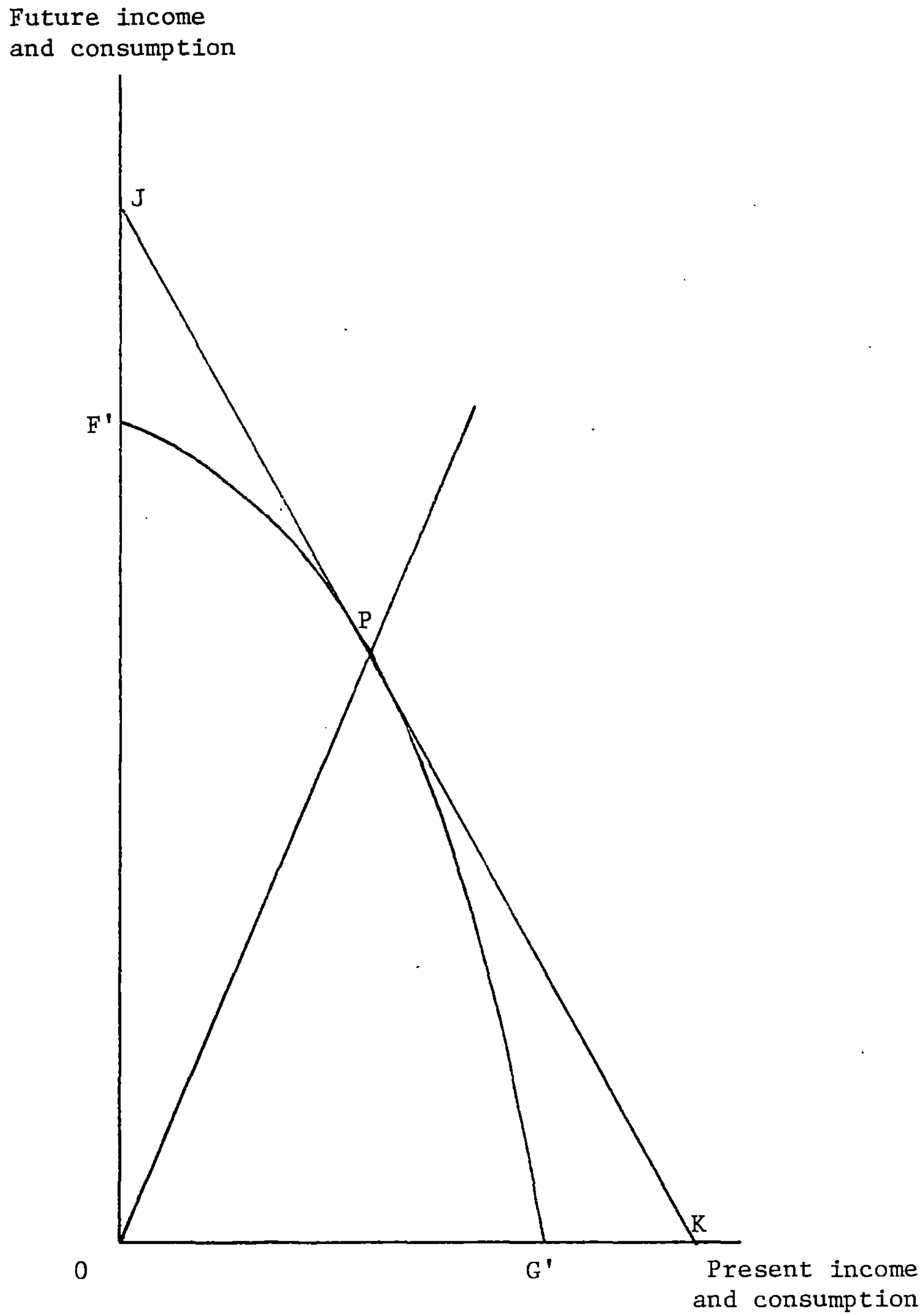

Figure 4. The Optimal Production

More importantly, in analyzing capital formation, the financial side of the economy should not be ignored. In an economy like that of the United States, each decision to create more physical capital must have a financial counterpart.

Friedman (1983) shows that the relationship between outstanding debt and economic activity in the United States is stable. The same is true for all non-financial corporations.[22] If the stability of the economy's aggregate non-financial debt to income ratio is a regular phenomenon, then the corporate sector is able to undertake more investment and increase capital formation only if the government's relative indebtedness falls, or the corporations turn increasingly to equity finance.

The Solution

The model can be represented by equations (2.2), (3.7), and (3.11). In equation (2.2), $\bar{r}$ must be replaced by $\underline{r_N}$. It is useful to show the entire model once again.

$$\sigma(1 - h)f - (1 - \sigma)nm - nk = 0 \tag{3.13}$$

$$m - L(r_N)k = 0 \tag{3.14}$$

$$\begin{aligned} r_N - (1 - \theta)(1 - \tau)f' - \Pi\{1 - b(\theta - \tau) - \mu(1 - b) \\ - \zeta(1 - \theta)\} = 0 \end{aligned} \tag{3.15}$$

Totally differentiate equations (3.13), (3.14), and (3.15) with respect to $\underline{k}$, $\underline{m}$, $\underline{r_N}$, and the predetermined variables $\underline{\Pi}$, $\underline{\tau}$, $\underline{\theta}$, and $\underline{b}$, to find the solution to the model. This solution is given by equation (3.16). If $(dk/d\Pi)$ is calculated from equation (3.16), equation (3.12) emerges.

$$\begin{bmatrix} \sigma(1-h)f' - n & -(1-\sigma)n & 0 \\ -L & 1 & -L'k \\ -(1-\alpha)f'' & 0 & 1 \end{bmatrix} \begin{bmatrix} dk \\ dm \\ dr_N \end{bmatrix} =$$

$$\begin{bmatrix} 0 \\ 0 \\ 1-\beta \end{bmatrix} d\Pi + \begin{bmatrix} 0 \\ 0 \\ -(1-\theta)f' + b\Pi \end{bmatrix} d\tau +$$

$$\begin{bmatrix} 0 \\ 0 \\ -(1-\theta)f' - b\Pi + \zeta\Pi \end{bmatrix} d\theta + \begin{bmatrix} 0 \\ 0 \\ -(\theta-\tau) + \mu \end{bmatrix} db \qquad (3.16)$$

The Effect of Government Budget Deficit on Capital Formation

The federal budget deficit is the excess of federal government expenditures over receipts. In analyzing the sources of the deficit and its effect on the economy, it is important to distinguish between the active and the passive components of the budget deficit. Spending, taxes, and therefore the actual deficit are affected by both direct policy actions and changes in the level of economic activity, prices, and interest rates. The latter changes occur passively, that is, without fiscal policy actions. Active deficits, on the other hand, are those that arise from legislated changes in spending or taxes.

In the neoclassical monetary growth model which deals with the long-run and full employment, passive deficits play no role and the analysis is based on actual deficits. From equation (2.10), the government deficit, G, is defined as $g - T = m(n + \Pi)$. Therefore,

$$dG = (n + \Pi)dm + md\Pi \tag{3.17}$$

Substitute equation (3.17) into equation (2.19) to obtain:

$$(dk) = \{((1 - \sigma)n)/(\sigma(1 - h)f' - n)\}\{(dG - md\Pi)/(n + \Pi)\} \tag{3.18}$$

Friedman (1969) suggests that the policy of the government should be to keep the rate of growth of money stock constant. Since this policy leads to $d\Pi = 0$, the effect of a government deficit is to reduce capital intensity if the rate of growth of money is held constant.[23] To see why, substitute $d\Pi = 0$ into equation (3.18) to find.

$$(dk/dG) = \{(1 - \sigma)n\}/\{(n + \Pi)\{(1 - h)f' - n\}\} \tag{3.19}$$

(dk/dG) is negative in this case. Therefore, a reduced level of capital intensity is the cost of avoiding a higher inflation rate. The effect of this policy is clear. With no change in the rate of inflation, the interest rates must increase when the deficit increases. The faster growth of the deficit must be absorbed without increasing the rate of growth of money. The higher interest rates make this possible by reducing the demand for money. Therefore, this policy of higher deficit and higher interest rate reduces the capital intensity of production.

The real per capita deficit, G, is defined as the product of the economy's nominal growth rate, $n + \Pi$, and the real per capita money stock, m, according to equation (2.10). The only way to keep both inflation and capital intensity unchanged is to keep the deficit unchanged. Equation (3.17) shows that $dm = d\Pi = 0$ implies $dG = 0$.

If the debt policy is conducted to keep the real per capita deficit constant, then $dG = 0$, and from equation (3.18):

$$(dk/d\Pi) = \{-(1 - \sigma)nm\}/\{(\sigma(1 - h)f' - n)(n + \Pi)\} \tag{3.20}$$

$(dk/d\Pi)$ is positive, suggesting that an increase in the rate of inflation increases capital formation when the government deficit is held constant.

The Effect of Corporate Tax Rate on Capital Formation

τ is the corporate tax rate on profits. Even though the statutory rate is 46%, depending on tax breaks on an industry-by-industry basis, companies face actual rates from zero up to 46%.[24] To study the effect of corporate tax rate, τ, on capital formation, $(dk/d\tau)$ can be found from equation (3.16).

$$(dk/d\tau) = \{(1 - \sigma)nL'\{-(1 - \theta)f' + b\Pi\}k\}/\{\sigma(1 - h)f' - (1 - \sigma)n\{L + L'f''(1 - (\tau + \theta - \tau\theta))k\} - n\} \tag{3.21}$$

The denominator is negative as mentioned in all previous cases. The numerator is positive if $(1 - \theta)f' > b\Pi$. Given the values prevailing in the economy, this condition is easily satisfied. Therefore, an increase in the corporate tax rate would lower capital formation and capital intensity. At very high levels of inflation, the numerator could become negative. In this case, $(dk/d\tau)$ becomes positive, suggesting that at high levels of inflation the advantages of deductibility of interest expenses may outweigh the negative effects of an increase in corporate tax rate. Equation (3.21) suggests that $(dk/d\tau)$ is negative when there is no inflation, i.e., $\Pi = 0$. It is also obvious that $(dk/d\tau) = 0$, if $(1 - \theta)f' = b\Pi$. Therefore, the corporate taxation becomes neutral if the personal tax rate, θ, is set equal to $1 - (b\Pi/f')$. Equation (3.21) also suggests that an increase in debt-capital ratio, b, would lower the negative effects of an increase in corporate tax rates. This could be the reason why b has been increasing in recent years.

If ζ is defined as τZ, where Z is the discounted sum of all future tax savings as of the time that one dollar of investment is made, then the numerator of equation (3.21) becomes $(1 - \sigma)nL'\{-(1 - \theta)f' + b\Pi - Z(1 - \theta)\Pi\}k$.[25] This suggests that if $b\Pi = (1 - \theta)f' + Z(1 - \theta)\Pi$, then $(dk/d\tau) = 0$. This is consistent with Stiglitz (1976) who suggests that a tax on corporate income with appropriate depreciation allowances and interest deductibility can be non-distortionary.[26] However, given the parameters that prevail in the economy, this outcome is not likely and $(dk/d\tau)$ is negative.[27] It is also interesting to notice that in this more general case, higher levels of inflation would result in higher negative effects of corporate tax on capital formation.[28]

The Effect of Personal Tax Rate on Capital Formation

From equation (3.16),

$$(dk/d\theta) = \{(1 - \sigma)nL'\{-(1 - \tau)f' - b\Pi + \zeta\Pi\}k\}/\{\sigma(1 - h)f' - (1 - \sigma)n\{L + L'f''(1 - (\tau + \theta - \tau\theta))k\} - n\} \qquad (3.22)$$

The denominator is negative. The numerator is positive if $(1 - \tau)f' + b\Pi > \zeta\Pi$. Given the values that prevail in the economy, this condition is satisfied.[29] Equation (3.22) suggests that an increase in personal tax rate, θ, leads to a decrease in capital intensity.

The Effect of Debt-Equity Ratio on Capital Formation

From equation (3.16),

$$(dk/db) = \{(1 - \sigma)nL'\{-(\theta - \tau) + \mu\}k\}/\{\sigma(1 - h)f' - (1 - \sigma)n\{L + L'f''(1 - (\tau + \theta - \tau\theta))k\} - n\} \qquad (3.23)$$

The denominator is again negative. The numerator is negative if $(\theta - \tau) < \mu$. The marginal rate of personal tax, θ, is about 30% right now. The marginal rate of corporate tax, τ, is 46%, and μ, the capital gains tax rate is about 5%.[30] Given the current tax parameters, $(\theta - \tau)$ is less than μ, and, therefore, (dk/db) is positive. According to equation (3.23), a higher debt-equity ratio increases capital formation.

Inflation as a Tax[31]

Phelps (1973) argues that a high rate of inflation raises government revenue through the inflation tax and, therefore, reduces the other distortionary taxes.[32] Inflation is an alternative to taxation because it transfers real purchasing power to the public sector. It provides the government with an indirect tax revenue. The implications of an inflation tax depend on the nature and magnitude of inflation involved, the way capital is financed in the economy, and the tax laws, as shown in this section of the paper.

An inflation tax can be imposed without any legislative approval. It also has no collection costs. However, like any kind of taxation, there are costs associated with inflationary taxation. Before using inflationary finance, the marginal cost of it must be compared to the costs of alternative methods of finance. The combined effects of inflation and taxes play an important part in determining the revenue raised by inflationary taxes, and, therefore, should be included in the calculations.

To see whether inflation is really able to be a substitute for ordinary taxation and to generate inflation revenue in the model presented in this chapter, equation (2.10) can be rearranged to give the per capita real taxes, T.

$$T = hy - (n + \Pi)m \tag{3.24}$$

Totally differentiate equation (3.24), to obtain

$$dT = hdy - (n + \Pi)dm - md\Pi \tag{3.25}$$

Divide both sides of equation (3.25) by $d\Pi$, to obtain

$$\left(\frac{dT}{d\Pi}\right) = h\left(\frac{dy}{d\Pi}\right) - (n + \Pi)\left(\frac{dm}{d\Pi}\right) - m \tag{3.26}$$

Since $dy = f'dk$, therefore, $(dy/d\Pi) = f'(dk/d\Pi)$ and equation (3.26) can be rewritten as

$$\left(\frac{dT}{d\Pi}\right) = f'h\left(\frac{dk}{d\Pi}\right) - (n + \Pi)\left(\frac{dm}{d\Pi}\right) - m \tag{3.27}$$

The sign of $(dT/d\Pi)$ cannot be determined theoretically. The last term, $-m$, is obviously negative. The other two terms in the equation are both positive, however. From equation (3.16),

$$(dm/d\Pi) = \{(1-\beta)L'\{\sigma(1-h)f' - n\}k\}/\{\sigma(1-h)f' - (1-\sigma)n\{L + L'f''(1-(\tau+\theta-\tau\theta))k\} - n\} \qquad (3.28)$$

The denominator is again negative. In the numerator, β, the tax rate on returns due to inflation is about 12%.[33] L' and $\sigma(1-h)f' - n$ are both negative.[34] This makes the numerator positive and $(dm/d\Pi)$ negative. Summers (1981c) finds that if m is the total stock of money, then $(dm/d\Pi) = -\$1800$ billion.[35]

Equations (3.27) and (3.28) show that the effect of inflation on tax revenue depends on the tax parameters and the way corporations finance capital, i.e., debt-equity ratio, b. Equation (3.27) shows that Phelps' argument is likely to be correct. Even though, according to equation (3.27), a high rate of inflation does not necessarily lead to a higher level of tax revenue, $(dT/d\Pi)$ is likely to be positive. The first two terms in equation (3.27) tend to be more important than the last term which reflects the direct revenue loss due to inflation.

The analysis presented in this section suggests that an increase in the rate of inflation is likely to lead to an increase in real tax revenue collected by the government. In the next chapter, the model presented in this chapter is used to measure the magnitude of the combined effects of inflation and taxes on capital formation.

ENDNOTES

[1]For analysis of corporate taxes as a tax on profits, entrepreneurship, and risk taking, see Stiglitz (1976), pp. 303-311.

[2]See Feldstein (1980b), p. 648.

[3]See Feldstein and Slemrod (1978), pp. 107-118.

[4]See Feldstein and Summers (1978), pp. 91-99.

[5]See Feldstein and Summers (1979), pp. 455-461.

[6]See Boskin (1978).

[7]Taxes have already been introduced into the model in the form of a lump-sum tax in equations (2.9) and (2.10). However, to study the direct effect of taxes on capital stock, business tax rate and depreciation allowances must be incorporated.

[8]See Feldstein (1976), pp. 810-811.

[9]See Feldstein, Green and Sheshinski (1978), pp. s58, equation (11).

[10]See equation (5) in Hendershott (1981), p. 912.

[11]$\underline{\gamma}$ is therefore the dividend-payout ratio.

[12]See the appendix to Feldstein, Green and Sheshinski (1978).

[13]See equation (7) on p. 912 in Hendershott (1981), or equation (20) on p. s61 in Feldstein, Green and Sheshinski (1978). This equation is also derived later on in chapter V.

[14]See von Furstenberg (1972). He indicates in table I that $\underline{b}$ is close to .25 in the United States.

[15]The values of $\underline{\tau = .46}$ and $\underline{\theta = .03}$ are taken from Feldstein (1980a). He states in the appendix to his paper that $\underline{z = .39}$. Given these values $\underline{\quad = .3 - .46 + (.46)(.39)(1 - .3) = -.03}$. A sensitivity analysis is presented later in the paper.

[16]Using the values for the parameters that have been used so far, that is, $\underline{b = .25}$, $\underline{\tau = .46}$, $\underline{\theta = .3}$, $\underline{\zeta = \tau z = (.46)(.39) = .18}$ and $\underline{\mu = .05}$, $\underline{\beta = \mu + \zeta(1 - \theta) = \mu + \tau z(1 - \theta) = .05 + (.46)(.39)(1 - .3) = .18}$.

