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Summary

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This paper studies the long-run impact of fiscal policies on inflation and capital formation. The analysis uses an expanded monetary growth model in which the government finances its deficit by issueing both money and interest-bearing debt.

One major focus of the paper is the effect of a permanent increase in the government's real deficit in a fully employed economy. The analysis shows that a greater deficit must increase inflation, reduce capital formation, or both. With U.S. tax rules and the prevailing monetary and debt-management policies, a greater deficit is likely to cause both more inflation and lower capital intensity.

The second purpose of the paper is to analyze the effect of an exogenous increase in the saving rate and the possibility of "excessive saving" that arises when the yield on capital becomes so low that individuals prefer to hold government bonds rather than the more risky claims to real capital. Under some such conditions, an increase in saving could cause unemployment. The analysis shows that this problem can be avoided however by reducing the tax on capital income (or, in some cases, by an increased deficit that absorbs some but not all of the higher savings rate). In short, by using fiscal incentives as well as monetary accomodation, an increased saving rate can be converted to greater capital intensity.

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Fiscal Policies, Inflation and Capital Formation

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The unprecedently large government deficits in recent years have stimulated speculation about the adverse effects of such deficits on inflation and on private capital formation. While it is clear that deficits may have no adverse effect in an economy with sufficient unemployed resources, the effects of a deficit when there is full employment are less clear. Is a persistent increase in the government deficit necessarily inflationary? Does it necessarily reduce private capital formation? Is it possible to avoid both adverse effects? A primary purpose of this paper is to answer these questions in the context of a fully employed and growing economy.

A closely related issue is the relation between private saving and capital formation when money and other government liabilities are alternatives to real capital in individual portfolios. Keynes (1936), Harrod (1948) and Tobin (1965) have all emphasized the possibility of excess saving when individuals will not hold capital unless its yield exceeds some minimum required return. When the return on capital is too low, an increase in saving only reduces aggregate demand. If prices are flexible downward, this causes deflation until the increased value of real balances causes a sufficient reduction in saving; if prices cannot fall, the excess saving results in unemployment.

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Three ways of averting such "excess saving" have been emphasized in both theory and practice. The thrust of the Keynesian prescription was to increase the government deficit to provide demand for the resources that would not otherwise be used for either consumption or investment. In this way, aggregate demand would be maintained by substituting public consumption for private consumption. A second alternative prescription was to reduce the private saving rate. Early Keynesians like Seymour Harris (1941) saw the new social security program as an effective way to reduce aggregate saving. The third type of policy, developed by James Tobin, relies on increasing the rate of inflation and making money less attractive relative to real capital. In Tobin's analysis, the resulting increase in capital intensity offsets the higher saving rate and therefore maintains aggregate demand.

The current paper will examine ways of increasing capital intensity in this context without raising the rate of inflation. The analysis will also show why, contrary to Tobin's conclusion, a higher rate of inflation may not succeed in increasing investors' willingness to hold real capital.

An important feature of the analysis in this paper is a monetary growth model that distinguishes between money and interest-bearing government bonds. With this distinction, we can compare government deficits financed by borrowing with deficits financed by creating money. It is possible also to examine the effect of changes in the interest rate on government debt while maintaining the fact that money is not interest bearing. The two types of government liabilities also permit analyzing the distinction between the traditional liquidity preference and a demand for government bonds that we shall call safety preference. In practice, this safety preference may be much more important than the traditional liquidity preference.

The first section of the paper develops the three-asset monetary growth model that will be used in the remaining analysis. Section two then considers the effects of changes in the government deficit. The effects of increased saving on aggregate demand and capital intensity are developed in section three. There is a brief concluding section.

1. A Three Asset Model of Monetary Growth

The model developed here differs from the traditional monetary growth (e.g., Tobin, 1965, and Levhani and Patinkin 1968) in two important ways. First, instead of the usual assumption that all taxes are lump sum levies, the current analysis recognizes taxes on capital income that lower the net rate of return.[1] Second, the government deficit is financed not only be increasing the money supply but also by issueing interest bearing government debt.[2] Throughout the analysis we maintain the simplifying assumption that the savings rate out of real disposable income is fixed; the tax on capital income affects the allocation of saving but not the saving rate itself. Because the analysis in the sections that follow will focus on comparative steady-state dynamics, only these steady state properties will be discussed here.[3]

The economy is characterized by an exogenously growing population

$$N = N_o e^{nt} \quad . \tag{1.1}$$

The labor force is a constant fraction of the population and technical progress is subsumed into population growth. Production can be described by an aggregate production function with constant returns to scale. The relation between per capita output (y) and the per capita capital stock (k) is

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[1] Feldstein (1975) and Feldstein, Green and Sheshinski (1978) show the importance of recognizing capital income taxes in analyzing the effects of inflation in a monetary growth model. Corporate and personal taxes were distinguished there but will not be in the current paper.

[2] Green and Sheshinski (1977) examine an economy with both bonds and money but assume that such bonds are perfect substitutes for private capital in investors' portfolios. Their analysis generally focuses on quite different issues.

[3] Section 3 will however consider the possibility of disequilibrium behavior associated with excess saving.

(1.2) $y = f(k)$

with $f'>0$ and $f''<0$. For simplicity, output is measured net of depreciation and depreciation is not explicitly included in the analysis.