[17]$\beta = b(\theta - \tau) + \mu(1 - b) - \zeta(1 - \theta) = .25(.3 - .46) + .05(1 - .25) + (.46)(.39)(1 - .3) = .12$. Obviously, the sign of $(dk/d\Pi)$ cannot be determined theoretically.

[18]See Nordhaus (1980).

[19]For a more detailed explanation of this phenomena, see Dougherty (1980), p. 74.

[20]Unity plus the rate of time preference gives the slope of the social indifference curve. The rate of time preference measures the proportion by which the value of consumption today exceeds that of consumption tomorrow. To show the equilibrium level of present and future consumption, the indifference curves must be drawn. Since the inferiority of an income tax on consumption tax is in its distortionary effects on the production decision, not the consumption decision, it is the production aspects of the analysis that are studied here.

[21]See Stiglitz (1976), p. 310.

[22]See Friedman (1983), pp. 87-95.

[23]Empirical evidence suggests that the government conducts its policies in such a way to keep the real interest rate on government debt unchanged. See Feldstein and Eckstein (1970), pp. 363-375.

[24]See Federal Tax Course.

[25]Note that in derivation of equation (3.16), ζ is assumed to be exogenous.

[26]See Stiglitz (1976), p. 304.

[27]See endnote (15) for the value of some of these parameters.

[28]This is so because $b\Pi < z(1 - \theta)\Pi$, given the prevailing parameters in the economy.

[29]See endnotes (15) and (16) for the values of τ, f', and ζ.

[30]See endnote (16).

[31]The welfare cost of inflation has been analyzed by Bailey (1956). This section has been added to demonstrate the capability of the model.

[32]See Phelps (1973).

[33]See endnote (17).

[34]See Chapter II for $\sigma(1 - h)f' - n < 0$.

[35]See Summers (1981c), p. 191.

CHAPTER IV

THE COMBINED EFFECTS OF INFLATION AND TAXES ON CAPITAL FORMATION

Introduction

Capital formation is an integral part in economic growth. Since the United States is a very wealthy nation, it has a high capital labor ratio, low marginal productivity of capital, and a low saving rate compared to the other countries. However, there are some institutional factors, such as the tax system, that contribute to the high cost of saving, and, therefore, the low rate of capital formation.

Taxes can cause inefficiencies and waste in the economy. Income taxes, for example, discourage work and investment, change the allocation of resources among industries, generate administrative and collection costs, and encourage tax avoidance and evasion. These economic distortions are called the dead-weight loss due to taxation. As the tax rates rise, these dead-weight losses rise more than proportionately.[1] Resources are wasted adjusting to the change in tax rates.

The present tax system is complex and promotes inefficiency. It has two basic drawbacks: (1) it separates the corporate and personal income taxes, and (2) it does not define income appropriately. There is a difference between taxable and economic income because of preferential treatment given to some types of income or expenditures or because of variations in definitions of income, revenue, and expenses. About one-third of capital income is taxed twice, once because the corporate income tax applies to profits and a second time when dividends and retained earnings are each again taxed at the personal level as dividends or as capital gains.[1] This causes a reallocation of resources in various sectors in the economy which differ in the degree to which they are incorporated.

The present U.S. tax system is biased against saving and in favor of consumption uses of current income, hence against capital formation and in favor of consumption uses of production capability. This bias is inherent in the basic structure of the tax system with its heavy emphasis on income taxation. In analyzing the U.S. tax system, one questions whether the capital income should be taxed at all.

If inflation is seen primarily as a taxation of liquidity, this could have positive effects on real investment and growth.[2] However, since the current tax laws were written for an economy with little or no inflation, the combined effect of the tax system and rising rate of inflation has resulted to lower rates of capital formation.

The model presented in chapter III describes how the current U.S. tax laws are affecting private capital formation in an inflationary environment. According to the model, changes in capital intensity depend on portfolio allocation. Here, since the assumption of a constant saving rate eliminates any tax effects on the rate of accumulation, it is only through the net of tax rates of return on asset holding that capital intensity can be studied.

It is possible to arrive at a numerical evaluation of how taxes and inflation affect capital formation, provided that the purpose is to look for estimates that are roughly suggestive of the pattern of corporate tax in the United States, rather than as an exact estimate. To to this, it is necessary to pull together the various empirical findings about the values of the parameters of the model. The next section is devoted to this task.

The Choice of Parameter Values

So far, it has been assumed that each parameter of the model takes a single value that remains the same through time. However, in reality parameters can assume a range of values over time. The possible effects of taxation and inflation on capital formation as determined in the last chapter could depend heavily on the particular values assumed for the parameters of the model. In this section, the results of some empirical research are reported so that the sensitivity of the findings of the model to the assumed parameter values can be studied. These results are reported in table I, along with the values of the parameters that are used in this dissertation.

The debt-equity ratio, $\underline{b}$, is probably the most important parameter in the model. $\underline{b}$ is the proportion of capital that is financed by debt. As mentioned earlier, von Furstenberg (1977) finds that $\underline{b}$ remained close to .25 throughout the 1952-76 period.[3] Schwartz and Aronson (1967) show that $\underline{b}$ was .45 for all industries in 1961 and 1928.[4] Bulow and Shoven (1982) report the aggregate balance sheets for all non-financial corporations for 1949-79 period.[5] When $\underline{b}$ is calculated based on Bulow and Shoven's (1982) findings, its value ranges from

TABLE I

THE RANGE OF VALUES FOR THE PARAMETERS OF THE MODEL*

Parameter	Values Reported in Empirical Research	Values Assumed in This Paper
b:		
Lower Limit	.18	$.18 \leq b \leq .26$
Upper Limit	.26	
f':		
Lower Limit	.08	f' = .11
Upper Limit	.117	
h:		h = .2
L:		L = .018
L':		L' = -38.6
n:		
Lower Limit	.02	n = .03
Upper Limit	.04	
σ:	.07	$\sigma = .07$
μ:		
Lower Limit	.05	$\mu = .05$
Upper Limit	.06	
τ:	.46	$\tau = .46$
θ:	.3	$\theta = .3$

*Values for _h_, _L_, and _L'_ are based on 1983 figures.

.18 in 1951 to .26 in 1975-78 period. However, the value of b remains close to .25 as reported by von Furstenberg (1977) for 1952-76 period. Given these findings, it seems to be safe to assume that b can take values from .18 to .26.

The tax parameters include the corporate tax rate, τ, the personal tax rate, θ, and the capital gains tax rate, μ. The corporate tax rate, τ, at the present is equal to .46. The value for θ can be taken from Feldstein (1980a), Feldstein, Green and Sheshinski (1978), Hendershott (1981), or any similar research work. All of these authors agree at $\theta = .3$ as representative for the United States. Bailey (1969) estimates that μ ranges from $(\theta/6)$ to $(\theta/5)$. Since $\theta = .3$, then μ is between .05 and .06.

ζ is defined as τ, the corporate tax rate, times Z, the discounted sum of all future tax savings due to depreciation allowances. If economic depreciation is allowed, $\zeta = 0$, and when historic method of depreciation is allowed, $\zeta > 0$. ζ is a linear approximation of the reduction in net corporate profits per unit of capital for each additional percentage point of inflation. The value of ζ has been calculated by Feldstein (1980a), Feldstein and Summers (1979), and Feldstein, Green and Sheshinski (1978), especially the appendix by Auerbach. The values reported for ζ range from .18 to .3.

h, the fraction of national income consumed by the government is about .2.[7] As mentioned in footnote (38) in chapter II, L', the slope of the money demand equation, is -38.6, and L, the money-capital stock ratio, is .018, based on 1983 figures. These parameters tend to remain stable through time.

The propensity to save is shown by David and Scadding (1974) to be constant over time. von Furstenberg (1981) shows that the propensity to save ranges from -.006 for the government to .07 for the private sector in 1955-78 period.[8] He finds that the national propensity to save, σ, is almost .07.

Based on the findings of the empirical research reported in this section, it seems appropriate to assume that: $.18 \leq b \leq .26$, $\tau = .46$, $\theta = .3$, $\mu = .05$, $.18 \leq \zeta \leq .3$, $h = .2$, $L' = -.386$, $L = .038$, and $\sigma = .07$. In addition, it is necessary to specify the range of values for the marginal product of capital net of depreciation, f', and the rate of growth of the population, n.

Feldstein and Summers (1977) estimate f' for 1948-76 period. They find that f' was approximately .11 for the period as a whole.[9] f' ranged from 7.9% in 1970-76 period, to 11.7% in 1960-69 period.

The rate of growth of the population, n, has ranged from 2% in the last few years to 5% in 1940s.[10] An appropriate range of values for n in recent years is from 2% to 4%.

Given the parameter values and assuming $.08 \leq f' \leq .11$, and $.02 \leq n \leq .04$, it is possible to find qualitative estimates of the effects of the change in different variables on capital formation. However, it turns out that even though different assumptions about parameter values lead to different estimates, the direction of the estimated effects do not change. For the purpose of simplicity and the fact that this model can only produce estimates that are roughly suggestive of the pattern of corporate taxes in the United States, rather than as an exact estimate, in the following sections of this paper it is assumed that: $\tau = .46$, $\theta = .3$, $\mu = .05$, $\zeta = .18$, $h = .2$, $L' = -38.6$,

$L = .018$, $\sigma = .07$, $f' = .11$, $n = .03$, and $.18 \leq b \leq .26$. That is, only the debt-equity ratio, b, is allowed to assume different values, and only the sensitivity of the estimates to changes in the value of b is studied. The sensitivity analysis is presented in the following sections of this chapter.

The Effect of Inflation

Using equation (3.12), and assuming that $f'' = 0$, and $b = .18$, it can be shown that in 1983:[11]

$$\begin{aligned}(dk/d\Pi) &= \{(1 - .07)(.03)(-38.6)\{1 - .18(.3 - .46) - \\ &.05(1 - .18) - .18(1 - .3)\}(41{,}108)\}/\{.07(1 - .2)(.11) - \\ &(1 - .07)(.03)(.018) - .03\} = -38{,}153/-.024 = \\ &\$1{,}589{,}708 \end{aligned} \tag{4.1}$$

For $b = .26$,

$$\begin{aligned}(dk/d\Pi) &= \{(1 - .07)(.03)(-38.6)\{1 - .26(.3 - .46) - \\ &.05(1 - .26) - .18(1 - .3)\}(41{,}108)\}/-.025 = \\ &-38{,}896/-.024 = \$1{,}620{,}667\end{aligned} \tag{4.2}$$

Therefore, if inflation was one percentage point higher in 1983, the capital stock, K, would have been somewhere between \$178,047 billion and \$181,515 billion higher in the long run, depending on the value of b.[12]

In a fully indexed tax system $\beta = b(\theta - \tau) + (1 - b)\mu + \zeta(1 - \theta) = 0$, and from equation (3.12),

$$(dk/d\Pi) = (1 - .07)(.03)(-38.6)(41{,}108)/-.024 = \$1{,}844{,}619 \tag{4.3}$$

In this case, the capital stock, K, would have increased by almost \$206,597 billion in the long run, as a result of one percentage point increase in the rate of inflation in 1983.

The Effect of the Government Deficit

Using equation (3.18), the effect of the government deficit, G, on capital formation can be found. For 1983 figures:[13]

$$dk = -16.7dG - 58.45 \tag{4.4}$$

Therefore, the relationship between the government deficit and capital formation is negative. In 1983, the change in the rate of inflation was negative ($d\Pi = -.02$). If it was positive, then the second term in equation (4.4) would have been positive. But this does not change the conclusion that an increase in the government deficit leads to lower capital formation.

If the debt policy is conducted to keep the rate of inflation from going higher, then $d\Pi = 0$, and from equation (4.4), $(dk/dG) = -16.7$. Therefore, this policy of higher deficit, constant rate of inflation, and, therefore, higher interest rates, leads to a reduction of capital intensity of production.

The Effect of Corporate Tax Rate

Using equation (3.21), and assuming that $f'' = 0$, and $b = .18$, it can be shown that in 1983:[14]

$$(dk/d\tau) = \{(1 - .07)(.03)(-38.6)\{-(1 - .3)(.11) + (.18)(.04)\}(41,108)\}/-.024 = 3,096/-.024 = -\$129,000 \tag{4.5}$$

For $b = .26$,

$$(dk/d\tau) = \{(1 - .07)(.03)(-38.6)\{-(1 - .3)(.11) + (.26)(.04)\}(41,108)\}/-.024 = 2,929/-0.24 = -\$122,042 \quad (4.6)$$

Therefore, if corporate tax rate was increased by one percentage point in 1983, the capital stock, K, would have been reduced by an amount between \$13,669 billion and \$14,448 billion in the long run, depending on the value of b.[15]

As shown in section (3.4), the corporate taxation becomes neutral if the personal tax rate, θ, is equal to $1 - (b\Pi/f')$. Given the values used so far, θ was between $1 - [(.26)(.04)]/.11 = .1$, and $1 - [(.18)(.04)]/.11 = .07$ in 1983.

As the previous sections suggest, high levels of the government deficits and high corporate tax rates could create problems for capital formation. Perhaps the best way to deal with this problem is to cut taxes. A tax cut threatens deficits. To balance the budget, the government has to reduce its spending now. This way, the cycle of higher spending, larger deficits, and higher taxes could be reversed. Any way at which it is looked, a tax cut seems to be beneficial.

The Effect of Personal Tax Rate

Using equation (3.22), and again assuming that $f'' = 0$, and $b = .18$, it can be shown that is 1983:[16]

(—)

$$(dk/d\theta) = \{(1 - .07)(.03)(-38.6)\{-(1 - .46)(.11) - (.18)(.04) + (.18)(.04)\}(41,108)\}/-.024 = 2,636/-.024 = -\$109,833 \quad (4.7)$$

For $\underline{b = .26}$,

$$(dk/d\theta) = \{(1 - .07)(.03)(-38.6)\{-(1 - .46)(.11) - (.26)(.04) + (.26)(.04)\}(41{,}108)\}/-.024 = 2{,}770/-.024 = -\$115{,}417 \quad (4.8)$$

Therefore, if personal tax rate was one percentage point higher in 1983, the capital stock would have been reduced by an amount between \$12,301 billion and \$12,927 billion in the long run, depending on the value of b.[17]

Equations (4.5), (4.6), (4.7), and (4.8) suggest that a higher debt-equity ratio lowers the negative effects of corporate taxation and increases the negative effects of personal taxation on the capital formation in the presence of inflation.

The Effect of Debt-Equity Ratio

Using equation (3.23), and assuming that $\underline{f'' = 0}$, it can be shown that in 1983:[18]

$$(dk/db) = \{(1 - .07)(.03)(-38.6)\{-(.3 - .46) + .05\}(41{,}108)\}/-.024 = -9{,}204/-.024 = \$383{,}500 \quad (4.9)$$

Therefore, if the debt-equity ratio, b, was one percentage point higher in 1983, the capital stock, K, would have been about \$42,952 billion higher.[19]

It is interesting to calculate the effect of inflation on government revenue. The next section is devoted to this calculation.

The Effect of Inflation on Tax Revenue

Equation (3.27) gives the effect of inflation on tax revenue. To calculate $\underline{(dT/d\Pi)}$, it is necessary to find $\underline{(dk/d\Pi)}$ and $\underline{(dm/d\Pi)}$

which feed into equation (3.27). $(dk/d\Pi)$ has already been calculated in equations (4.1) and (4.2)

As mentioned in Chapter III, in a world with mixed debt and equity finance, β, the tax rate on the return due to inflation is $b(\theta - \tau) + \mu(1 - b) + \zeta(1 - \theta)$. Assuming $b = .26$, β is equal to $.26(.3 - .36) + .05(1 - .26) + .18(1 - .3) = .12$. Therefore, from equation (3.28), and assuming $f'' = 0$,

$$(dm/d\Pi) = \{(1 - .12)(-38.6)\{(.07)(1 - .2)(.11) - .03\} (41,108)\}/-.024 = 33,263/-0.24 = -\$1,385,958 \tag{4.10}$$

For $b = .18$, β is equal to $.18(.3 - .46) + .05(1 - .18) + .18(1 - .3) = .138$. Therefore, from equation (3.28), and assuming $f'' = 0$,

$$(dm/d\Pi) = \{(1 - .138)(-38.6)\{(-.07)(1 - .2)(.11) - .03\} (41,108)\}/-.024 = 32,635/-.024 = -\$1,359,792 \tag{4.11}$$

For $b = .26$, substitute equations (4.2) and (4.10) into equation (3.27) to find the effect of inflation, Π, on per capita real taxes, T, in the long run.[20]

$$(dT/d\Pi) = (.11)(.2)(1,620,667) - (.03 + .04)(-1,385,958) - 340 = \$132,332 \tag{4.12}$$

For $b = .18$, substitute equations (4.1) and (4.11) into equation (3.27) to find the effect of inflation on per capita real taxes in the long run.

$$(dT/d\Pi) = (.11)(.2)(1,589,708) - (.03 + .04)(-1,359,792) - 340 = \$129,819 \tag{4.13}$$

Equations (4.12) and (4.13) give the effect of inflation on per capita real taxes in the long run. To find the effect of inflation on real taxes, $(dT/d\Pi)$ must be multiplied by the population in 1983. Equations (4.12) and (4.13) show that a one percentage point increase in the rate of inflation in 1983 could produce somewhere between $30,378 billion and $30,966 billion more revenue for the government in the long run, depending on the value of *b*.[21]

ENDNOTES

[1]See Harberger (1974).

[2]See Mundell (1963), pp. 280-283.

[3]See von Furstenberg (1977), table 1.

[4]See Schwartz and Aronson (1967), p. 13.

[5]See Bulow and Shoven (1982), pp. 246-253.

[6]See Bailey (1969), appendix B. He shows that because of the deferral of taxation, the effective rate of capital gains tax is less than the statutory rate. See also Manarik (1981) for a more recent analysis of capital gains taxation.

[7]See Survey of Current Business, for data.

[8]See von Furstenberg (1981), table 1.

[9]See Feldstein and Summers (1977), table 1. They also show how the gross marginal product of capital can be measured.

[10]See the Statistical Abstract of the United States.

[11]The 1983 figures are reported in endnote (38) in chapter II. It is shown there that $k = \$41,108$.

[12]These figures are found by multiplying \$1,589,708 from equation (4.1) and \$1,620,667 from equation (4.2) by 112 million, where 112 million is the labor force in 1983.

[13]In 1981, 1982, and 1983, the consumer price indexes were 195.6, 207.38, and 215.34, respectively. Therefore, in 1982, $\Pi = (207.38 - 195.6)/195.6 = .06$, and in 1983, $\Pi = (215.34 - 207.38)/207.38 = .04$. The change in the rate of inflation, $d\Pi$, in 1983, was $.04 - .06 = -.02$. From equation (3.18), $dk = \{(1 - .07)(.03)/(.07)(1 - .2)(.11) - .03)\}\{(dG - 175.1(-.02))/(.03 + .04)\}$, which gives equation (4.4).

[14]See endnotes (11) and (13).

[15]These values are found by multiplying -\$129,000 from equation (4.5) and -\$122,042 from equation (4.6) by 112 million, which is the labor force in 1983.

[16]See endnotes (11) and (13).

[17]These figures are found by multiplying -\$109,833 from equation (4.7) and -\$115,417 from equation (4.8) by 112 million, which is the labor force in 1983.

[18]See endnotes (11) and (13).

[19]This value is found by multiplying \$383,500 from equation (4.9) by 112 million, which is the labor force in 1983.

[20]In 1983, the consumer price index was 215.34, the population of the U.S. was 234 million, and the stock of outside money was \$171.5 billion. Therefore, $\underline{m}$, the stock of real per capita outside money in 1983, can be found by [\$171,500,000,000/(215.34)(234,000,000)](100) = \$340.

[21]These figures are found by multiplying \$132,332 from equation (4.12) and \$129,819 from equation (4.13) by 112 million, which is the labor force in 1983.

CHAPTER V

THE DISAGGREGATED STRUCTURE OF THE ECONOMY

Introduction

So far, the subject of the long term relationship between inflation and economic growth has been discussed. In this chapter, however, the question is how inflation affects investment which in turn affects economic growth. It is widely believed that inflation subjects the returns to assets to higher effective tax rates and greater risk.[1] The result is a reduction in the net of tax rate of return which would lead to a lower demand for capital goods and slower growth in capital stock.

The general rise in prices leads to an overstatement of the operating income of businesses. Because taxes are based on inflated measures of profit and income, the proportion of correctly measured income paid in taxes rises with the rate of inflation. This is all done through an overstatement of inventory holding gains and the understatement of the costs of capital. On the other hand, maximizing after-tax profits depends on effective tax rates and, therefore, the rate of inflation. At the same time inflation affects risk and after-tax profits, and, therefore, reduces the before-tax return to investors. This lowers the incentive for investors to purchase stocks and bonds. Therefore, the supply of funds to the businesses will be reduced. In addition, private investors are subject to personal taxes which treat all increases in nominal values as increases in real values.

To understand the effects of inflation and taxes on the rate of return on assets, it is necessary to develop a model that captures the characteristics of the U.S. tax laws and explains the financial and investment behavior of firms and households. Not all the tax details are included in the model, however. This makes the model simple and still realistic enough. The model is then used in the next chapter to demonstrate the combined effects of taxes and inflation on the rate of return on equity and the rate of return on debt.

A Model of Financial Equilibrium

Recently, in studying the effects of changes in corporate and personal taxes in an economy with a rising rate of inflation, it has become common to assume that all business activity takes a corporate form.[2] This allows the analyst to look at the detailed effects of the corporate tax structure on the financial and investment decisions of the incorporated firm and draw conclusions about the combined effects of taxes and inflation on the economy.

With the exception of investment in private housing and agriculture, the vast majority of private sector investment projects are initiated by incorporated firms, and so they should undoubtedly be the focus of interest in studying taxation, investment, and finance. Therefore, it seems that studying the combined effects of taxes and inflation on macroeconomic variables through the use of a model that unites a simple macroeconomic model with a model of financial and investment decisions of an incorporated firm is justifiable.

Feldstein, Green and Sheshinski (1978) presented such a model of corporate financial policy in a growing economy and then used this model to study the effects of changes in corporate and personal taxes on the economy. They found that the current U.S. tax system is designed for an economy with little or no inflation. They concluded that inflation causes changes in the effective rate of tax on capital income and, therefore, in the real net rate of return that savers receive. These changes not only led to temporary disequilibrium effects but also persisted in steady state equilibrium.

One difficulty with their model can be seen in their equation for the market's demand for debt relative to all capital.[3] They assume that the debt-equity ratio for the entire economy is a function of the difference between real-net-of-tax return on debt and the real-net-of-tax return on equity. This ignores the important and explicit role that risk plays in the equilibrium condition in the securities market. The model can be improved by replacing this equation with another equation that explains the activities in the financial markets more explicitly. In this chapter an attempt is made to make this improvement. It is also possible to present a graphical solution of the model.

The economy must be described at both the level of the aggregate and the individual firm. The aggregate model was presented in chapter III. Unfortunately, it cannot answer questions about the rate of return on assets, because it does not take into account the restrictions imposed by the financial markets and the suppliers of funds. It remains for the disaggregated model to explain how the combined effects of inflation and taxes affect the profitability and, therefore, the rate of return on assets. The important assumption here is that all firms have the same constant return-to-scale technology so that the two levels can be linked via symmetry conditions in the equilibrium.[4]

The economy consists of a number of individual firms. Each firm is governed by the rule of value maximization, given the technological possibilities as expressed by a production function. Technology and net prices are identical between firms, as a result of the assumption of perfect competition. The individual production functions exhibit constant return-to-scale. Therefore, firms differ only with respect to scale, while elasticities of substitution are the same. Under these assumptions, the aggregation problem amounts to aggregating firms that are identical, except possibly for scale of operation. Therefore, the behavior of an aggregate of firms (all business activity) can be represented by that of "representative firm" with characteristics equal to aggregate of individual characteristics. It is the behavior of this "representative firm" that is studied next.

According to equation (2.11), per capita disposable income, $\underline{d}$, depends only on the stock of per capita real capital, $\underline{k}$. Let the money-capital ratio, $\underline{L}$, in equation (2.2), be constant and, therefore, $\underline{L' = 0}$.[5] Under these circumstances, government monetary and tax policies do not affect the unique steady state level of the aggregate variables presented by equation (3.7).[6] Therefore, the values of $\underline{k}$, $\underline{m}$, and $\underline{y}$, can be taken as given in the analysis, and these values will serve to determine the solution of the disaggregated model. Because the rate of growth of money is determined by the government, Π is considered as predetermined by the virtue of equation (2.4).

At this point, it is useful to present a list of the variables that have been introduced so far in the dissertation and are relevant to this chapter.

- b: debt-capital ratio
- e: real rate of return on equity
- e_N: real net rate of return on equity
- f': net marginal product of capital
- i: nominal rate of interest
- i_N: real net rate of interest
- u: gross marginal product of capital
- X: true rate of physical decay when economic depreciation is allowed
- Z: present value of all the future tax savings as a result of depreciation allowances
- γ: proportion of corporate income paid out as dividends
- μ: tax rate on capital gains
- ζ: physical depreciation rate of capital
- Π: rate of inflation
- τ: corporate tax rate
- θ: personal tax rate

The nominal rate of interest can be found from equation (3.2) to be:

$$i = \frac{i_N + \Pi}{1 - \theta} , \tag{5.1}$$

where i_N is the real net rate of interest, and θ is the marginal rate of personal tax. After assuming that all earnings are paid out as dividends, i.e., $\gamma = 1$, the nominal rate of return on equity can be found from equation (3.3) to be:[7]

$$e + \Pi = \frac{e_N + \mu\Pi + (1 - \theta)\Pi}{1 - \theta}, \tag{5.2}$$

where e_N is the real net rate of return on equity, and μ is the capital gains tax rate. The real net cost of a unit of capital is defined as:[8]

$$C = b(1 - \tau)i + (1 - b)(e + \Pi) - \Pi, \tag{5.3}$$

where b is the proportion of capital that is financed by debt, and τ is the corporate tax rate.

To study the financial and investment behavior of the firm, it is necessary to start with its objective. The following section examines the objective function of the firm.

The Objective of the Firm

The subject of business motivation is very complex, and it is difficult to determine the "goals" of the firm. The neoclassical theory of optimal capital formation can be formulated in two alternative ways. First, the firm can be treated as accumulating assets in order to supply capital services to itself. The objective of the firm here is to maximize its value, subject to technology and a set of constraints. Alternatively, the firm may be treated as renting assets from itself or from other firms. In this case, the objective of the firm is to maximize its current profit.

An optimal debt-equity mixture can be selected which would maximize the value of the firm, or equivalently, a particular value of b can be found that would minimize the real net cost of a unit of capital, C (see figure 5). To find the optimal level of b, the first derivative of C, which is defined in equation (5.3), with respect to b must be set equal to zero.[9] This is done in equation (5.6) below.

The supply of investment funds to the firm can be specified through the inverse supply functions as a function of the corporate debt-capital ratio, b, reflecting the risk of bankruptcy associated with leverage. As the following figure shows, only a small number of a priori conditions are imposed on the debt and equity cost of supply functions, and they represent the most probable forms of the i_N and e_N functions.[10] The equations for i_N and e_N can be specified as:

$$i_N = \rho(b), \ \rho' > 0, \text{ and} \tag{5.4}$$

$$e_N = \varepsilon(b), \ \varepsilon' > 0. \tag{5.5}$$

Minimize C, in equation (5.3), after substituting for i and e + Π from equations (5.1) and (5.2), and for i_N and e_N from equations (5.4) and (5.5), and obtain:[11]

$$(1 - \tau)i_N - e_N + \Pi(\theta - \tau - \mu) + b(1 - \tau)\rho' + (1 - b)\varepsilon' = 0, \tag{5.6}$$

where $\rho' = (di_N/db)$, and $\varepsilon' = (de_N/db)$ are both positive as specified in equations (5.4) and (5.5).

Tax parameters corresponding roughly to the current U.S. tax law are: $\tau = .46$, $\theta = .3$, and $\mu = \theta/6 = .05$.[12] The value of b ranges from .18 to .26.[13] The long-run values for interest rate, return on equity, and inflation rate are reported by Ibboston and Sinquefield (1976): $i = .036$, $e + \Pi = .085$, and $\Pi = .022$. If the U.S. tax law remains the same and tax rates are not changed in the future, from

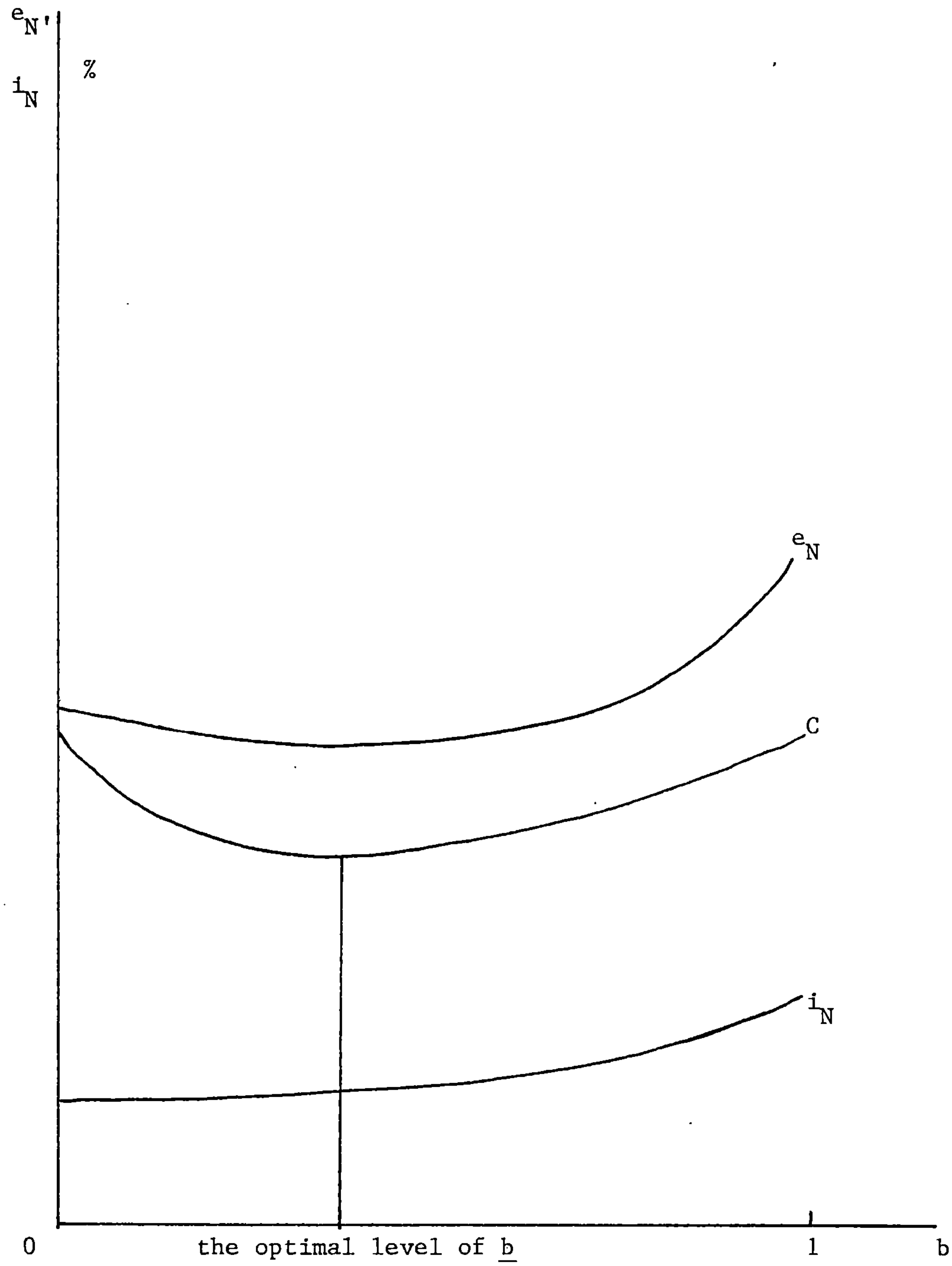

Figure 5. The Cost of Capital

equations (5.2) and (5.1), the long-run real net return on equity, $\underline{e_N}$, and the long-run real net rate of interest, $\underline{i_N}$, can be calculated. Table II shows the possible values for $\underline{e_N}$ and $\underline{i_N}$. They are independent of the value of $\underline{b}$. $\underline{e_N = (1 - \theta)(e + \Pi) - \mu\Pi - (1 - \theta)\Pi =}$ $\underline{(1 - .3)(.085) - (.05)(.022) - (1 - .3)(.022) = .043}$, and $\underline{i_N = (1 - \theta)i - \Pi = (1 - .3)(.036) - .022) = .0032.}$[14]

TABLE II

THE RANGE OF VALUES FOR $\underline{e_N}$, $\underline{i_N}$, $\underline{\rho'}$, $\underline{\varepsilon'}$, $\underline{E(e_N, b)}$, AND $\underline{E(i_N, b)}$

Variable	b = .18	b = .26
e_N:	.043	.043
i_N:	.0032	.0032
ρ':	$.05 \leq \rho' \leq .47$	$.06 \leq \rho' \leq .33$
ε':	$0 \leq \varepsilon' \leq .05$	$0 \leq \varepsilon' \leq .05$
$E(e_N, b)$:	$0 \leq E(e_N, b) \leq .29$	$0 \leq E(e_N, b) \leq .29$
$E(i_N, b)$:	$3.9 \leq E(i_N, b) \leq 367.2$	$4.69 \leq E(i_N, b) \leq 25.78$

When the relevant values for the tax rates, long-run interest rates, and $\underline{b = .25}$ are introduced, a simple linear relationship between $\underline{\rho'}$ and $\underline{\varepsilon'}$ can be obtained from equation (5.6):[15]

$$.135\rho' = .046 - .75\varepsilon' \tag{5.7}$$

Since both ρ' and ε' are assumed to be positive, then $0 \leq \rho' \leq .34$, and $0 \leq \varepsilon' \leq .06$.

Feldstein, Green and Sheshinski (1979) assumed that ρ' and ε' are independent of i_N and e_N.[16] They stated, however, that a more natural assumption would consider the elasticity of the interest cost function with respect to a change in corporate debt, $E(i_N, b)$ and the elasticity of the equity cost function with respect to the concomitant change in equity capital $E(e_N, b)$ as being constant. $E(i_N, b)$ and $E(e_N, b)$ are defined as:

$$E(i_N, b) = (di_N/db)(b/i_N) = \rho'(b/i_N), \text{ and} \tag{5.8}$$

$$E(e_N, b) = (de_N/db)(b/e_N) = \varepsilon'(b/e_N) \tag{5.9}$$

As debt capital is increased, the interest cost can be expected to rise, giving a positive value to ρ', as shown in equation (5.4). Given the values for the tax rates and the interest rates prevailing in the economy in the long-run, $b = .25$, and the fact that $0 \leq \rho' \leq .34$,

$$0 \leq E(i_N, b) = \rho'(\frac{b}{i_N}) = \rho'(\frac{.25}{.0032}) \leq 26.5 \tag{5.10}$$

As mentioned earlier, here $E(i_N, b)$ is assumed to be constant.