1.1 The Government Budget Constraint

Government spending (G), which includes payment of interest on the government debt, must be financed by either tax receipts, money creation, or borrowing. Total real tax receipts (T) are the sum of a lump sum tax (T_0) and the revenue that results from taxing the income from real capital at rate τ. The money created by the government (M) is the only money in the economy and does not bear interest. The time rate of change of the stock of nominal money is DM; the real value of the extra money created in this way is DM/p. Government bonds bear interest at rate i; the nominal market value of these bonds is B and the real value of new borrowing is DB/p.[1]

The government's budget constraint may be written

$$(1.3) \qquad G = T + \frac{DM}{p} + \frac{DB}{p} \quad .$$

Alternatively, it will be convenient to denote the real government deficit by Δ and write

$$(1.4) \qquad \Delta = \frac{DM}{p} + \frac{DB}{p} \quad .$$

In steady state, the ratio of real money per unit of real capital (M/pK)

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[1] These bonds may be thought of as treasury bills although their maturity is irrelevant for steady state analysis as long as that maturity is finite. We ignore changes in the market value that would temporarily result from changes in the interest rate if the maturity were not very short.

must remain constant. This implies that the rate of growth of M is equal to the rate of growth of pK, or with $Dp/p=\pi$,[1]

(1.5) $$\frac{DM}{M} = \pi + n \quad .$$

Similarly, the steady state rate of growth of nominal government bonds equals the inflation rate plus the real growth rate of the economy:

(1.6) $$\frac{DB}{B} = \pi + n \quad .$$

Substituting these expressions into 1.4 and dividing by the population gives the steady state per capita deficit:

(1.7) $$\frac{\Delta}{N} = (\pi+n)\frac{M}{pN} + (\pi+n)\frac{B}{pN} \quad .$$

With lower case letters representing real per capita values, 1.7 can be rewritten

(1.8) $$\delta = (\pi+n)\ (m+b) \quad ;$$

the real per capita deficit equals the product of the economy's nominal growth rate and the real per capita government liabilities.

1.2 Portfolio Behavior

The real value of household assets is the sum of the real values of government liabilities and the capital stock:[2]

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[1]This uses the fact that in steady state $k=K/N$ is constant, implying $DK/K=n$.

[2]The private bonds and equities that represent the ownership claims to the capital stock are not explicitly recognized. The tax rate τ can be regarded as the effective tax rate corresponding to the steady state mix of debt and equity finance. See Feldstein, Green and Sheshinski (1978b).

$$(1.9) \qquad a = b + m + k \quad .$$

We shall simplify the description of the households' portfolio behavior by assuming that the equilibrium ratio of real bonds to capital depends on the difference between the net real yield on capital (r) and the real yield on government bonds $(i-\pi)$:[1]

$$(1.10) \qquad \frac{b}{k} = \beta\ [r+\pi-i] \quad , \ \beta'<0 \quad .$$

Because the depreciation method used in the United States and in most other countries is based on the original costs of plant and equipment, the tax liability per unit of capital increases with the rate of inflation.[2] We shall therefore write the net rate of return as

$$(1.11) \qquad r = f' - \tau\ (f' + \lambda\pi)$$

where the parameter λ indicates the extent to which a higher inflation rate increases the tax liability. Substituting into 1.10 yields the equilibrium bond portfolio condition:

$$(1.12) \qquad \frac{b}{k} = \beta\ [(1-\tau)f' + (1-\tau\lambda)\pi - i] \quad , \ \beta'<0 \quad .$$

With safe short-term interest bearing government debt available, individuals should hold money only for transaction purposes. As Baumol (1952) and others have shown, this demand for money varies positively with the level of

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[1]Recall that we are ignoring the personal tax on investment income; alternatively τ may be assumed to include both the personal and corporate taxes while i is net of personal tax.

[2]See Feldstein, Green and Sheshinski (1978), especially the appendix by Alan Auerbach, and Feldstein and Summers (1977).

income and inversely with the rate of interest:[1]

$$\frac{m}{y} = L(i), \; L'<0 \quad . \tag{1.13}$$

An important feature of an economy with money or other government liabilities is the possibility that individuals will be unwilling to hold capital unless its yield is above some minimum level. In the traditional two-asset Keynesian model, this is represented as a liquidity trap, i.e., as an infinitely elastic demand for money at some low rate of interest. A more realistic description is possible with the current three-asset model. When the real net yield on capital becomes very low relative to the real yield on government bonds, investors will want to hold government bonds instead of capital; in the notation of equation 1.12, the absolute value of β' becomes infinite when the real differential becomes very small.[2] The reason that investors prefer government bonds in this situation is that the pretax profitability of private capital is uncertain. The bond demand behavior will therefore be referred to as a "safety preference" relation to distinguish it from the liquidity preference relation that governs the demand for money.[3]

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[1]This simplifies by assuming that individuals regard the interest bearing government debt rather than real capital as an alternative to transaction balances. Transaction balances are also assumed to depend on income rather than wealth when in reality both are important.

[2]This unwillingness to own real capital may also increase the demand for money but that effect is likely to be small relative to the increased demand for bonds.

[3]The private securities are generally as marketable as government bonds and, to the extent that they have the same maturity structure, their price will be as sensitive to interest rate fluctuations. Their liquidity is therefore similar even though the safety and predictability of the yields differ substantially.

1.3 The Supply and Demand for Savings

The supply of savings (S) is proportional to the households' real disposable income (H):

(1.14) $$S = \sigma \cdot H \ .$$

The saving propensity will be assumed to be constant. Disposable income is equal to national income (Y) minus both the government's tax receipts (T) and the fall in the real value of the population's money and government bonds ($\pi M/p$ and $\pi B/p$).[1]
Saving is therefore

(1.15) $$S = \sigma(Y - T - \frac{\pi M}{p} - \frac{\pi B}{p})$$

or, using equation 1.3,

(1.16) $$S = \sigma\ (Y - G + \frac{DM}{p} + \frac{DB}{p} - \frac{\pi M}{p} - \frac{\pi B}{p}).$$

Since $DM/p - \pi M/p = nM/p$ (with a similar equivalence for bonds),

(1.17) $$S = \sigma\ (Y - G + \frac{nM}{p} + \frac{nB}{p}).$$

In steady state, government spending must bear a stable relation to national income. The analysis that follows assumes that a fraction γ of national income is devoted to government spending inclusive of interest on the government debt. This implies that any increase in interest on the government debt causes a corresponding reduction in other government spending.

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[1]This assumes that households as a whole regard government bonds as net worth, implicitly ignoring the corresponding tax liabilities that they and future generations must bear in order to pay the interest and principal on these bonds.

All saving must be absorbed in either real capital accumulation or additional real money and bonds:

$$(1.18) \qquad S = DK + D(M/p) + D(B/p) \quad .$$

The constant ratio of capital to labor in steady state growth implies DK=nK. Similarly, the constancy of m=M/pN and b=B/pN implies that D(M/p)=nM/p and D(B/p)=nB/p. Thus

$$(1.19) \qquad S = nK + \frac{nM}{p} + \frac{nB}{p} \quad .$$

Combining equations 1.17 and 1.19, writing γY for G, and dividing by N yields the per capita growth equilibrium condition:

$$(1.20) \qquad \sigma\,[y(1-\gamma) + nm + nb] = nk + nm + nb \quad .$$

2. Deficits, Inflation and Capital Intensity

The model developed in section 1 can now be used to analyze how changes in the government deficit affect the rate of inflation and the capital intensity of the economy. Can the government increase the real steady-state deficit in this fully employed economy without causing either inflation, reduced capital intensity, or both? What policies can be pursued to mitigate the adverse effects of the deficit? What happens when the policy options of the government are restricted?

To answer these questions, it is useful to collect the four equations that describe the steady state behavior of the economy:

$$\delta = (\pi+n)\ (m+b) \tag{2.1}$$

$$m = L(i) \cdot f(k) \tag{2.2}$$

$$b = \beta\ [(1-\tau)f'(k) + (1-\tau\lambda)\pi - i] \cdot k \tag{2.3}$$

$$\sigma\ [(1-\gamma)f(k) + nm + nb] = n\ [k + m + b] \tag{2.4}$$

Where f(k) has been substituted for y in 2.2 and 2.4. The policy instruments controlled by the government are the size of the deficit (δ), the share of government spending in national income (γ), the interest rate on government bonds[1] (i) and the tax rates on capital income (τ and λ). For given values of these policy instruments and the exogenous growth rate (n), the four equations determine the values of k, π, m and b.

It is clear from these four equations that the government can increase its deficit without inducing any changes in inflation or capital intensity if

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[1] Recall that this would not in general equal the rate of return on private capital.

it can vary all of the other policy instruments (γ, i, τ and λ). In practice, however, the government does not alter the share of government spending in national income (γ) in order to neutralize the effect of a deficit.[1] It is tempting to conclude that, even if γ is held constant, the government can still increase the deficit without changing π or k because it still has three unconstrained instruments. It is easily shown, however, that this is not true; an increased deficit must then be accompanied by a change in either inflation, capital intensity, or both. To see this note that (with γ constant) equation 2.4 implies that if $dk=0$ it is also true that $d(m+b)=0$. Equation 2.1 shows that $d(m+b)=0$ and $d\pi=0$ together imply $d\delta=0$. The deficit must be unchanged if both inflation and capital intensity are unchanged.

The government can however affect the combination of changes in inflation and capital intensity that occurs by its debt management policy and its tax policy. Because changes in tax policy (in τ and λ) are not a typical government response, most of this section will assume that τ and λ as well as γ are unchanged. Our analysis focuses on debt management policy, i.e., on the way that the government adjusts the relative supply of money and bonds or, equivalently, the rate of interest on government debt.

2.1 A Deficit Causing Both Increased Inflation and Reduced Capital Intensity

With the type of debt policy currently pursued in the United States, an increase in the steady state deficit is likely to cause both a higher rate of inflation and a reduced capital intensity of production. More specifically, most empirical research indicates that the government issues a mix of money and

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[1]This would in particular require reducing the share of government spending in national income. To see this, note that equation 2.1 implies $d\delta = (\pi+n)\, d\,(m+b)$ if $d\pi=0$. Equation 2.4 implies $-k\sigma f d\gamma = (1-\pi)\, n\, d\,(m+b)$ since $dk=0$. Combining these two shows $d\gamma/d\delta<0$.

debt in such a way that the real interest rate on government debt remains approximately unchanged.[1] The effect of an increased deficit can therefore be analyzed by totally differentiating equations 2.1 through 2.4 subject to the condition $di=d\pi$.