If the assumption of general risk-aversion in the securities markets is made, then as the equity capital is reduced, the rate of return on equity can be expected to increase in response to the increased risk position of the equity-holders. This suggests that $\varepsilon' > 0$, as shown by equation (5.5). Given the values for the tax rates and the rates of return on equity prevailing in the economy in the long-run, $b = .25$, and the fact that $0 \leq \varepsilon' \leq .06$, from equation (5.9),

$$0 \leq E(e_N, b) = \varepsilon'(\frac{b}{e_N}) = \varepsilon'(\frac{.25}{.043}) \leq .35 \tag{5.11}$$

Equation (5.6), which is the first-order condition, implies that the firm is continuously choosing a debt-capital ratio, b, that minimizes its cost of capital. It can be rewritten as:[17]

$$(1 - \tau)(1 + E(i_N, b))i_N + \{\{(1 - b)/b\}E(e_N, b) - 1\}e_N + \Pi(\theta - \tau - \mu) = 0 \tag{5.12}$$

The second-order condition for choosing b to minimize the cost of capital, C, implies:[18]

$$U = (1 - \tau)(1 + E(i_N, b))\rho' + \{\{(1 - b)/b\}E(e_N, b) - 1\}\varepsilon' - (E(e_N, b)/b^2)e_N > 0 \tag{5.13}$$

If i_N and e_N are linear functions of b, i.e., $\rho'' = 0$, and $\varepsilon'' = 0$, then the second order condition for minimizing C can be found from equation (5.6) as:[19]

$$U = (1 - \tau)\rho' - \varepsilon' + (1 - \tau)\rho' - \varepsilon' > 0 \tag{5.14}$$

From equation (5.14), $U = 2(1 - \tau)\rho' - 2\varepsilon' > 0$. Given $\tau = .46$, $U = 1.08\rho' - 2\varepsilon' > 0$, or

$$\rho' > 1.85\varepsilon' \tag{5.15}$$

Given the first order condition represented by equation (5.7) and the second order condition represented by inequality (5.15), it is possible to limit the range of the values for ρ' and ε' even further. The following graph of the inequality $\rho' > .185\varepsilon'$ and equation (5.7), which is $\rho' = .34 - 5.56\varepsilon'$, shows that the first and the second order conditions for minimizing C are satisfied by the points to the left of B up to A on line AB (figure 6).

At point A, $\rho' = .34$ and $\varepsilon' = 0$. At point B, $\rho' = .06$ and $\varepsilon' = .05$.[20] This suggests that $.06 \leq \rho' \leq .034$, and $0 \leq \varepsilon' \leq .05$. Therefore, from equations (5.8) and (5.9), $4.69 \leq E(i_n, b) \leq 26.5$, and $0 \leq E(e_N, b) \leq .29$, when $b = .25$. The possible range of values for ρ', ε', $E(e_N, b)$ and $E(i_N, b)$ are presented in table II.

Empirical studies such as Arditti (1967) and Kolin (1969) have shown that the capital structure of the firm does not play a significant role in the determination of the rate of return on equity. These results are in agreement with the findings here that both ε' and $E(e_N, b)$ are close to zero. Therefore, it seems plausible to assume a zero value for ε' and $E(e_N, b)$. This assumption is consistent with the empirical research, provided that, as mentioned earlier, the objective is to look for estimates that are roughly suggestive of the pattern of corporate tax in the United States, rather than as an exact estimate. Under this assumption, from equation (5.7), when $b = .25$, the value of ρ' is found to be equal to .34, and, therefore, $E(i_N, b)$ is 26.5. It will be shown later than U plays an important role in the solution to the model. Under the assumption that $E(e_N, b) = 0$, from equation (5.13), $U = (1 - .46)(1 + 26.5)(.34) = 5$. This assumption will be relaxed later in the paper.

Having discussed the objective function of the firm (minimizing cost of capital), specific allowances must be made for the balance sheet constraint and the interdependent nature of the financing decision of the firm.

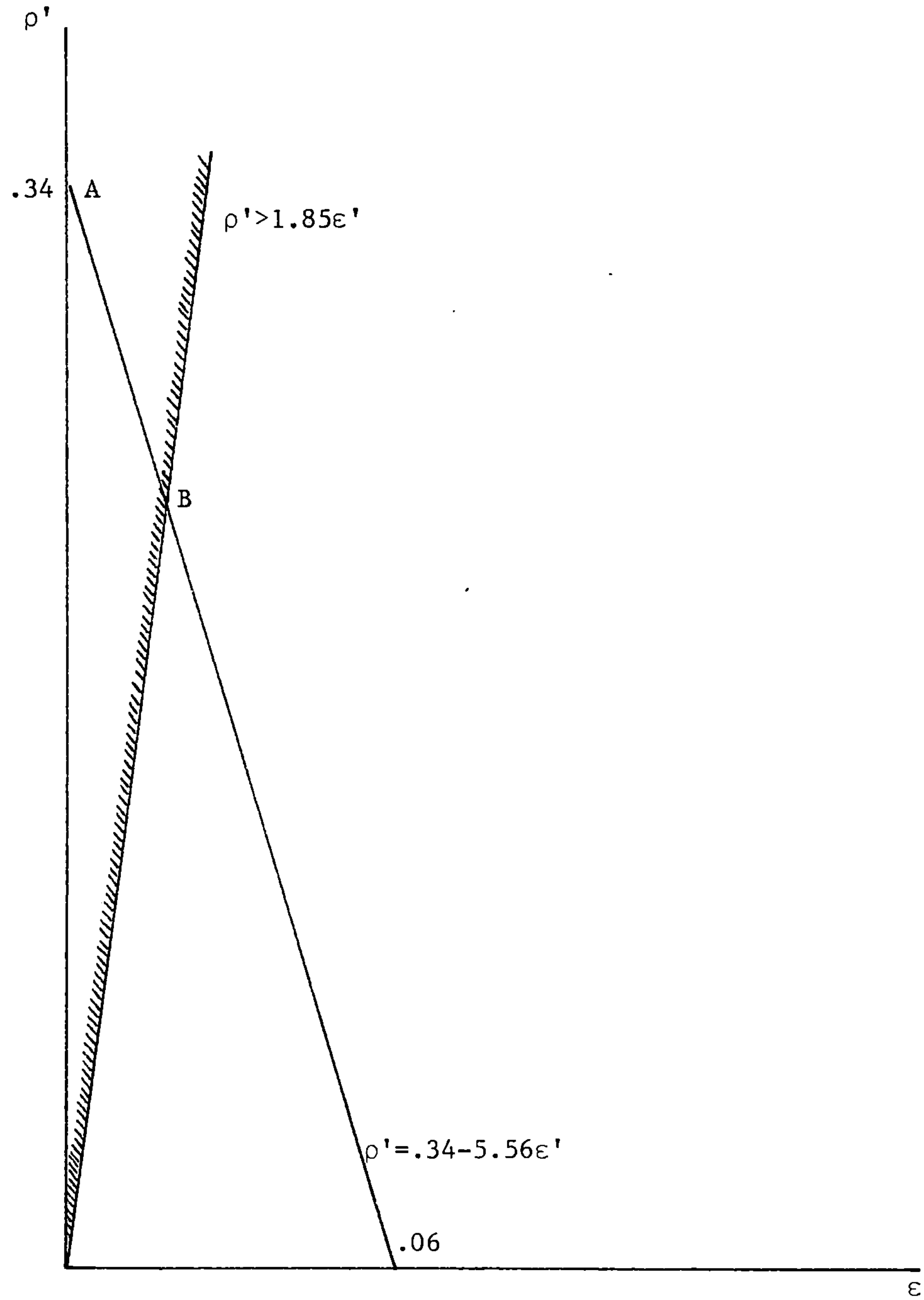

Figure 6. The Range of Values for $\underline{\rho}'$ and $\underline{\varepsilon}'$, when $\underline{b=.25}$

The Balance Sheet Constraint

The flow of funds through a corporation is a continual process, and at every step along the way each source of fund must be matched by an application, or use, of those funds. Changes in the balance sheet items in any period are constrained by the sources and uses identity, and this imposes a constraint on the firm's effort to minimize its cost of capital.

The following is a simplified long-run balance sheet of the firm.

NWA	net working assets i.e., inventories, net trade credit and other assets	D	long-term debt
NK	net capital stock, i.e., gross capital minus accumulated depreciation	E	equity, i.e., cumulative gross stock issues minus cumulative stock requirements plus cumulative retained earnings
A	assets	A	assets

Firm's real assets appear on the left side of the balance sheet and the financial assets on the right side. The sources and uses identity is given by the following equation.

$$d(A) = d(NWA) + d(NK) = d(D) + d(E) \quad (5.16)$$

It shows how the firm's expenditures on plant and equipment and working assets must be made up by changes in the right-hand side items. The sources and uses of funds identity for one unit of capital is given by equation (3.4). However, some time must be spent here to explain why this equation looks the way it does.

Financing for the acquisition of stocks of assets comes from internal sources--profits retained after dividend payments and reserves deductible under U.S. tax law for capital consumption (depreciation), and external sources--funds raised through the sale of financial instruments. Since all the funds raised from a source must be applied to one of the uses of corporate funds, the sources of funds sum to the total uses of funds.

The gross marginal product of capital, u, is taxed at a rate, τ. Therefore, the sources of funds amount to $(1 - \tau)u$. The uses of funds are composed of the direct capital costs of C and a tax allowance for depreciation. By taking into account the historical cost depreciation, the sources and uses identity can be written as:[21]

$$(1 - \tau)u = (C + X)(1 - \tau Z), \tag{5.17}$$

where u is the gross marginal product of capital and is given by $u = f' + X$. Parameter X has already been introduced as being equal to the true rate of physical decay when economic depreciation is allowed, and being greater than the true rate of physical decay when accelerated depreciation is allowed. Parameter Z has also been defined in chapter III, as the present value of the tax depreciation deduction on one dollar's investment.[22] When economic depreciation is allowed $Z = X/(C + X)$, and, therefore, from equation (5.17),[23]

$$(1 - \tau)f' = C \tag{5.18}$$

When the method of historical cost depreciation is assumed, $Z = X/(C + X + \Pi)$, and, therefore, from equation (5.17),[24]

$$(1 - \tau)f' = C + \tau Z\Pi \qquad (5.19)$$

This equation is the same as equation (3.4), keeping in mind that $\tau Z = \zeta$ and that equation (3.4) is written in terms of i_N and e_N. As mentioned earlier, if economic depreciation is allowed, then $\zeta = 0$. If accelerated depreciation is allowed, then ζ has a positive value. Z is a negative function of the rate of inflation. If the values for the cost of capital, inflation rate, and X are given, then Z can be calculated. If the long-term values reported by Ibbotson and Sinquefield (1976) are used, that is, assuming $i = .036$, $e + \Pi = .085$, $\Pi = .022$, and $b = .25$, then from equation (5.3), $C = .047$. Suppose that the rate of decay is $X = .1$, i.e., all machines depreciate one-tenth per year. Then $Z = .1/(.047 + .1 + .022) = .59$. To keep the analysis simple, it is assumed that Z is exogenous.

As mentioned earlier, $\zeta = \tau Z$, where ζ is a parameter such that $\zeta\Pi$ measures the difference between real depreciation and the historic depreciation allowance by the tax system. A decline in the statutory corporate income tax rate, τ, reduces the present value of all depreciation allowances by a uniform percentage. Since structures have a longer useful tax life, a reduction in τ reduces the present value of the costs of structures compared to the cost of equipment and, therefore, it could persuade the corporate sector to spend more on structures and other assets with longer useful lives.[25]

Capital goods, such as buildings and equipment, provide services in producing current output for periods up to decades. Firms are required to distribute the purchase price as a cost over a number of years, reflecting the consumption of capital services in producing current output. This procedure is necessary to measure production costs every year. However, the capital consumption, or depreciation allowance the firm can claim for tax purposes is based on the original purchase price of the capital good. As equation (5.19) indicates, under even moderate rates of inflation, the replacement price of the capital good will increase by $\underline{\zeta\Pi}$ over the depreciation period, and, therefore, the cost of capital in current dollars will rise above the capital consumption allowance based on the purchase price. This leads to understatement of the cost of capital and, therefore, raises taxable profits without raising actual profits. Thus, the tax liability and the effective tax rate become higher. All this should have been avoided if the entire purchase price could be entered as a cost in the year the capital good is obtained, or if economic, rather than historic cost depreciation is allowed.

Current depreciation law diverts investment from long-lived assets to assets with shorter useful lives. The present value of real depreciation allowances per dollar of investment, $\underline{Z}$, falls as asset durability increases for a given rate of inflation. Depreciation allowances are postponed with asset life, letting inflation to discount more heavily the value of future allowances.[26]

Most firms hold inventories of the materials used in their production. Usually, a considerable amount of time passes between the purchase of a batch of material and the sale of the final product containing that material. When the rate of inflation is high, prices of both the material and the final product rise over this interval. Under first-in, first-out, FIFO, inventory accounting, goods leave in the order in which they arrive. Thus, the cost of sales is based on the material prices that prevailed when those obtained farthest in the past were purchased for holding in the inventory. Since sales are measured in current dollars, increases in the rate of inflation create inventory holding gains and added taxable income. The tax liability of the firm can be reduced by using last-in, first-out, LIFO, inventory accounting which measures the cost of goods sold in current prices. Even under LIFO, some inventory appreciation can occur. Summers (1981a) shows that the taxation of nominal inventory profits raised corporate tax liabilities by over $30 billion in 1979.[27]

Therefore, the cost of maintaining inventory levels is understated for firms that use the FIFO method of inventory accounting. Suppose J is the ratio of inventories based on FIFO accounting to the stock of fixed capital. Then the term $\tau J\Pi$ captures the fact that when the FIFO method of inventory accounting is used, the real value of inventories is understated when inflation is positive, and thus real taxable profits are overstated.[28] Equation (5.19) can be generalized as:[29]

$$(1 - \tau)f' = C + \tau Z\Pi + \tau J\Pi \tag{5.20}$$

Sources and uses identity, after substituting for C, i, and $e + \Pi$, from equations (5.3), (5.1), and (5.2), respectively, can be obtained from equation (5.20).

$$\begin{aligned}(1 - \tau)(1 - \theta)f' = b(1 - \tau)i_N + (1 - b)e_N + \Pi\{b(\theta - \tau) + \\ \mu(1 - b) + \tau(1 - \theta)(Z + J)\}\end{aligned} \tag{5.21}$$

Equation (5.21) shows that the combined effect of inflation and taxes leads to the overstatement of inventory holding gains and the understatement of the costs of capital.

The Financial Constraint

The supply of funds to the entire economy is limited at each point in time and lenders determine the mixture of debt and equity on the basis of (a) the net rates of return that the market provides, and (b) default risk. This imposes a financial constraint on the firm. This constraint changes depending on whether it is imposed by banks, insurance companies, commercial banks, or other institutions, acting together.[30]

To arrive at a relationship between risk and returns in the financial markets, let F be the supply of funds available for lending and r be a measure of the risk that the lenders face. Then,

$$F = \psi(i_N, e_N, r) \tag{5.22}$$

This is a utility function for lenders. It is expected that an increase in the risk exposure of the loans decreases the amount that the lender is willing to lend. That is $(dF/dr) = \psi_3 < 0$. It is also expected that an increase in the after-tax rates of return on debt and equity increases the total funds available, i.e., $(df/di_N) = (df/de_N) = \psi_2 > 0$. It is assumed that $\psi_1 = \psi_2$, meaning that the lender values a unit increase in the rate of return on equity as much as it would value a unit increase in the rate of return on debt.

The supply of savings is assumed to be a constant fraction of disposable income according to equation (2.12). If the total differential of equation (5.22) is set equal to zero, the trade-off between return and risk can be determined.

$$dF = \psi_1(di_N + de_N) + \psi_3 dr = 0 \tag{5.23}$$

Suppose that the risk exposure, r, depends on the debt-capital ratio of the firm. That is,

$$r = r(b),\ r' > 0 \tag{5.24}$$

Therefore, an increase in debt-capital ratio of the firm is assumed to result to an increase in the risk premium required by the lenders in order for them to continue the supply of funds. From equation (5.24),

$$dr = r'db \tag{5.25}$$

Substitute equation (5.25) into equation (5.23) to obtain:

$$di_N + de_N + \delta db = 0, \tag{5.26}$$

where $\delta = (\psi_3 r'/\psi_1)$ is negative. Equation (5.26) can now be rewritten as:[31]

$$i_N\ E(i_N,\ b) + e_N\ E(e_N,\ b) + \delta b = 0 \tag{5.27}$$

Equation (5.27) represents the financial constraint in the model. The supply of funds to the firm has already been specified by equations (5.4) and (5.5).[32] Equation (5.27) gives the mixture of risk and return that is acceptable to the investors. It also shows that the firm's choice of the debt-capital ratio would have to depend on the elasticities of the debt and equity supply equations. δb in equation (5.27) measures the risk premium that investors require in order to absorb the risk from the investment.

If $E(e_N, b)$ is equal to zero, then i_N is positively related to b, and the constraint has a slope equal to $\delta/E(i_N, b)$. The lender faces a risk-return trade-off where risk is measured by the firm's debt-capital ratio, and the real net interest rate represents the return. If the firm can borrow funds from more than one lender, the constraint represents the least-cost combination of available funds. Suppose there are two lenders--a commercial bank, CB, and a finance company, FC. Figure 7 represents the constraint imposed by each of the lenders.

As shown, CB requires a higher return for each particular level of risk compared to FC. Here, FC is more willing to assume the high-risk loans than is CB. This may be so because of the nature of the business of the commercial financing companies that they grant high-risk loans at lower interest rates than do commercial banks.

Equation (5.22) from which the financial constraint, or equation (5.27), is derived, explains the effect of inflation and taxes on the supply of household savings to businesses. Inflation raises effective tax rates on the returns to investment in both stocks and bonds. Usually, the before-tax rate on return can only contribute to the maintenance of the purchasing power of the stockholder. Feldstein and Slemrod (1978) show that individuals who were holding stocks in 1973, paid capital gains taxes on what was actually a capital loss in real terms.[33] Bondholders, on the other hand, receive interest income which compensates them for the depreciation of the currency in which the loan is repaid. However, interest income is taxed. Thus, the combined effect of inflation and taxes reduces the incentive for individuals to supply funds in the debt or equity markets.