The key to the adverse effect of inflation on capital intensity is seen in the total differential of 2.3 subject to $di=d\pi$:

$$(2.5) \qquad db = (\beta + k\beta'(1-\tau)f'')dk - k\beta'\tau\lambda d\pi \quad .$$

The partial effect of an increase in inflation is to increase the demand for bonds rather than capital because the real yield on bonds is maintained while the real yield on capital falls by $\tau\lambda d\pi$. If this positive effect of inflation on the demand for bonds is large enough to outweigh the negative effect of inflation on the demand from money that is implied by equation 2.2 with $di=d\pi$:

$$(2.6) \qquad dm = Lf'dk + fL'd\pi \quad ,$$

the effect of an increased deficit can be shown unambiguously to reduce k. To see this, note first that 2.4 implies

$$(2.7) \qquad d(m+b) = \frac{(1-\gamma)f'-n}{(1-\sigma)n}\,dk \quad .$$

Adding 2.5 and 2.6 and then using 2.7 to eliminate $d(m+b)$ yields:

$$(2.8) \qquad \frac{(1-\gamma)f'-n}{(1-\sigma)n}\,dk = (Lf'+\beta+k\beta'(1-\tau)f'')dk + (fL'-k\beta'\tau\lambda)d\pi \quad .$$

Similarly, differentiating equation 2.1 and using 2.7 yields

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[1]Evidence that the nominal interest rate rises by approximately the rate of inflation was presented by Irving Fisher (1954) and has been verified by Yohe and Karnovsky (1969), Feldstein and Eckstein (1970), Feldstein and Summers (1977), and others. The assumption in Tobin (1965) that $di=0$ is clearly inconsistent with experience when i is interpreted as the yield on government debt rather than the yield on money.

$$(2.9) \qquad \lambda\delta = \frac{\sigma(1-\gamma)f'-n}{(1-\sigma)n}\, dk + (m+k)d\pi \quad .$$

Using 2.8 to eliminate $d\pi$ from 2.9 yields:

$$(2.10) \qquad \left.\frac{dk}{d\delta}\right|_{di=d\pi} = \frac{(1-\sigma)\ n\ (fL'-k\beta'\tau\lambda)}{(\pi+n)(\sigma(1-\gamma)f'-n)(fL'-k\beta'\tau\lambda) + (m+b)(\sigma(1-\gamma)f'-n-n(1-\sigma)(Lf'+\beta+k\beta'(1-\tau)f''))}$$

With the increased demand for bonds induced by higher inflation greater than the reduced demand for money, $fL'-k\beta'\tau\lambda > 0$ and the numerator is positive. Since stability required $\sigma(1-\gamma)f'-n < 0$, the denominator is negative. Under these quite plausible conditions, a higher deficit reduces capital formation. Since 2.8 implies that dk and $d\pi$ are of opposite signs, the higher deficit also increases inflation.

2.2 A Deficit without Inflation

The bleak outcome of increased inflation and reduced capital intensity is not a necessary implication of a greater deficit. By totally differentiating equation 2.1 through 2.4 with the constraint that $d\pi=0$, it is possible to find the change in the interest rate and corresponding debt policy that permits a noninflationary deficit:

$$(2.11) \qquad d\delta = (\pi+n)\ d(m+b) \quad ,$$

$$(2.12) \qquad d(m+b) = (fL'-k\beta')di + (Lf'+\beta+k\beta'(1-\tau)f'')dk$$

and

$$(2.13) \qquad (\sigma(1-\gamma)f'-n)dk = (1-\sigma)nd(m+b) \quad .$$

The separate behavior of m and b is irrelevant for determining the change in i that is required to keep the inflation rate unchanged. Equation 2.13 can be substituted into 2.12 to eliminate dk and 2.11 can then be used to eliminate d(m+b). The resulting equation shows that

$$(2.14) \qquad \left.\frac{di}{d\delta}\right|_{d\pi=0} = \frac{\sigma(1-\gamma)f'-n-(Lf'+\beta+k\beta'(1-\tau)f'')(1-\sigma)n}{(\pi+n)(\sigma(1-\gamma)f'-n)(fL'-k\beta')}$$

The numerator is unambiguously negative since (1) $\sigma(1-\gamma)f'-n<0$ for stability and (2) $f'>0$, $\beta'<0$ and $f''<0$ make $-(Lf'+\beta+k\beta'(1-\tau)f'')(1-\sigma)n<0$. The first term of the denominator is positive while, as already noted, the second term is negative. The final term in the denominator is the difference between the effect on the demand for money of an increase in the interest rate on government debt and its effect on the demand for the bonds themselves. Since a higher value of i can be expected to increase the demand for bonds by more than it reduces the demand for money, this term will be taken to be positive. The denominator as a whole is therefore negative. Thus, $di/d\delta > 0$.