Some analysts believe that inflation and taxes reduce the supply of funds to businesses by making the alternatives to bonds and stocks more attractive. Homeownership is the most mentioned alternative.[34]

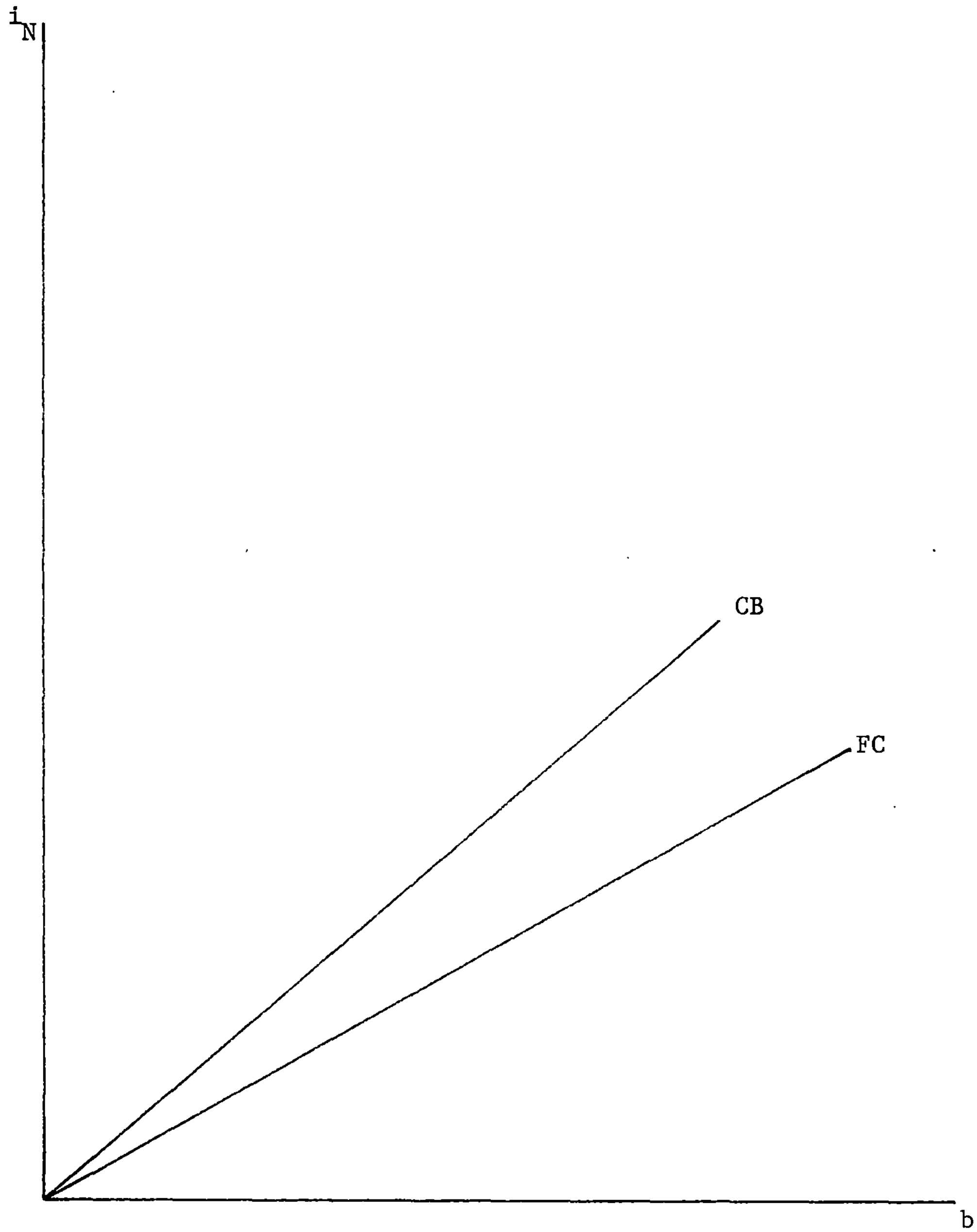

Figure 7. The Financial Constraint

Tax laws offer some advantages to homeowners. Inflation magnifies these advantages. For example, inflation raises interest rates, and, therefore, interest payments which are tax deductible will also increase. Thus, inflation causes the tax system to subsidize the repayment of the principal and the payment of the interest on the mortgage. In addition, capital gains realized on the appreciation of owner-occupied homes are tax exempt. All these will encourage people to put more funds into housing and less into stocks and bonds.

The model presented in this chapter explains and captures the essential characteristics of a "representative firm." As mentioned earlier, these characteristics are equivalent to the characteristics of an aggregate of firms (all business activity). It is now possible to study the combined effects of inflation and taxes on the financial and investment decisions of the "representative firm," and draw conclusions about the behavior of the entire economy. Working of the model and its implications are left for the next chapter.

ENDNOTES

[1]See Hamada (1979), for inflation-tax effects on relative risk of and return on assets. He studies the combined effects of inflation and taxes on the private sector's balance sheet items.

[2]See for example, Hendershott (1981), or Feldstein, Green and Sheshinski (1978).

[3]See equation (17), on p. s60, in Feldstein, Green and Sheshinski (1978).

[4]See equation (16), on p. s59, in Feldstein, Green and Sheshinski (1978).

[5]Feldstein (1982), p. 301, shows that the importance of interest elasticity of demand for money in the United States should not be overemphasized. Feldstein (1976) shows that the inflation tax effects induced through shifts in L are insignificant.

[6]In monetary growth models, money balances are assumed to be held by individuals, rather than firms.

[7]From equation (3.3), $\underline{e_N = (1 - t')e - \mu\Pi}$, and $\underline{t' = \gamma\theta + \mu(1 - \theta)}$. Since $\underline{\gamma = 1}$, then $\underline{t' = \theta}$, and, therefore, $\underline{e_N = (1 - \theta)e - \mu\Pi}$. From this equation $\underline{e = (e_N + \mu\Pi)/(1 - \theta)}$, or $\underline{e + \Pi = (e_N + \mu\Pi)/(1 - \theta) + \Pi}$, which gives equation (5.2).

[8]See equation (6), on p. s57, in Feldstein, Green and Sheshinski (1978).

[9]See equation (22), on p. s61, in Feldstein, Green and Sheshinski (1978).

[10]See for example, Ballentine and McLure (1980).

[11]The equation to minimize after substitution is:
$\underline{(1 - \theta)C = b(1 - \tau)i_N + (1 - b)e_N + \{b(\theta - \tau) + (1 - b)\mu\}\Pi}$.

[12]See table 1.

[13]See table 1.

[14]Different assumptions with regard to $\underline{e_N}$ would obviously give different expressions and values.

[15]From equation (5.6), $(1 - .46)(.0032) - .043 + .022(.3 - .46 - .05) + .25(1 - .46)\rho' + (1 - .25)\varepsilon' = 0$, which gives equation (5.7)

[16]See Feldstein, Green and Sheshinski, p. 414, note 4.

[17]Equation (5.6) can be rewritten as:

$$(1 - \tau)i_N - e_N - \Pi(\theta - \tau - \mu) + (1 - \tau)i_N(di_N/db)(b/i_N) + \{(1 - b)e_N/b\}(de_N/db)(b/e_N) = 0.$$

Equation (5.12) follows, keeping in mind that $E(i_N, b) = (di_N/db)(b/i_N)$, and $E(e_N, b) = (de_N/db)(b/e_N)$.

[18]To find U, differentiate equation (5.12) with respect to b, keeping in mind that $E(e_N, b)$ and $E(i_N, b)$ are assumed to be constant and $d[(1 - b)/b]/db = -1/b^2$.

[19]To find U, differentiate equation (5.6) with respect to b.

[20]The following two equations have to be solved for ρ' and ε' simultaneously.

$$\begin{cases} \rho' = .34 - 5.56\varepsilon' \\ \rho' = 1.85\varepsilon' \end{cases}$$

[21]See Feldstein, Green and Sheshinski (1978), p. s68.

[22]See the appendix to Feldstein, Green and Sheshinski (1978).

[23]From equation (5.17), $(1 - \tau)u = (C + X)(1 - \tau Z)$. Since $Z = X/(C + X)$, and $u = f' + X$, therefore, $(1 - \tau)(f' + X) = (C + X)(1 - \tau(X/(C + X))$, or $(1 - \tau)f' + (1 - \tau)X = C + X - \tau X = C + (1 - \tau)X$. This gives equation (5.18).

[24]From equation (5.17), and since $Z = X/(C + X + \Pi)$ and $u = f' + X$, $(1 - \tau)f' + (1 - \tau)X = (C + X)(1 - \tau(X/(C + X + \Pi))$ or $(1 - \tau)f' = -(1 - \tau)X + C + X - [\tau X(C + X)/(C + X + \Pi)] = C + \tau X - [\tau X(C + X)/(C + X + \Pi)]$. Therefore, $(1 - \tau)f' = C + \tau X[1 - ((C + X)/(C + X + \Pi))] = C + \tau X[\Pi/(C + X + \Pi)]$. This gives equation (5.19).

[25]See Tannewald (1982), pp. 27-39.

[26]See Kopcke (1981), pp. 123-128.

[27]See Summers (1981a), p. 123. In note 5, p. 123, he argues that firms stay with FIFO because of some intramarginal economic gain.

[28]While $\tau Z\Pi$ measures the difference between real depreciation and the historic depreciation allowance by the tax system, $\tau J\Pi$ measures the difference between real value of inventories and the book value of inventories.

[29]See Hendershott (1981), p. 911.

[30]Financial constraint can be specified in a number of different ways. See chapter 9 in Lerner and Carleton (1966).

[31]Substitute $\underline{(i_N E(i_N, b) db/b)}$ and $\underline{(e_N E(e_N, b) db/b)}$ for $\underline{di_N}$ and $\underline{de_N}$, respectively. Then divide equation (5.26) by $\underline{db}$ and multiply by $\underline{b}$ to obtain equation (5.27).

[32]Gordon (1984) presents a financial constraint which is very similar to equation (23). See equation (1) on p. 314.

[33]See Feldstein and Slemrod (1978), p. 107.

[34]See for example Feldstein (1982a), or Downs (1980).

CHAPTER VI

INFLATION, TAXATION, AND THE REAL RATES OF RETURN

Introduction

Several studies have examined the profit rate for non-financial corporations and arrived at different conclusions. Nordhaus (1974) and Lovell (1977) found that the rate of return earned by U.S. business has been declining over the last 40 years. However, Feldstein and Summers (1977) found no evidence of this decline. Allman (1981) found that the aggregate rate of profit has been declining since 1952, with manufacturing industry contributing the most to the aggregate decline. He found that the finance, insurance, and real estate industry to be the only one with a positive change in profit rate in the 1952 to 1981 period.

Feldstein and Summers (1977) prove that the before-tax profit rate equals the return that the society earns on additional investment in physical capital.[1] With respect to the individual investor, i.e., the household, there is little doubt that the nominal before-tax value of its investment portfolio is not what counts, but rather its real after-tax value. It follows that investors are concerned with the real or inflation-adjusted net rate of return rather than the nominal rate of return on their investments. Recent studies of the real rate of return on corporate capital indicate that the real rate of return to both debt and equity combined is in the range of 6 to 7% per year.[2] They also indicate that the combined effect of inflation and taxes lowers the returns to the investors.

As mentioned earlier, corporate income is taxed at both the corporate and individual level. Therefore, the effective tax rates on returns to investors depend on the taxable profit of the corporations and the taxable income of its shareholders. As a result, corporate income tends to be highly taxed at the personal level. Therefore, what appears to be relatively low rates of tax on interest income, capital gains, and corporate profit may actually be very high tax rates. That would lower the supply of funds to the corporate sector and shift them to less productive sectors of the economy. The total effective tax rate increased from 55.1% in 1965 to 74.5% in 1979, while the real net rate of return decreased from 6.5% to 2.3%.[3] These low returns have been blamed for lowering the rate of growth of investment expenditures in the last two decades.

To study the combined effect of inflation and taxes on real net-of-tax rates of return, the model which has been developed in chapter V can be used.

The Solution to the Model and the Effect of Inflation on Debt-Capital Ratio

It is useful to write the complete model by putting together equations (5.12), (5.21), and (5.27).

$$i_N = -\frac{\{(1 - b)/b\}E(e_N, b) - 1}{(1 - \tau)(1 + E(i_N, b))} e_N - \frac{\theta - \tau - \mu}{(1 - \tau)(1 + E(i_N, b))} \Pi \qquad (6.1)$$

$$i_N = -\frac{1-b}{b(1-\tau)} e_N + \frac{1-\theta}{b} f' - \{\frac{b(\theta-\tau)+\mu(1-b)}{b(1-\tau)} +$$

$$\frac{\tau(1-\theta)(Z+J)}{b(1-\tau)}\} \Pi \tag{6.2}$$

$$i_N = -\frac{E(e_N, b)}{E(i_N, b)} e_N - \frac{\delta b}{E(i_N, b)} \tag{6.3}$$

Equation (6.1) represents the objective function of the firm, OF; equation (6.2) represents the sources and uses identity and the constraint imposed on the firm by the balance sheet, BF; and equation (6.3) represents the financial constraint, FF. Here $\underline{i_N}$, $\underline{e_N}$, and $\underline{b}$ are the unknowns of the model.

Totally differentiate equations (6.1), (6.2), and (6.3) with respect to $\underline{i_N}$, $\underline{e_N}$, $\underline{b}$, and the predetermined, $\underline{\Pi}$, to find the solution to the model. This solution is given by equation (6.4), where $\underline{U}$ is given by equation (5.13) and is positive, and $\underline{Q}$ is equal to $\underline{(1-\tau)i_N - e_N + \Pi(\theta-\tau-\mu)}$, and as implied by equation (5.6), $\underline{Q = -b(1-\tau)\rho' - (1-b)\varepsilon' < 0}$.

$$\begin{bmatrix} (1-\tau)(1+E(i_N, b)) & \{(1-b)/b\}E(e_N, b) - 1 & U \\ b(1-\tau) & 1-b & Q \\ E(i_N, b) & E(e_N, b) & \delta \end{bmatrix}$$

$$\begin{bmatrix} di_N \\ de_N \\ db \end{bmatrix} = -\begin{bmatrix} \theta-\tau-\mu \\ b(\theta-\tau)+\mu(1-b)+\tau(1-\theta)(Z+J) \\ 0 \end{bmatrix} d\Pi \tag{6.4}$$

Assuming $\underline{E(e_N, b) = 0}$, from equation (6.4), the effect of a change in the rate of inflation on the firm's debt-capital ratio, given the present tax laws, can be found as:

$$(db/d\Pi) = \frac{E(i_N, b)\{(\tau - \theta) - \tau(1 - \theta)(Z + J)\}}{W} , \qquad (6.5)$$

where $W = E(i_N, b)\{Q + (1 - b)U\} - \delta(1 - \tau)\{(1 + (1 - b)E(i_N, b)\}$. It is not possible to determine the sign of $(db/d\Pi)$ theoretically. However, given the value of the parameters prevailing in the economy, Q can be calculated. Assuming $\tau = .46$, $i_N = .0032$, $e_N = .043$, $\Pi = .022$, $\theta = .3$, and $\mu = .05$, then $Q = (1 - \tau)i_N - e_N + \Pi(\theta - \tau - \mu) = (1 - .46)(.0032) - .043 + .022(.3 - .46 - .05) = -.046$. The range of possible values for b has been discussed in section (4.2).[4] U has already been found to be equal to 5 in section (5.2.1), assuming that $b = .25$ in the long-run. If $E(e_N, b) = 0$, then from equation (6.3): $\delta = - E(i_N, b)i_N/b = - (26.5)(.0032)/.25 = -.34$.[5] Therefore, $W = 26.5 \{-.046 + (1 - .25)(5)\} + .34(1 - .46)\{1 + (1 - .25)(26.5)\} = 102$.

In the case of economic depreciation and no FIFO inventory accounting, i.e., $Z = J = 0$, the sign of $(db/d\Pi)$ is determined by the sign of $(\tau - \theta)$. As the gap between the corporate and personal tax rates increases, firms borrow more as the rate of inflation rises. Given the present values for τ and θ, $(db/d\Pi) = E(i_n, b)(\tau - \theta)/W = 26.5(.46 - .3)/102 = .042$. That is, a one percentage point increase in the rate of inflation results to a .042 percentage point increase in the firm's debt-capital ratio.

Equality of depreciation for tax purposes with true economic depreciation is rather difficult to achieve. Given the factors such as the decay of capital, the change in the price of capital, and the rate of scrapping, it is almost impossible to find the true rate at which capital is used up. Consequently, equating the tax allowance with the economic value of the capital which is used up in any period can only be done approximately.

In a more general case, represented by equation (6.5), the sign of $(db/d\Pi)$ depends on whether $(\tau - \theta)$ is larger or smaller than $\tau(1 - \theta)(Z + J)$. If it is larger, $(db/d\Pi)$ is positive, and if it is smaller, $(db/d\Pi)$ is negative. In any case, the gap between the personal and corporate tax rates is the determining factor.

The value of J is reported by Hendershott (1981) to be approximately .2.[6] J is negative in some years, but in the long run it is about .2.[7] The value of Z is inversely related to the useful tax life of the equipment. As the tax code reduces the useful life of an asset, Z increases, resulting in a possible change of sign of $(db/d\Pi)$ from positive to negative.[8] Assuming $Z = .39$, $\tau = .46$, $\theta = .3$, $J = .2$, and $W = 102$, from equation (6.5), $(db/d\Pi) = [26.5(.46 - .3) - .46(1 - .3)(.39 + .2)]/102 = .04$. That is, a one percentage point increase in the rate of inflation results to a .04 percentage point increase in the firm's debt-capital ratio.

Equation (6.5) suggests that if one of the aims of the tax system is to be nondistortionary, i.e., $(db/d\Pi) = 0$, then the tax rates must be such that $(\tau - \theta) = \tau(1 - \theta)(Z + J)$. Another (and very unlikely) way of preventing inflation from having an effect on the capital structure of the firm is to abolish the corporate and personal taxes, i.e., $\tau = \theta = 0$. If $\tau = \theta > 0$, then $(db/d\Pi)$ is extremely small and negative.