In short, the interest rate must increase when the deficit increases if the inflation rate is to remain constant. It is easy to understand why this interest rate increase is necessary. Equation 2.11 indicates that a stable inflation rate requires that m+b must increase with the deficit. This is so because a higher value of m+b permits the larger annual increase in the money supply and/or government borrowing that must accompany an increased deficit to be absorbed without a higher proportional rate of growth of either money or bonds. To state this same point in a slightly different way, the faster growth of government liabilities can be absorbed without increasing the <u>proportional</u> growth rate of either money or bonds if the <u>level</u> of money and bonds that is demanded (i.e., the denominators of the proportional growth rates) is increased. The higher interest rate makes this possible by increasing the demand for bonds by more than it decreases the demand for money.

Note that in practice the required change would come about by financing the increased deficit with a higher ratio of bonds to money than had prevailed in the initial equilibrium. Achieving this reduction in liquidity would require paying a higher rate of interest on those bonds.

It is clear that this policy of a higher interest rate and an increased supply of real government debt must reduce the capital intensity of production. This can be seen directly by combining equations 2.11 and 2.13:

$$(2.15) \qquad \left.\frac{dk}{d\delta}\right|_{d\pi=0} = \frac{(1-\sigma)n}{(\pi+n)(\sigma(1-\gamma)f'-n)} < 0$$

The cost of avoiding the higher inflation rate that would otherwise accompany an increased deficit is a lower level of capital intensity and a smaller real income.

2.3 A Deficit without Reduced Capital Intensity

The crowding out of real capital accumulation by the government deficit can be avoided by allowing inflation to occur. It is worth examining how much inflation and what change in the interest rate are needed to keep capital intensity unchanged.

Differentiating 2.4 with dk=0 shows immediately that m+b must also remain unchanged. Equation 2.1 then implies that $d\delta = (m+b)d\pi$, i.e., that an increase in the deficit must increase inflation. With $d(m+b)=0$, equations 2.2 and 2.3 together imply

$$(2.16) \qquad 0 = (fL'-k\beta')di + (1-\tau\lambda)k\beta'd\pi \quad .$$

Substituting $(m+b)^{-1}d\delta$ for $d\pi$ yields the change in i required to keep k fixed:

$$(2.17) \qquad \left.\frac{di}{d\delta}\right|_{dk=0} = \frac{-(1-\tau\lambda)k\beta'}{(m+b)(fL'-k\beta')}$$

As explained above, the denominator is positive in the likely case that a rise in the interest rate increases the demand for bonds by more than it decreases the demand for money. The value of λ would be zero if the tax law did not cause inflation to reduce the real net return on capital. In that case, the numerator is positive and $di/d\delta>0$. More generally, even when historic cost depreciation rules do raise the effective tax rate on real profits ($\lambda>0$), the numerator will still be positive as long as inflation raises the nominal after tax return on capital.[1]

The mechanism by which a higher interest rate permits a constant value of k is clear from the derivation. A constant value of k implies a constant value of m+b and therefore an increased value of π. With a constant value of k, a higher rate of inflation would actually decrease b (and therefore m+b) unless i is raised to prevent this.

Comparing equation 2.17 and 2.14 shows that the increase in i that keeps k unchanged is less than the increase in i that keeps π unchanged:

$$(2.18) \qquad \left.\frac{di}{d\delta}\right|_{d\pi=0} - \left.\frac{di}{d\delta}\right|_{dk=0} = \frac{\sigma(1-\gamma)f'-n-(Lf'+\beta+k\beta'(1-\tau)f'')(1-\tau)n(m+b)-}{(m+n)(fL'-k\beta')(\pi+n)(\sigma(1-\gamma)f'-n)}$$

$$\frac{(\pi+n)(\sigma(1-\gamma)f'-n)(1-\tau\lambda)k\beta'}{} > 0 \; .$$

The reason for this is clear. Holding k and therefore m+b constant implies $d\pi>0$. Making $d\pi=0$ requires an increase in m+b and therefore a higher rate of interest.

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[1] The nominal after tax return on capital is $(1-\tau)f'+(1-\tau\lambda)\pi$.

2.4 A Deficit Financed by Interest-bearing Debt

A particularly interesting debt policy requires that any increase in the deficit be financed only by additional borrowing. The real growth of the money supply remains constant. This section looks briefly at the effect of such a policy. This specification of debt policy implies that the real rate of new money creation remains unchanged: DM/pN is constant. Since DM/pN= m(DM/M)=m(π+n), this debt policy implies m(π+n)=c, a constant. The implication of this for capital intensity and inflation depends on the interest elasticity of the demand for money. On the simplifying assumption that the money demand is completely inelastic (L'=0) it is easily shown that the deficit unambiguously decreases capital intensity and increases inflation.

With m(π+n)=c,

$$(2.19) \qquad d\delta = (\pi+n)db + bd\pi$$

and

$$(2.20) \qquad dm = \frac{-m}{\pi+n}\, d\pi \quad .$$

Combining m=Lf and m(π+n)=c yields

$$(2.21) \qquad (\pi+n)f'dk = -fd\pi \quad .$$

Thus inflation and capital intensity move in opposite directions. The growth equilibrium condition of equation 2.4 implies

$$(2.22) \qquad \frac{\sigma(1-\gamma)f'-n}{(1-\sigma)n}\, dk = db + dm$$

Using 2.20 and 2.21 to eliminate dm yields

$$(2.23) \qquad db = \left(\frac{\sigma(1-\gamma)f'-n}{(1-\sigma)n} - \frac{mf'}{f} \right) dk$$

Equation 2.19 can thus be rewritten using 2.21 and 2.23 as

$$d\delta = (\pi+n)\left\{\frac{(1-\gamma)f'-n}{(1-\sigma)n} - \frac{mf'}{f} - \frac{bf'}{f}\right\} dk \tag{2.24}$$

This shows that $dk/d\delta<0$ and 2.21 then implies that $d\pi/d\delta>0$. Thus even with a debt policy that keeps the growth of real money balances unchanged, the deficit increases inflation and reduces capital intensity.