Equation (6.5) shows that the capital gains tax rate is not a factor in determining the sign of $(db/d\Pi)$. This is so only because $E(e_N, b)$ is assumed to be zero.

Equation (6.5) indicates that inflation and taxes have a small effect on the debt-capital ratio. This is consistent with new studies that show personal taxes in general and capital gains taxation in particular do not influence corporate finance significantly.[9]

If $E(e_N, b) \neq 0$, then the calculation of $(db/d\Pi)$ becomes complicated, and the capital gains tax rate, μ, affects debt-capital ratio of the firm. The graphical solution of the model in section (6.5), indicates that $(db/d\Pi)$ is likely to be positive. Table III presents the possible values of $(db/d\Pi)$ under different assumptions.

TABLE III

THE POSSIBLE VALUES OF $(db/d\Pi)$*

Assumption	b: .18	b: .26
$E(e_N, b) = Z = J = 0$	.0368	.042
$E(e_N, b) = 0$	.0356	.04
$E(e_N, b) = \tau = \theta = 0$	0	0
$E(e_N, b) = 0,\ \tau = \theta > 0$	-.001	-.002
$\tau > \theta > 0$	$(db/d\Pi) > 0$	$(db/d\Pi) > 0$

*When $E(e_N, b) = 0$ and $b = .18$, from table II, $E(i_N, b) = 36.72$. Therefore, $\delta = .47$ and $W = 113.2$. When $E(e_N, b) = 0$ and $b = .26$, from table II, $E(i_N, b) = 25.78$. Therefore, $\delta = -.32$ and $W = 97.67$

The structure of corporate and personal income taxes and the relative costs of debt and equity have caused corporations to prefer debt. The corporate tax code favors debt by making the deductibility of interest expenses from gross corporate income possible. Angelo and Masulis (1980) show that by relying more on debt, corporations have reduced taxable income by raising tax-deductible interest expenses.

Investors are the ones who determine the relative prices (required rates of return) at which corporations offer debt and equity securities. Tax laws for personal investment income should have lowered both debt-capital ratio and the dividend-payout ratio of the corporations, since interest and dividends paid to individuals are taxed at the ordinary rate while capital gains are taxed when realized at about one-sixth the ordinary rate. As mentioned earlier, empirical evidence shows that personal income taxes do not influence corporation debt-capital ratio significantly.[10] Despite the opposite effects of the personal tax laws, the reason for greater use of debt by corporations may be the growth of financial intermediaries along with changes in the legal and tax restrictions on investors.[11]

Another reason for the use of more debt in recent years has been the higher cost of equity finance. Empirical studies show that relative costs are very important in financial decisions of the corporations. Cost of equity and debt were 5.5% and .07% in 1960-1964, and they were 6.4% and -2.5% in 1975-1981.[12]

The analysis above shows that the combined effect of inflation and taxes is likely to increase the debt-capital ratio in the economy. $\underline{(db/d\Pi)}$ may not be very significant, but nevertheless it is positive according to the model presented in this chapter.

The Effect of Inflation on the Real Net Rate of Interest

The effect of a change in the rate of inflation on the real net rate of return on debt, assuming $E(e_N, b) = 0$, is given by equation (6.4) as:

$$(di_N/d\Pi) = -\frac{\delta\{(\tau - \theta) - \tau(1 - \theta)(Z + J)\}}{W} \tag{6.6}$$

Equation (6.6) shows that δ, the risk measure that the lenders in the financial markets are facing has a definite effect on i_N.

In the case of economic depreciation and no FIFO inventory accounting, i.e., $Z = J = 0$, the sign of $(di_N/d\Pi)$ is determined by the sign of $(\tau - \theta)$. Under current tax law, $(\tau - \theta) > 0$. As the gap between the corporate and personal tax rates increases, investors expect to see higher returns as inflation continues to surge.

The magnitude of the change in i_N can be found approximately by using the values prevailing in the economy in equation (6.6). Assuming $Z = J = 0$,

$$\left(\frac{di_N}{d\Pi}\right) = -\frac{\delta(\tau - \theta)}{W} . \tag{6.7}$$

Since $b = .25$, $\delta = -.34$, $W = 102$, $\tau = .46$, and $\theta = .3$, then $(di_N/d\Pi) = .0005$. That is, a one percentage point increase in the rate of inflation will increase the real net rate of interest very slightly.

If the shift in the debt-capital ratio is ignored, i.e., $E(i_N, b) = E(e_N, b) = 0$, and if it is assumed that $Z = J = 0$, i.e., economic depreciation and no FIFO inventory accounting is assumed, then from equation (6.6),

$$\left(\frac{di_N}{d\Pi}\right) = \frac{\tau - \theta}{1 - \tau} \,. \tag{6.8}$$

Because $i_N = (1 - \theta)i - \Pi$, then

$$\left(\frac{di}{d\Pi}\right) = \frac{1}{1 - \tau} \,, \tag{6.9}$$

which is a well-known result.[13] Given the values of $\tau = .46$, and $\theta = .3$, the effect of a one percentage point increase in the rate of inflation would be a .3 percentage point increase in the real net rate of interest and a 1.9 percentage point increase in the nominal rate of interest under the assumption of $E(i_N, b) = E(e_N, b) = Z = J = 0$.[14]

It can be shown that:[15]

$$\frac{d(i - \Pi)}{d\Pi} = \frac{\tau}{1 - \tau} \,. \tag{6.10}$$

That is, $d(i - \Pi)/d\Pi = .85$, or a one percentage point increase in the rate of inflation will result to a .85 percentage point increase in the real rate of interest.

The assumptions that lead to equations (6.8), (6.9), and (6.10) are very restrictive. However, they provide very important and interesting results. They indicate that the tax system has a definite and a significant effect on the behavior of nominal, real, and real net rates of interest, if $E(i_N, b) = E(e_N, b) = Z = J = 0$.

From equation (6.9), it is clear that Fisher's conclusion that $(di/d\Pi) = 1$ corresponds to the special case of no corporate taxes. In the more general case in which corporate taxes are recognized, the nominal rate of interest may increase by almost twice the rate of inflation.

From equation (6.10), again the Fisherian conclusion that the real rate of interest is not affected by inflation, i.e., $d(i - \Pi)/d\Pi = 0$, can be derived. But this requires the assumption of no corporate taxation. In the more general case in which $\tau > 0$, the real rate of interest may increase by a rate lower than the rate of inflation.

From equation (6.8), $(di_N/d\Pi) = .3$. This indicates that the real net rate of interest may increase by an amount (substantially) lower than the rate of inflation.

In a more general case, with historic cost depreciation method and FIFO inventory accounting, the sign of $(di_N/d\Pi)$ is the same as the sign of $(db/d\Pi)$. If they are both positive, then the yield of debt increases because the debt-equity ratio rises, increasing the riskiness of debt. Inflation increases uncertainty, this uncertainty results to lenders' insistence on higher returns. Therefore, lenders insist on not only being compensated for inflation, but also for uncertainty resulting from it.

Inflation increases the present value of depreciation and the costs associated with FIFO inventory accounting. This dampens the increase in the real net rate of interest as a result of an increase in the rate of inflation. Given the relevant parameter values prevailing in the economy, $(di_N/d\Pi)$ is found to be extremely small. Assuming $b = .25$, $\tau = .46$, $\theta = .3$, $Z = .39$, $J = .2$, $\delta = -.34$, and $W = 102$, $(di_N/d\Pi) = [(-.34)[(.46 - .3) - .46(1 - .3)(.39 + 2)]/102]$, from equation (6.6), which is almost equal to zero.

Equation (6.6) shows that the real net rate of interest does not change as a result of a change in capital gains tax rate. However, this conclusion is true only if $E(e_N, b) = 0$.

If $E(e_N, b) \neq 0$, then the calculation of $(di_N/d\Pi)$ becomes complicated, and the capital gains tax rate, μ, affects the real net rate of interest. The graphical solution of the model, presented in section (6.5), indicates that $(di_N/d\Pi)$ is likely to be positive, but small. Table IV presents the possible values of $(di/d\Pi)$, $(d(i - \Pi)/d\Pi)$, and $(di_n/d\Pi)$ under different assumptions.

The Effect of Inflation on the Real

Net Rate of Return on Equity

The effect of a change in the rate of inflation on the real net rate of return on equity, assuming $E(e_N, b) = 0$, is given by equation (6.4) as:

$$(de_N/d\Pi) = \frac{E(i_N,b)(PQ-UH)+\delta\{(1 - \tau)(1+E(i_N,b)H - b(1 - \tau)P\}}{W} \quad (6.11)$$

where $P = \theta - \tau - \mu$ and $H = b(\theta - \tau) + \mu(1 - b) + \tau(1 - \theta)(Z + J)$.

By ignoring the change in debt-capital ratio, i.e., by assuming $E(i_N, b) = E(e_N, b) = 0$, the approximate value of $(de_N/d\Pi)$ can be found from equation (6.11).

$$(de_N/d\Pi) = - \mu - \tau(1 - \theta)(Z + J) \quad (6.12)$$

Since from equation (5.2) the nominal rate of return on equity, $e + \Pi$ is $\{e_N + \mu\Pi + (1 - \theta)\Pi\}/(1 - \theta)$, then:

$$\{d(e + \Pi)/d\Pi\} = 1 - \tau(Z + J). \quad (6.13)$$

TABLE IV

THE POSSIBLE VALUES OF $(di/d\Pi)$, $(d(i - \Pi)/d\Pi)$, AND $(di_N/d\Pi)$*

	b: .18	b: .26
Assumption: $E(e_N, b) = E(i_N, b) = Z = J = 0$		
$(di/d\Pi)$	1.85	1.85
$(d(i - \Pi)/d\Pi)$	.85	.85
$(di_N/d\Pi)$	.3	.3
Assumption: $E(e_N, b) = Z = J = 0$		
$(di/d\Pi)$	1.43	1.43
$(d(i - \Pi)/d\Pi)$	.43	.43
$(di_N/d\Pi)$	.0007	.0005
Assumption: $E(e_N, b) = 0$		
$(di/d\Pi)$	1.43	1.43
$(d(i - \Pi)/d\Pi)$	.43	.43
$(di_N/d\Pi)$	0	0
Assumption: $E(e_N, b) = \tau = \theta = 0$		
$(di/d\Pi)$	1.43	1.43
$(d(i - \Pi)/d\Pi)$	.43	.43
$(di_N/d\Pi)$	0	0
Assumption: $E(e_N, b) = 0$, $\tau = \theta > 0$		
$(di/d\Pi)$	1.43	1.43
$(d(i - \Pi)/d\Pi)$	.43	.43
$(di_N/d\Pi)$	0	0
No Restrictive Assumption		
$(di/d\Pi)$	Positive	Positive
$(d(i - \Pi)/d\Pi)$	Positive	Positive
$(di_N/d\Pi)$	Positive & small	Positive & small

*Obviously, $(di/d\Pi) = (1/(1 - \theta))[(di_N/d\Pi) + 1]$ and $(d(i - \Pi)/d\Pi) = (1/(1 - \theta))[(di_N/d\Pi) + \theta]$.

The effect of inflation on the real rate of return on equity in this case is given by:

$$(de/d\Pi) = -\tau(Z + J) \tag{6.14}$$

Equations (6.12), (6.13), and (6.14) can give the effect of inflation on real net, nominal, and real rate of return on equity. The value of $\underline{J}$ is reported in Hendershott (1981) to be equal to .2. The value of $\underline{Z}$ is reported in Feldstein, Green and Sheshinski (1978) to be about .39.[16] Given these values, from equation (6.12), the change in the real net rate of return on equity is found to be equal to -.24 percentage point for a one percentage point increase in the rate of inflation.[17] From equation (6.13), a one percentage point increase in the rate of inflation results to a .73 percentage point increase in the nominal rate of return on equity.[18] From equation (6.14), a one percentage point increase in the rate of inflation results to a .27 percentage point reduction in the real rate of return on equity.[19] To the investor, obviously, it is the .24 percentage point reduction in the real net rate of return on equity that matters.

In a more general case represented by equation (6.11), $\underline{(de_N/d\Pi) = -.25}$, implying that a one percentage point increase in the rate of inflation reduces the real net rate of return on equity by .25 percentage point.[20] This is a substantial reduction. This also indicates a .71 percentage point reduction in the real rate of return on equity, when $\underline{E(e_N, b) = 0}$, and $\underline{E(i_N, b) \neq 0}$.[21]

If $\underline{E(e_N, b) \neq 0}$, then the calculation of $\underline{(de_N/d\Pi)}$ becomes complicated. The graphical solution of the model, presented in the next section, indicates that $\underline{(de_N/d\Pi)}$ is likely to be negative and substantial. Table V presents the possible values of $(de/d\Pi)$, $(d(e + \Pi)/d\Pi)$, and $(de_N/d\Pi)$ under different assumptions.

Graphical Solution and Additional Results

It is possible to present a graphical solution of the model presented by equations (6.1), (6.2), and (6.3). Here, there is no need for any restrictive assumption with regard to the value of $E(i_N, b)$, or the value of $E(e_N, b)$.

Equation (6.1) represents the objective function, OF, and can be rewritten as:

$$b = \frac{e_N E(e_N, b)}{-(1 - \tau)(1 + E(i_N, b))i_N + (1 + E(e_N, b))e_N - \Pi(\theta - \tau - \mu)} \cdot \tag{6.15}$$

Equation (6.2) represents the balance sheet constraint, BF, and can be rewritten as:

$$b = \frac{(1 - \tau)(1 - \theta)f' - e_N - \Pi\{\mu + \tau(1 - \theta)(Z + J)\}}{(1 - \tau)i_N - e_N + \Pi\{\theta - \tau - \mu\}} \cdot \tag{6.16}$$

Equation (6.3) represents the financial constraint, FF, and can be rewritten as:

$$b = - \frac{e_N\ E(e_N, b)}{\delta} - \frac{E(i_N, b)}{\delta}\ i_N \tag{6.17}$$

The following graph (figure 8) of equations (6.15), (6.16), and (6.17) gives the solution to the model for b and i_N. The graph is two dimensional, instead of three, to show the relationship between b and i_N. The relationship between i_N and e_N is analyzed later in this section.

TABLE V

THE POSSIBLE VALUES OF $(de/d\Pi)$, $(d(e + \Pi)/d\Pi)$, AND $(de_N/d\Pi)$*

	b	
	.18	.26
Assumption: $E(e_N, b) = E(i_N, b) = 0$		
$(de/d\Pi)$	-.27	-.27
$(d(e + \Pi)/d\Pi)$	.73	.73
$(de_N/d\Pi)$	-.24	-.24
Assumption: $E(e_N, b) = 0$		
$(de/d\Pi)$	-.39	-.29
$(d(e + \Pi)/d\Pi)$	.61	.71
$(de_N/d\Pi)$	-.32	-.25
No Restrictive Assumptions		
$(de/d\Pi)$	Substantially Negative	Substantially Negative
$(d(e + \Pi)/d\Pi)$	Positive	Positive
$(de_N/d\Pi)$	Substantially Negative	Substantially Negative

*Obviously, $(de/d\Pi) = (1/(1 - \theta))[(de_N/d\Pi) + \mu]$, and $(d(e+\Pi)/d\Pi) = (1/(1 - \mu))[(de_N/d\Pi) + \mu + (1 - \theta)]$.

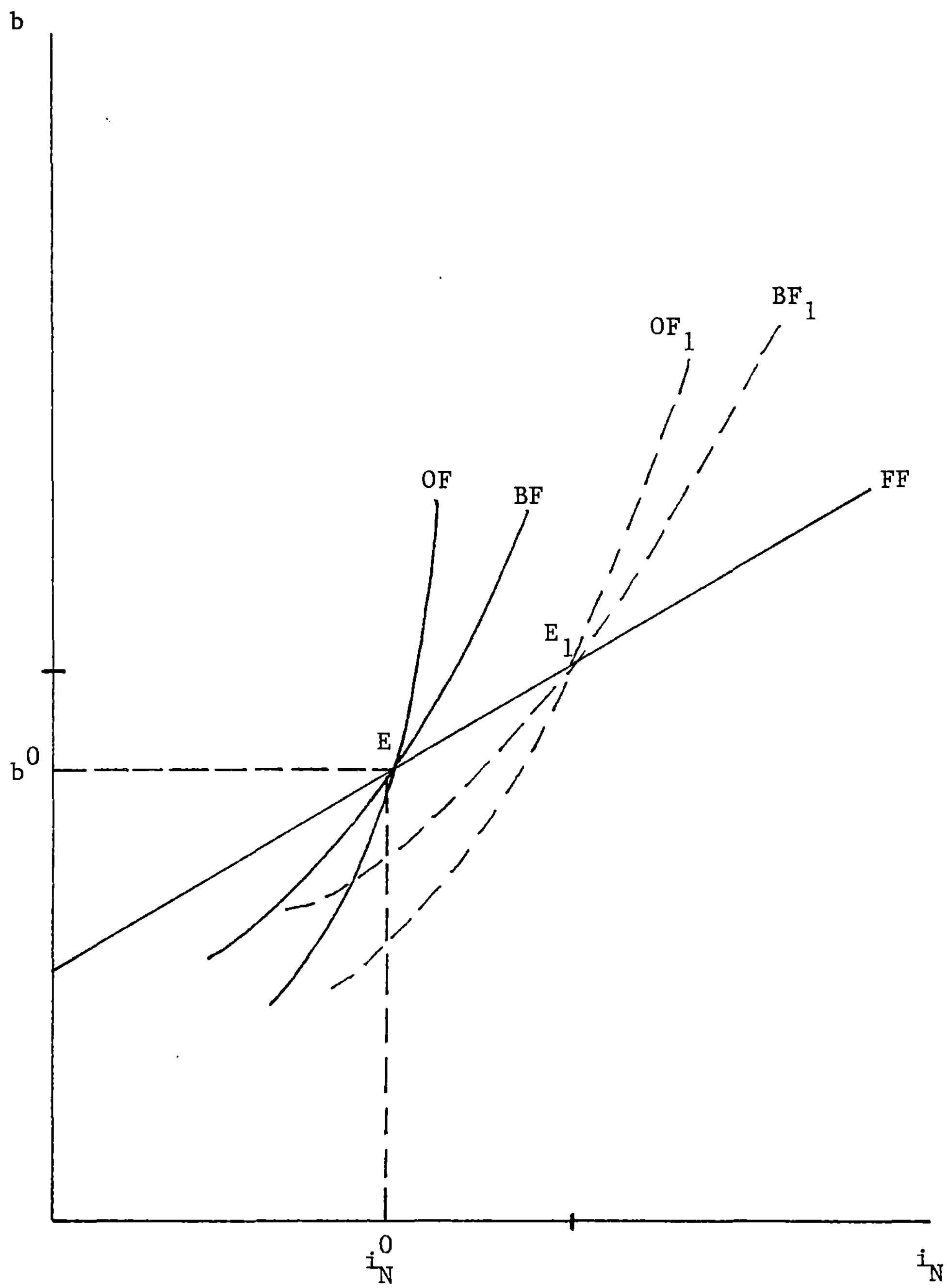

Figure 8. The Relationship Between $\underline{i_N}$ and $\underline{b}$

The financial constraint equation, FF, is an upward sloping line with a sharp slope of $-E(i_N, b)/\delta$. The objective function, OF, and the balance sheet constraint, BF, are rectangular hyperbolas.[22] A rectangular hyperbola has asymptotes that are parallel to the coordinate axes and can be written in the standard form of $(X - A)(Y - B) = D$, where (A, B) is the center of the hyperbola, and $X = A$ and $Y = B$ are the asymptotes. (D/A) gives the intercept of the hyperbola with the vertical axis.