3. Fiscal Incentives, Saving and Aggregate Demand

The three-asset growth model can be used to analyze the effects of an exogenous increase in the saving rate.[1] The most important issue to be examined is the possibility of excess saving. Under quite reasonable conditions, an increase in the saving rate will be absorbed into higher capital intensity without any problem for aggregate demand if there is accomodating monetary policy. The possibility of excess saving arises when investors are unwilling to hold real capital in their portfolio at a lower rate of return; we shall refer to this as a "safety trap" by analogy to the traditional Keynesian liquidity trap. The problem is exacerbated if the yield on government bonds also cannot be lowered, i.e., if the economy is also in a liquidity trap.

The problem of excess saving can manifest itself in two ways. Under some conditions, the extra saving could be absorbed in additional capital if the steady state rate of inflation is reduced. If there is no inflation in the initial equilibrium, the increased saving rate would involve a continuous price deflation. While there may be no theoretical problem with this, as a practical matter the downward rigidity of money wages could prevent this from occurring. The additional saving would not be absorbed but would result in unemployment. The problem is even worse when the "safety trap" and "liquidity trap" conditions both prevail. Under these conditions, the extra savings cannot be absorbed in increased capital even if the inflation rate could be permanently reduced.

The problem of excess saving arises only if the government restricts its accomodating action to monetary policy. This section shows how tax incentives,

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[1] Such an increase in the saving rate (σ) may reflect a change in taste or a change in institutions such as social security that are not explicitly included in the model.

or under some conditions an increased deficit, can be used to assure that an increase in the saving rate results in a greater rate of capital formation.

3.1 Increased Saving with Accomodating Monetary Policy

Before studying the problem of excess saving, it is useful to examine the nature of the well-behaved equilibrium in which additional saving can be absorbed with the help of only accomodating monetary policy. We impose the requirement that the real deficit (δ), the share of the government in national income (γ), and the tax rates on capital income (τ and λ) remain constant. The rate of inflation will also be required to remain unchanged, thus precluding the problem of unattainable pure deflation.

The key change from the analysis of section 2 is that the differential of the growth equilibrium condition (equation 2.4) now involves a change in the saving rate:

$$(3.1) \qquad [(1-\gamma)f+n(m+b)]d\sigma + [\sigma(1-\gamma)f'-n]dk - (1-\sigma)nd(m+b) = 0$$

with a constant deficit ($d\delta=0$) and constant inflation rate ($d\pi=0$), the government budget constraint

$$(3.2) \qquad d\delta = (\pi+n)d(m+b) + (m+b)d\pi$$

implies $d(m+b)=0$. Together with 3.1 this shows immediately that the higher saving rate increases capital intensity

$$(3.3) \qquad \frac{dk}{d\sigma} = -\frac{(1-\gamma)f+n(m+b)}{\sigma(1-\gamma)f'-n} > 0 \quad .$$

The required change in the interest rate can then be derived from the money demand relation (equation 2.2) and the bond demand relation (equation 2.3).

Together these imply:

(3.4) $$d(m+b) = [Lf'+\beta+k\beta'(1-\tau)f'']dk + (fL'-k\beta')di + k\beta'(1-\tau\lambda)d\pi \quad .$$

With $d(m+b)=d\pi=0$,

(3.5) $$\frac{di}{dk} = -\frac{Lf'+\beta+k\beta'(1-\tau)f''}{fL'-k\beta'} \quad .$$

If the effect of a change in the interest rate on the demand for bonds exceeds its effect on the demand for money, the denominator is positive and $(di/dk)<0$. To achieve this reduction in the equilibrium interest rate on government debt, the money supply must be increased relative to real income and the supply of bonds must be reduced relative to the capital stock. The precise changes are indicated by equations 2.2 and 2.3 and satisfy $d(m+b)=0$.

In short, if investors are willing to accept a lower return on capital accompanied by a less than equal reduction in the yield on government debt, an increase in the saving rate can raise capital intensity without any change in inflation or other government policies.[1]

3.2 Safety Preference and Excess Saving

The basic insight of the Keynesian analysis is that, in a monetary economy, additional saving will not automatically be invested. When the yield on real capital becomes too low, individuals will prefer to hold government bonds rather than to assume the greater risk associated with the ownership of real capital. More precisely, the demand for government bonds becomes infinitely elastic at some low differential between the yield on real capital

[1] If the interest rate on government debt cannot be reduced, an increase in the rate of inflation could achieve the same thing (as long as $1-\tau\lambda>0$). This is essentially Tobin's (1965) solution since he assumes $di=0$. The implication of section 3.1 and the remainder of section 3 is that Tobin's inflationary policy is unnecessary.