Suppose that anticipated inflation rate is initially $\Pi = 0$. The solid lines in figure 8 represent this situation. The intercepts and also the asymptotes are not shown in the graph for simplicity. The intercept of FF is $-e_N E(e_N, b)/\delta$. The intercept of OF is $e_N E(e_N, b)/(1 + E(e_N, b))e_N$, and the intercept of BF is $\{(1 - \tau)(1 - \theta)f' - e_N\}/(-e_N)$. E is the point of equilibrium and b^0 and i_N^0 represent the initial debt-capital ratio and real net rate of interest. The tax system is neutral if: (1) $Z = 0$, i.e., assets are depreciated at the economic rate of decay; (2) $J = 0$, i.e., no FIFO inventory accounting; (3) $\mu = 0$, i.e., capital gains are not taxed; and (4) $\tau = \theta$, i.e., there is no gap between personal and corporate tax rates. In this case, an increase in the rate of inflation from zero to $\Pi > 0$ would have no effect on b and i_N.

Under the current tax law, $\tau > \theta$, $\mu > 0$, $Z > 0$, and $J > 0$. If inflation rate is increased to $\Pi > 0$, the position of the objective function and the balance sheet constraint changes. However, for the financial constraint, since it is assumed that the market adjusts to changes in the rate of inflation and tax rules, the position of FF does not change, i.e., $(db/d\Pi) = 0$ on FF.

From equation (6.15) the intercept of OF is very small. If $\Pi > 0$, then OF shifts to OF_1, which has an even smaller intercept of $e_N\, E(e_N, b)/\{(1 + E(e_N, b))e_N - \Pi(\theta - \tau - \mu)\}$. The vertical asymptote of OF_1 is given by $\{(1 + E(e_N, b))e_N - \Pi(\theta - \tau - \mu)\}/(1 - \tau)$ $(1 + E(i_N, b))i_N$, which is also small, suggesting that OF_1 is steep.[23] On OF, $(db/d\Pi) = \{-[-\theta - \tau - \mu]\, e_N E(e_N, b)\}/\{-(1 - \tau)(1 + E(i_N, b))i_N + (1 + E(e_N, b))e_N - \Pi(\theta - \tau - \mu)\}^2 < 0$. The denominator is always positive. The numerator is negative, given the tax parameters prevailing in the economy. This suggests that an increase in the rate of inflation shifts OF to the right to OF_1.

For BF_1, the intercept is $\{(1 - \tau)(1 - \theta)f' - e_N - \Pi\{\mu + \tau(1 - \theta)(Z + J)\}\}/\{-e_N + \Pi(\theta - \tau - \mu)\}$, from equation (6.16). The vertical asymptote for BF_1 is given by $\{e_N - \Pi(\theta - \tau - \mu)\}/(1 - \tau)$, which is to the right of the asymptote for OF_1, suggesting that BF_1 is flatter than OF_1. Since BF and BF_1 intersect, $(db/d\Pi)$ on BF depends on the value of i_N.

Figure 8 indicates that the combined effect of inflation and taxes is likely to result to higher levels of the real net interest rate and the debt-capital ratio. However, all three equations of the model, i.e., OF, BF, and FF, are extremely steep, suggesting that increases in i_N are likely to be minimal. As indicated earlier b may experience a larger increase compared to i_N in the presence of inflation. But again increases in b are not likely to be substantial either.

The following graph (figure 9) of the three equations of the model shows the relationship between i_N and e_N. The slope (di_N/de_N), of the objective function, OF, which is represented by equation (6.1),

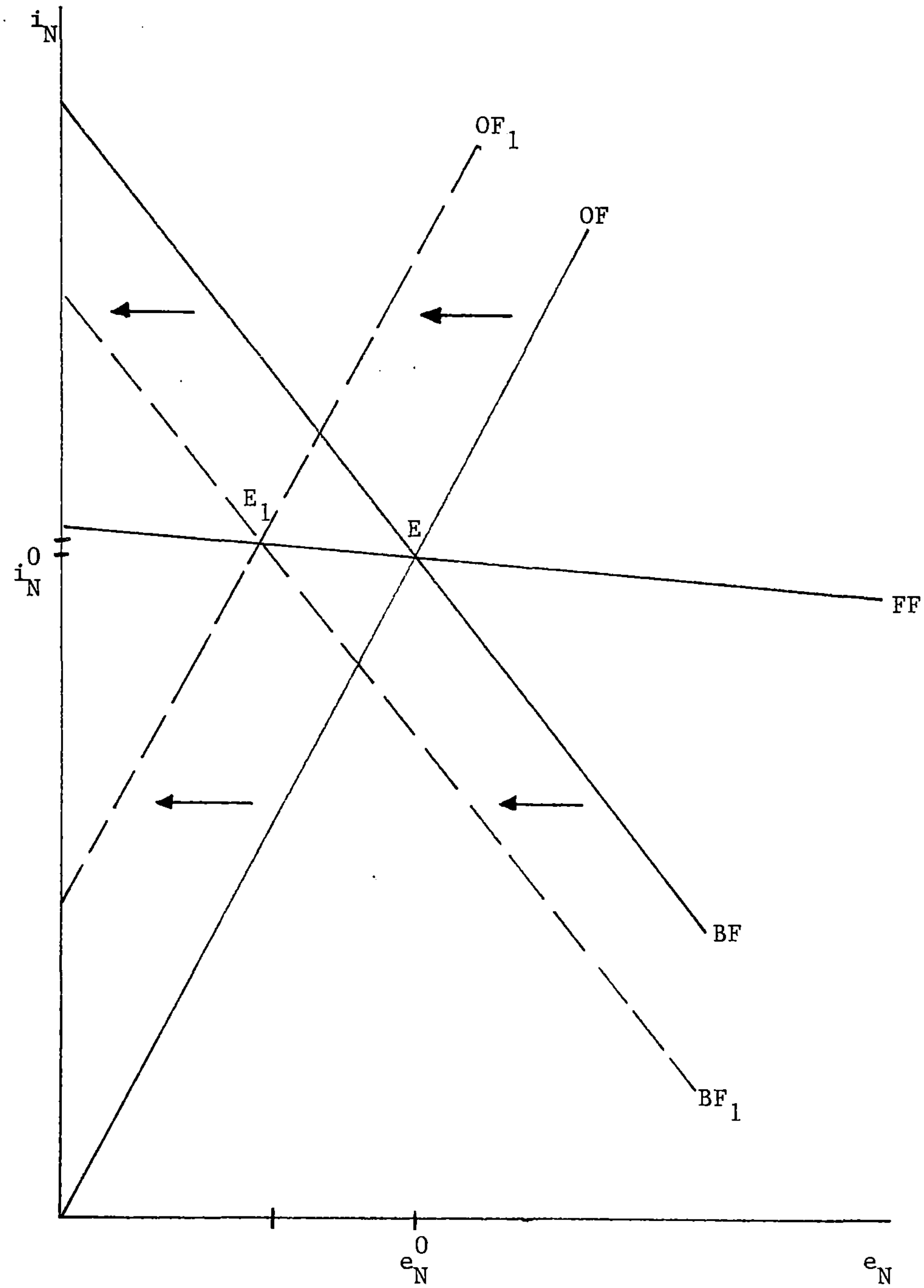

Figure 9. The Relationship Between i_N and e_N

is given by $-\{\{(1 - b)/b\}E(e_N, b) - 1\}/\{(1 - \tau)(1 + E(i_N, b))\}$, which is positive. The slope of the sources and uses of funds identity, BF, represented by equation (6.2), is $-(1 - b)/b(1 - \tau)$, and is negative. FF represents the financial constraint and has a slope equal to $-E(e_N, b)/E(i_N, b)$, which is negative and very small, as shown by equation (6.3).

In figure 9, suppose that anticipated inflation rate is initially $\Pi = 0$. The solid lines represent this situation. E is the point of equilibrium and i_N^0 and e_N^0 represent the real net rate of return on debt and equity, respectively. The tax system would be neutral if: (1) $Z = 0$, i.e., assets are depreciated at the economic rate of decay; (2) $J = 0$, i.e., no FIFO inventory accounting exists; (3) $\mu = 0$, i.e., capital gains are not taxed; and (4) $\tau = \theta$, i.e., there is no gap between personal and corporate tax rates. In this case, an increase in the rate of inflation from zero to $\Pi > 0$ would have no effect on i_N and e_N. However, the nominal rate of interest will rise by $\Pi\{1/(1 - \theta)\}$ and the nominal rate of return on equity will rise by Π.[24] Since it is only the real net rate that matters and not the nominal rate, firms can afford to pay these higher nominal returns, and investors supply the same amount of funds as before.

Under the current tax law, $\tau > \theta$, $\mu > 0$, $Z > 0$, and $J > 0$. If inflation rate is increased to $\Pi > 0$, since the effective corporate tax rate is raised by the interaction of inflation with the tax laws, firms cannot afford to pay enough to keep i_N and e_N unchanged. OF and BF will shift to OF_1 and BF_1, respectively. Interest costs can be deducted from taxable income by the corporations. The model shows that the real net interest rate increases by a slight amount, if any.

However, there is a definite reduction in the real net rate of return on equity.

In the face of inflation, both bondholders and stockholders are worse off. However, it seems that the current tax system works mostly against the equityholders in inflationary times. For the bondholders the increase in $\underline{i_N}$ is not enough to compensate them for the lost income due to inflation. For the equityholders the loss of income due to the combined effect of inflation and taxation is substantial.

The fact that real net rates of return change as a result of a change in the rate of inflation, makes the current tax system undesirable. To make the tax system neutral, one of the most important things is to eliminate the inflation-induced taxation of equity earnings. In other words, the taxation of nominal capital gains must be eliminated, i.e., $\underline{\mu = 0}$. Another change that must be made is to let capital assets depreciate at their economic rate of decay. The method of replacement cost depreciation makes $\underline{Z = 0}$. Still another change is to make the corporations that are still using FIFO inventory accounting method to switch to LIFO method. This makes $\underline{J = 0}$. In addition, firms must be allowed to deduct only the real interest expenses, and individuals should be taxed only on their real interest income, $\underline{i - \Pi}$. These changes are called the full indexing of the tax system. If all these changes are made, then equation (5.1) becomes:

$$i = \frac{i_N}{1 - \theta} + \Pi, \text{ or } i_N = (1 - \theta)(i - \Pi) \tag{6.18}$$

Equation (5.2) becomes:

$$e + \Pi = \frac{e_N}{1 - \theta} + \Pi, \text{ or } e_N = (1 - \theta)e \tag{6.19}$$

Equation (5.3) becomes:

$$C = b(1 - \tau)(i - \Pi) + (1 - b)e \tag{6.20}$$

Under these circumstances, the model represented by equations (6.1), (6.2), and (6.3) can be represented as:

$$i_N = -\frac{((1 - b)/b)E(e_N, b)-1}{(1 - \tau)(1 + E(i_N, b))} e_N \tag{6.21}$$

$$i_N = -\frac{1 - b}{b(1 - \tau)} e_N + \frac{1 - \theta}{b} f' \tag{6.22}$$

$$i_N = -\frac{E(e_N, b)}{E(i_N, b)} e_N \frac{\delta b}{E(i_N, b)} \tag{6.23}$$

Therefore, the model is completely independent of the rate of inflation and the tax system is neutral. A full indexation will not reduce taxes. Instead, it keeps the characteristics of the progressive tax system intact. There are, however, some analysts who find indexation very costly to administer.[25] In addition, they believe that it makes the economy more sensitive to supply stocks. Moreover, it is almost impossible to depreciate capital at the true economic rate of decay, and there is a debate over the true measurement of inflation. Some believe that the consumer price index is not the best measure of the rate of inflation and an immediate write-off would be a better alternative.

Conclusions

According to the Keynesian view, monetary expansion lowers interest rates, reducing the cost of funds to businesses, and, therefore, it encourages the accumulation of plant and equipment. However, this has not been the case in the U.S. in recent years.[26] Monetary expansion has resulted to higher rates of nominal interest; however, the real net-of-tax cost of funds, which is what really matters to the lenders, has remained low.[27] At the same time, the lower cost of funds produced in this way has encouraged investment in housing and consumer durables rather than more investment in plant and equipment.

The interaction of inflation and taxes can mislead monetary authorities so that they think that the cost of funds is too high. As a result they might resort to expansionary policies to lower this cost. But because of the combined effect of inflation and taxes, these expansionary policies can only lead to lower investment in plant and equipment and to discourage saving. This conclusion is based on Boskin (1978), who finds that the reductions in the real net rates of return will reduce the saving rate and, therefore, reduce the rate of growth of the economy. Meanwhile, the low real after-tax rates of return can encourage the growth of consumer spending and investment in real estate.

In this chapter it has been shown that the interaction of the tax laws and inflation may result to very small positive changes in $\underline{i_N}$ and substantial negative changes in $\underline{e_N}$. It is interesting to note that even though $\underline{i_N}$ and $\underline{e_N}$ can be negative in the short-run, they are always positive in the long-run. Green (1971) explains why $\underline{i_N}$ and $\underline{e_N}$ cannot be negative in the long-run.[28] He identifies the three forces that are at work to make $\underline{i_N}$ and $\underline{e_N}$ positive in the long-run. These forces were originally identified by Bohm-Bawek. The first force is the expectation of earnings growing through time. The second force is impatience which implies a positive rate of time preference. The last force is the technical superiority of present goods in the sense that every unit of current consumption goods can be transformed into more than one unit of future consumption goods. It follows that since $\underline{e_N}$ must be positive in the long-run, reduction in $\underline{e_N}$ as a result of higher rates of inflation cannot continue forever. That is, unless something is done about inflation, taxes, and combined effects of inflation and taxes, eventually $\underline{e_N}$ approaches negative values and investors stop supplying equity funds.

ENDNOTES

[1] See the appendix to Feldstein and Summers (1977).

[2] See Brainard, Shoven, and Weiss (1980) and Feldstein and Summers (1977).

[3] See table 2, p. 120 in Summers (1981a), or table (4.2), p. 123 in Bosworth (1984).

[4] Gordon and Malkiel (1981) provide estimates of b for the nonfinancial corporations for the 1957-78 period. See table 1, p. 158.

[5] Gordon (1984) finds $\delta = -.24$ in table II, p. 326.

[6] See Hendershott (1981), p. 911.

[7] See Kopcke (1983), table 3. Since almost 70% of inventories are accounted for by FIFO, to find J, the ratio of inventories to fixed capital and land must be multiplied by .7 for each year.

[8] Z is equal to 1, if all capital expenditures are allowed to be immediately offset against taxes.

[9] See for example Gordon and Masulis (1980).

[10] See for example Gordon and Bradford (1980), or Black and Scholes (1974).

[11] Commercial banks, for example, are prevented from investing in corporate stocks but are allowed to hold corporate bonds.

[12] See Nakamura and Nakamura (1982), or Taub (1979).

[13] Since $i_N = (1 - \theta)i - \Pi$, then $(\frac{di}{d\Pi}) = \frac{1}{1 - \theta}[(\frac{di_N}{d\Pi}) + 1] = \frac{1}{1 - \theta}[\frac{\tau - \theta}{1 - \tau} + 1] = \frac{1}{1 - \tau}$.

[14] In this case, $(\frac{di_N}{d\Pi}) = \frac{\tau - \theta}{1 - \tau} = \frac{.46 - .3}{1 - .46} = .3$, and $(\frac{di}{d\Pi}) = \frac{1}{1 - \tau} = 1.9$.

[15] Here, $\frac{d(i - \Pi)}{d\Pi} = (\frac{di}{d\Pi}) - 1 = \frac{1}{1 - \tau} - 1 = \frac{\tau}{1 - \tau}$.

[16] See the appendix to Feldstein, Green and Sheshinski (1978).

[17] From equation (6.12), $(\frac{de_N}{d\Pi}) = -.05 - .46(1 - .3)(.39 + .2) = -.24$.

[18] From equation (6.13), $(\frac{d(e + \Pi)}{d\Pi}) = 1 - .46(.39 + .2) = .73$.