$((1-\tau)f'+(1-\tau\lambda)\pi)$ and the yield on government bonds (i). In the notation of the bond demand equation,

$$(3.6) \qquad b = k\beta((1-\tau)f' + (1-\tau\lambda)\pi - i) \quad ,$$

$\beta'=-\infty$ at some low value of $(1-\tau)f'+(1-\tau\lambda)\pi-i$. We can refer to this situation as being in a "safety trap".

When the economy has reached this condition, a further fall in $(1-\tau)f'+(1-\tau\lambda)\pi-i$ is not possible. This additional constraint on the adjustment of the economy can be the source of an excess saving problem. When certain further conditions exist, the increase in capital intensity could only occur if the rate of inflation could be reduced. If the initial equilibrium had no inflation (or a very low rate), the required reduction in inflation might not be achievable and the extra saving would result in an unemployment disequilibrium.[1]

To see the conditions under which this problem would arise, note that the safety trap condition implies

$$(3.7) \qquad (1-\tau)f''dk + (1-\tau\lambda)d\pi - di = 0 \quad .$$

This in turn implies that $db=\beta dk$ and therefore that

$$(3.8) \qquad d(m+b) = fL'di + (Lf'+\beta)dk \quad .$$

With no change in the government deficit, the government budget constraint entails:

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[1]The dynamics of such an employment disequilibrium will not be considered. The relative strength of the Pigou effect and Wicksell effect would influence the ultimate path. For the current purpose, it is sufficient that price deflation and unemployment would be required for at least some period of time.

(3.9) $(\pi+n)d(m+b) + (m+b)d\pi = 0.$

Using this equation to eliminate d(m+b) from 3.8 and using 3.7 to rewrite di in terms of $d\pi$ and dk yields

(3.10) $$\frac{d\pi}{dk} = -\frac{fL'(1-\tau)f''+Lf'+\beta}{\frac{m+b}{\pi+n} + fL'(1-\tau\lambda)} .$$

The numerator is unambiguously positive. If the denominator is also positive, an increase in capital intensity must be accompanied by a lower rate of inflation. There are two different plausible conditions under which the denominator will be positive. If the demand for money is interest inelastic ($L'=0$), or, more generally, if the effect of interest on money demand is small ($(\pi+n)fL'(1-\tau\lambda) < m+b$), the denominator will be positive. Alterntively, regardless of the size of L', if inflation raises the effective tax rate on capital income by enough to make the nominal after tax yield on capital vary inversely with inflation ($1-\tau\lambda<0$), both terms in the denominator will be positive. In either case, increased capital intensity could not accompany a higher saving rate unless the rate of inflation could be reduced.

It is easy to see why the safety trap condition implies that a greater capital intensity entails a lower rate of inflation. Consider the case of inelastic money demand. The safety trap implies that the demand for bonds increases in proportion to the capital stock: $db=\beta dk$. With inelastic money demand, the money supply also increases with the capital stock: $dM=Lf'dk$. But with no change in the government deficit, the steady state value of m+b can increase only if the inflation rate is lower. In the alternate case in which inflation increases the effective tax rate, the analysis is only slightly more complex. If there were no change in inflation, the interest rate would have to fall to maintain the minimum yield differential with greater capital intensity. But this would increase the demand for money, raising m+b. This is incompatible with a constant inflation rate. If the inflation rate increased, this would further reduce the yield on capital relative to government bonds.

The problem of excess saving under these conditions can be avoided if the government uses fiscal policy as well as monetary policy to accomodate the additional saving. Consider first the possibility of responding to a higher saving rate by reducing the rate of tax on capital income, τ. With a lower tax rate, the net of tax yield on the real capital stock can be maintained while the greater capital intensity depresses the pretax yield. To confirm explicitly that this fiscal incentive is sufficient to permit greater capital intensity, with no change in the rate of inflation, consider the four equations that describe the "safety trap" equilibrium with $d\tau \neq 0$. The government budget constraint with $d\pi=0$ and $d\delta=0$ implies $d(m+b)=0$. Substituting this into the growth equilibrium (equation 3.1) shows $dk/d\sigma>0$ exactly as in equation 3.3. The two remaining conditions that must be satisfied are the "safety trap" condition with $d\pi=0$:

$$(3.11) \qquad (1-\tau)f''dk - di - (f'+\lambda\pi)d\tau = 0$$

and the condition that the change in the demands for debt and money leave m+b unchanged:

$$(3.12) \qquad 0 = fL'di + (\beta+Lf')dk \quad .$$

Equation 3.12 shows that the interest rate must rise, reducing the demand for money per unit of capital. With the unique increase in di determined by 3.12 and the unique increase in k determined by 3.3, equation 3.11 shows the required decrease in the tax rate τ.

A higher saving rate can be transformed into greater capital intensity with no change in inflation even without changing the tax rate on capital income by an accomodating increase in the government deficit accompanied by a lower rate of interest. The lower rate of interest balances the fall in the return on real capital, permitting the real capital to be absorbed. The greater deficit with the unchanged rate of inflation permits an increase in both money and bonds that is required by the fall in i and increase in k.