[19] From equation (6.14), $(de/d\Pi) = -.46(.39 + .2) = -.27$.

[20] From equation (6.11), $(de_N/d\Pi) = \{26.5\{(-.21)(-.046) - (5)(.1875)\} - .34\ (1 - .46)(1 + 26.5)(.1875 - .25(1 - .46)(-.21)\}/102 = -.25$.

[21] Since $e = \frac{e_N + \mu\Pi}{1 - \theta}$, $\frac{de}{d\Pi} = \frac{1}{1 - \theta}\{\frac{de_N}{d\Pi} + \mu\} = \frac{1}{1 - .3}\{-.25 + .05\} = -.29$, and therefore, $\frac{d(e + \Pi)}{d\Pi} = \frac{de}{d\Pi} + 1 = -.29 + 1 = .71$.

[22] See any mathematical economics text.

[23] The horizontal asymptotes for OF, OF_1, BF, and BF_1 are given by Y = 0.

[24] Since $(di/d\Pi) = (1/(1 - \theta))\{(di_N/d\Pi) + 1\}$, if $(di_N/d\Pi) = 0$, then $(di/d\Pi) = 1/(1 - \theta)$. Also, since $(d(e + \Pi)/d\Pi) = (1/(1 - \theta))\{(de_N/d\Pi) + (1 - \theta)\}$, if $(de_N d\Pi) = 0$, then $(d(e + \Pi)/d\Pi) = 1$.

[25] See Tatom (1985).

[26] See Feldstein (1982b).

[27] See Feldstein (1982c).

[28] See Green (1971), pp. 203-208.

CHAPTER VII

SUMMARY AND CONCLUSIONS

This dissertation has presented an analysis of the combined effects of inflation and the tax system on macroeconomic variables. In Chapter IV, it has been shown that a higher rate of inflation can cause people to shift their money balances into real capital, thereby increasing the rate of capital accumulation. This phenomena is called the Tobin effect. It has been argued here that the interaction of inflation and taxation may reduce the rate of growth of economy. Chapter IV suggests that lowering the corporate and personal tax rates may lead to a higher rate of capital formation. A higher debt-capital ratio for the entire economy may also result to a higher rate of growth of capital stock, as suggested by Chapter IV. Empirical evidence suggests that the economy's total debt ratio has remained stable over many years.[1] If the economy's total debt ratio is stable, then the current rise in government debt (and, therefore, government's debt ratio) would result to the economy's private sector not being able to increase its outstanding debt. Given the importance of debt in financing capital assets in the United States, in the absence of some break from government deficit, a substantial increase in capital formation is unlikely, even if some other policies are conducted successfully.

The analysis presented in chapter VI suggests that the interaction of the tax laws and inflation may result to very small positive changes in the real net rate of interest and substantial negative changes in the real net rate of return on equity. It follows that low rates of return lead to lower rates of capital accumulation. On the other hand, debt-capital ratio for the entire economy is likely to experience a small positive change.

In lieu of the results obtained throughout this dissertation, the following policy recommendations seem to be appropriate. Since it is impossible to use the methods based on actual wear of assets, replacing the historic cost method of depreciation with market value accounting may be better.[2] In addition, lowering the corporate and personal tax rates leads to lower cost of capital and may stimulate investment. Adjusting capital gains tax rates to reflect the fact that much of accrued capital gains represents inflationary gains could also lower the cost of capital and increase investment.

Sustained economic growth should be the long-run goal of the economic policy. Bringing down the budget deficit and changing the tax codes are the most important fiscal policy actions that could be taken to improve prospects for a balanced and sustained economic growth. Meanwhile the major contribution that the monetary policy can make is to ensure reasonable price stability.

If these steps are taken, then in the short run the increase in capital formation should contribute to higher rates of inflation because of an increase in investment. In the long run, however, capital formation raises productivity and output, thereby checking inflation from the supply side.

ENDNOTES

[1]See Friedman (1983), p. 88.

[2]See Bulow and Shoven (1982).

BIBLIOGRAPHY

Allman, Dale N. "The Decline in Business Profitability: A Disaggregated Analysis," Economic Review, Federal Reserve Bank of Kansas City, Jan. 1983, pp. 19-26.

Angelo, Harry D. and Ronald Masulis. "Optimal Capital Structure Under Corporate and Personal Taxation," Journal of Financial Economics, March 1980, pp. 3-19.

Arditti, Fred D. "Risk and the Required Return on Equity," Journal of Finance, 1967, pp. 19-36.

Bailey, Martin J. "Welfare Cost of Inflationary Finance," Journal of Political Economy, April 1956, pp. 93-110.

__________. "Capital Gains and Income Taxation," in The Taxation of Income from Capital, edited by A. G. Harberger and M. J. Bailey, Brookings Institution, 1969.

Ballentine, J. Gregory. "Dividend Policy and Tax Incidence in a Growing Economy," Quarterly Journal of Economics, Dec. 1980, pp. 781-87.

__________. Equity, Efficiency, and the U.S. Corporation Income Tax. Washington, D.C., American Enterprise Institute, 1980.

__________ and Charles E. McLure. "Taxation and Corporate Financial Policy," Quarterly Journal of Economics, March 1980, pp. 351-72.

Beebe, Jack and Jane Haltmaier. "An Intersectoral Secular Productivity Slowdown," Economic Review, Federal Reserve Bank of San Francisco, Fall 1980, pp. 5-15.

Berson, David W. "Money Growth Volatility, Uncertainty and High Interest Rates," Economic Review, Federal Reserve Bank of Kansas City, Nov. 1983, pp. 23-28.

Black, Fischer and Myron Scholes. "The Effects of Dividend Yield and Dividend Policy on Common Stock Returns and Prices," Journal of Finance, May 1974, pp. 1-22.

Boskin, Michael. "Taxation, Saving, and the Rate of Interest," Journal of Political Economy, April 1978, pp. s3-s27.

Bosworth, Barry P. Tax Incentives and Economic Growth, Washington, D.C., Brookings Institution, 1984.

__________. "Taxes and the Investment Recovery," Brookings Papers on Economic Activity, 1985:1, pp. 1-38.

Brainard, W. C., J. B. Shoven and L. Weiss. "The Financial Valuation of the Return to Capital," Brookings Papers on Economic Activity, 1980:2, pp. 453-502.

Bulow, Jeremy I. and John B. Shoven. "Inflation, Corporate Profits, and the Rate of Return to Capital," in The Changing Roles of Debt and Equity in Financing U.S. Capital Formation, edited by Benjamin M. Friedman, The University of Chicago Press, 1982.

Clark, Peter K. "Capital Formation and the Recent Productivity Slowdown," Journal of Finance, June 1978, pp. 965-976.

David, P. and J. Scadding. "Private Savings, Ultrarationality, Aggregation and Denison's Law," Journal of Political Economy, March-April 1974, pp. 225-249.

Dougherty, Christopher. Interest and Profit. New York, Columbia Press, 1980.

Downs, Anthony. "Too Much Capital for Housing?" Brookings Bulletin, Summer 1980.

Federal Tax Course, New Jersey, Prentice-Hall, published annually.

Feldstein, Martin. "Inflation, Tax Rules and the Stock Market," Journal of Monetary Economics, July 1980(a), pp. 309-331.

__________. "Fiscal Policies, Inflation, and Capital Formation," American Economic Review, Sept. 1980(b), pp. 636-650.

__________. "Adjusting Depreciation in an Inflationary Economy: Indexing Versus Acceleration," National Tax Journal, 1981, pp. 29-43.

__________. "Inflation, Tax Rules and the Accumulation of Residential and Nonresidential Capital," Scandinavian Journal of Economics, No. 2, 1982(a), pp. 293-311.

__________. "Inflation and the American Economy," The Public Interest, No. 67, Spring 1982(b), pp. 63-78.

__________. "Inflation, Capital Taxation, and Monetary Policy," in Inflation: Causes and Effects, edited by Robert E. Hall, The University of Chicago Press, 1982(c).

__________. "Why Tax Indexing Must Not be Repealed," Wall Street Journal, March 1, 1983.

__________ and Otto Eckstein. "The Fundamental Determinants of the Interest Rate," Review of Economics and Statistics, Nov. 1970, pp. 363-375.

__________ and Daniel Frisch. "Corporate Tax Integration: The Estimated Effects on Capital Formation and Tax Distribution of Two Integration Proposals," National Tax Journal, March 1977, pp. 37-52.

__________, J. Green and E. Sheshinski. "Inflation and Taxes in a Growing Economy with Debt and Equity Finance," Journal of Political Economy, 1978, pp. s53-s70.

__________ and Joel Slemrod. "Inflation and the Excess Taxation of Capital Gains on Corporate Stock," National Tax Journal, June 1978, pp. 107-118.

__________ and Lawrence Summers. "Is the Rate of Profit Falling?" Brookings Papers on Economic Activity, 1977:1, pp. 211-217.

__________. "Inflation, Tax Rules, and the Long-Term Interest Rate," Brookings Papers on Economic Activity, 1978:1, pp. 61-99.

__________. "Inflation and the Taxation of Capital Income in the Corporate Sector," National Tax Journal, Dec. 1979, pp. 445-470.

Fischer, Stanley. "Anticipations and the Non-Neutrality of Money," Journal of Political Economy, April 1979, pp. 225-252.

Friedman, Benjamin. "Implications of the Government Deficits for U.S. Capital Formation," in The Economics of Large Government Deficits, proceedings of a conference held in the Federal Reserve Bank of Boston in Oct. 1983, pp. 87-95.

Friedman, Milton. "Flat Rate Taxes," Newsweek, Aug. 18, 1980.

__________. "The Best Explanation for the Interest Rate Puzzle May be Wall Street's Myopia," Newsweek, Sept. 21, 1981.

__________. "How Flat is Flat?" Newsweek, Aug. 2, 1982.

Gordon, Roger H. "Inflation, Taxation, and Corporation Behavior," Quarterly Journal of Economics, May 1984, pp. 313-327.

__________ and David Bradford. "Taxation and the Stock Market Valuation of Capital Gains and Dividends," Journal of Public Economics, Oct. 1980, pp. 18-36.

__________ and Burton G. Malkiel. "Corporate Finance," in How Taxes Affect Economic Behavior, edited by H. J. Aaron and J. A. Pechman, Brookings Institution, 1981.

Green, H. A. John. Consumer Theory, Penguin Books, Inc., 1979.

Hafer, R. W. and Michael E. Trebing. "The Value-Added Tax--A Review of the Issues," Review, Federal Reserve Bank of St. Louis, Jan. 1980, pp. 3-10.

Harberger, Arnold. Taxation and Welfare, Boston, Little, Brown and Company, 1974.

Hendershott, Patric H. "The Decline in Aggregate Share Values: Taxation, Valuation Errors, Risk, and Profitability," American Economic Review, Dec. 1981, pp. 909-922.

Howrey, E. Philip and Saul Hymans. "The Measurement and Determination of Loanable-Funds Saving," Brookings Papers on Economic Activity, 1978:3, pp. 605-618.

Ibbotson, Roger G. and Rex A. Sinquefield. "Stocks, Bonds, Bills, and Inflation: Year-by-Year Historical Returns (1926-1974)," Journal of Business, Jan. 1976.

Johnson, Harry G. "The Neoclassical One-Sector Growth Model: A Geometric Exposition and Extension to a Monetary Economy," Economica, Aug. 1966.

Kendrick, John W. "Survey of Factors Contributing to the Decline in U.S. Productivity Growth," in The Decline in Productivity Growth, proceedings of a conference sponsored by the Federal Reserve Bank of Boston, June 1980.

King, Marvin A. and Don Fullerton, eds. The Taxation of Income from Capital: A Comparative Study of the United States, the United Kingdom, Sweden, and West Germany, the University of Chicago Press, 1984.

Kolin, Marshall. "The Relative Price of Corporate Equity," 1963, Ph.D. thesis, University of Chicago. The results of this study are reported by Luigi Tambini in The Taxation of Income from Capital, edited by Harberger and Bailey, Washington, D.C., Brookings Institution, 1969.

Kopcke, Richard W. "Inflation, Corporate Income Taxation, and the Demand for Capital Assets," Journal of Political Economy, Feb. 1981, pp. 123-128.

__________. "Will Big Deficits Spoil the Recovery?" in The Economics of Large Government Deficits, proceedings of a conference held in the Federal Reserve Bank of Boston, Oct. 1983, pp. 141-168.

Lerner, E. and W. Carlton. A Theory of Financial Analysis, New York, Harcourt, Brace & World, Inc., 1966.

Levhari, David and Don Patinkin. "The Role of Money in a Simple Growth Model," American Economic Review, Sept. 1968.

Lovell, Michael C. "The Profit Picture: Trends and Cycles," Brookings Papers on Economic Activity, 1977:1, pp. 211-227.

Meyer, Stephen A. and Robert J. Rossana. "Did the Tax Cut Really Cut Taxes?" Business Review, Federal Reserve Bank of Philadelphia, Nov./Dec. 1981, pp. 3-12.

Miller, Preston J. "Budget Deficit Mythology," Quarterly Review, Federal Reserve Bank of Minneapolis, Fall 1983, pp. 1-13.

Minarik, Joseph J. "Capital Gains," in How Taxes Affect Economic Behavior, edited by H. J. Aaron and J. A. Pechman, Brookings Institution, 1981.

Morris, Charles S. "The Productivity 'Slowdown': A Sectoral Analysis," Economic Review, Federal Reserve Bank of Kansas City, April 1984, pp. 3-15.

Mundell, Robert A. "Inflation and Real Interest," Journal of Political Economy, June 1963, pp. 280-283.

Nakamura, A. and M. Nakamura. "On the Firm's Production, Capital Structure, and the Demand for Debt," Review of Economics and Statistics, Aug. 1982, pp. 383-393.

Nerman, Tom. "Even Today's Steep Interest Rates Appear Low if Taxes and Inflation are Taken into Account," Wall Street Journal, 1980.

Nordhaus, William D. "The Falling Share of Profits," Brookings Papers on Economic Activity, 1974:2, pp. 169-216.

Ott, David J., Attiat F. Ott, and Jang H. Yoo. Macroeconomic Theory, New York, McGraw-Hill, 1975.

Pechman, Joseph A. Federal Tax Policy, New York, W. W. Norton and Company, Inc., Revised ed., 1971.

__________. What Should be Taxed: Income or Expenditures? Washington, D.C., Brookings Institution, 1980.

__________. Federal Tax Policy, Washington, D.C., Brookings Institution, 4th ed., 1983.

__________ and John Karl Sholz. "Comprehensive Income Taxation and Rate Reduction," Tax Notes, Oct. 11, 1982, pp. 83-93.

Phelps, Edmond. "Inflation in the Theory of Public Finance," Swedish Journal of Economics, March 1973, pp. 67-82.

Revising Individual Income Tax, Washington, D.C., Congressional Budget Office, 1983.

Sahling, Leonard and M. A. Akhtar. "What is Behind the Capital Spending Boom?" Quarterly Review, Federal Reserve Bank of New York, Winter 1984-85, pp. 19-30.

Schwartz, Eli and J. R. Aronson. "Some Surrogate Evidence in Support of the Concept of Optimal Financial Structure," Journal of Finance, March 1967, pp. 10-18.

Seidman, Lawrence S. "A Personal Consumption Tax: Can It Break the Capital Formation Deadlock?" Business Review, Federal Reserve Bank of Philadelphia, Jan./Feb. 1981, pp. 3-9.

Sellon, Gordon and Ronald L. Teigen. "The Choice of Short-Run Targets for Monetary Policy, Part III: A Historical Analysis," Economic Review, Federal Reserve Bank of Kansas City, May 1981, pp. 3-12.

Steindl, Frank G. "Specification and Consistency in General Equilibrium Models and Inflation and Interest Rates," memo, Oklahoma State University, Oct. 1981.

__________. "On Inflation, Income Taxes, Tax Rules, and the Rate of Interest: A General Equilibrium Analysis," Southern Economic Journal, January 1985, pp. 868-873.

Stiglitz, Joseph E. "The Corporation Tax," Journal of Public Economics, 1976:5, pp. 303-311.

Summers, Lawrence H. "Tax Policy and Corporate Investment," a paper presented at a conference on "The Supply Side Effects of Economic Policy," held at the Washington University and the Federal Reserve Bank of St. Louis, 1981(a), pp. 115-148.

__________. "Taxation and Capital Investment: A q-Theory Approach," Brookings Papers on Economic Activity, 1981(b):2, pp. 67-140.

__________. "Optimal Inflation Policy," Journal of Monetary Economics, 1981(c), pp. 175-189.

Tannenwald, Robert. "Federal Tax Policy and the Declining Share of Structures in Business Fixed Investment," Economic Review, Federal Reserve Bank of Boston, July/Aug. 1982, pp. 27-39.

__________. "Redistribution of Wealth in Conversion to a Flat Rate Tax," Economic Review, Federal Reserve Bank of Boston, Jan./Feb. 1983, pp. 5-27.

Tatom, John. "The 1981 Personal Tax Cuts: A Retrospective Look at Their Effects on the Federal Tax Burden," Review, Federal Reserve Bank of St. Louis, Dec. 1984, pp. 5-17.

__________. "Federal Tax Reform in 1985: Indexation," Review, Federal Reserve Bank of St. Louis, Feb. 1985, pp. 5-12.

Taub, Allen. "Determinants of the Firm's Capital Structure," Review of Economics and Statistics, Nov. 1978, pp. 410-416.

Tobin, James. "Money and Economic Growth," Econometrica, Oct. 1965.

Vickers, Douglas. "Elasticity of Capital Supply, Monopsonistic Discrimination and Optimal Capital Structure," Journal of Finance, March 1967, pp. 1-9.

von Furstenberg, G. M. "Corporate Investment: Does Market Valuation Matter in the Aggregate?" Brookings Papers on Economic Activity, 1977:2, pp. 347-397.

__________. "Saving," in How Taxes Affect Economic Behavior, edited by H. J. Aaron and J. A. Pechman, Brookings Institution, 1981.

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