To see all of this explicitly, note that with $d\tau = d\pi = 0$, the safety trap condition becomes

$$(3.13) \qquad (1-\tau)f''dk - di = 0 \quad .$$

The increased demand for money and bonds is

$$(3.14) \qquad d(m+b) = fL'di \qquad + (Lf'+\beta)dk$$

which, from 3.13, is

$$(3.15) \qquad d(m+b) = (fL'(1-\tau)f'' + Lf' + \beta)dk \quad .$$

Substituting this value of d(m+b) into the growth equilibrium (equation 3.1) yields

$$(3.16) \qquad \frac{dk}{d\sigma} = -\frac{(1-\gamma)f+n(m+b)}{(1-\gamma)f'-n-(fL'(1-\tau)f''+Lf'+\beta)} \quad .$$

This is unambiguously positive. The last term in the denominator, which reflects the increased deficit (i.e., d(m+b)), reduces the size of $dk/d\sigma$ but does not alter the fact that it is positive. With dk determined by 3.16, equation 3.15 implies a unique value of $d(m+b)>0$. The government budget constraint with $d\pi=0$ then gives the required change in the deficit, $d\delta = (\pi+n)d(m+b)>0$.

Although both the reduced tax on capital income and the increased deficit are capable of turning additional saving into greater capital intensity without a change in the price level (and therefore without the possibility of a deflationary unemployment disequilibrium), the reduced tax on capital income has at least three advantages over the increased government deficit. First, and probably most important, the equilibrium capital intensity is greater if the increased saving is accomodated by a lower tax rate. Second, the lower tax rate on capital income reduces the excess burden caused by a distorting tax.[1] Finally, the tax reduction can be effective under special conditions when the increased deficit would fail. More specifically, the lower interest rate that must accompany the increased deficit would not be possible if the economy is also in a liquidity trap, i.e., if investors are unwilling to hold any asset other than money at a lower rate of interest.[2] Even in this case, the tax reduction (and increased rate of interest) can be used to accomodate a higher rate of saving.

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[1]The welfare gain from reducing the tax rate on capital income depends on the way in which the lost tax revenue is recovered. Feldstein (1978) shows that even when the uncompensated elasticity of saving with respect to its return is zero, the excess burden of the tax system would be reduced by lowering the tax on capital income and raising it on labor income. In the current context there is the further complication that the increased deficit and lower interest rate would permit lower total taxes.

[2]In the notation of the model, $L'=-\infty$ at some low level of i. This implies the extra constraint $di\geq0$ which is consistent with equation 3.12 in the context of a tax rate reduction but not with equation 3.13 when $d\tau=0$ and $d\delta>0$. An increased deficit could avoid unemployment by the Keynesian remedy of absorbing all of the additional saving, i.e., with $dk=0$.

4. Some Conclusions

This paper has studied the long-run impact of fiscal policies on inflation and capital formation. The analysis uses an expanded monetary growth model in which the government finances its deficit by issueing both money and interest-bearing debt.

One major focus of the paper is the effect of a permanent increase in the government's real deficit in a fully employed economy. An important conclusion is that such an increased deficit must raise the rate of inflation or lower the capital intensity of production or both. The analysis shows that the combination of both increased inflation and reduced capital intensity is a likely outcome with current U.S. tax rules and the prevailing monetary policy of allowing the interest rate to rise with inflation in a way that keeps the real interest rate unchanged. Section 2 determines the debt management policy (and the corresponding change in the interest rate) that would be required to maintain either a constant inflation rate or a constant capital-labor ratio.

The second purpose of the paper is to analyze the effect of an exogenous increase in the saving rate and the possibility of "excessive saving". The problem of "excessive saving" arises when the yield on capital becomes so low that individuals prefer to hold government bonds rather than the more risky claims to real capital. Under some conditions, an increased rate of saving could only be absorbed in increased capital intensity if the rate of inflation could be permanently reduced. This requirement might entail a negative inflation rate which, as a practical matter, would be precluded by the downward rigidity of money wages. In this case, the additional saving would not be absorbed but would result in unemployment.

Section 3 shows first that there is no problem of excessive saving if (1) investors are willing to hold real capital even though the differential between its yield and that on government bonds is narrowed, and if (2) the government reduces the interest rate on government bonds by expanding the money supply more rapidly than the stock of bonds. When these conditions are met, an increase in saving can be absorbed in greater capital intensity without any change in either inflation or the government deficit.

A problem can arise if the economy is in a "safety trap," i.e., if investors would be unwilling to hold real capital if the difference between its yield and that on government debt were reduced. In that case, an increased saving rate can imply price deflation and therefore possible unemployment. This problem can be avoided however by reducing the tax on capital income (or, in some cases, by an increased deficit that absorbs some but not all of the higher savings rate). In short, by using fiscal incentives as well as monetary accomodation, an increased saving rate can be converted to greater capital intensity.

The analysis as a whole, although clearly a theoretical study of a simplified economy, suggests some insights that may help in understanding the unsatisfactory macroeconomic experience of the past decade and in designing more appropriate economic policies for the future. The recent years have been characterized by substantial inflation, a low rate of investment, and large government deficits. Section 2 shows how an increased government deficit can give rise to both greater inflation and reduced capital intensity. The combination of inflation and historic cost depreciation raised the effective tax rate on the income from real capital while the monetary and debt management policies have kept the real interest rate on government debt unchanged. The reduced equilibrium capital-labor ratio that this implies manifests itself as a lower rate of investment. The problem is then exacerbated when the government responds to increased investment by further enlarging its deficit. The analysis suggests that a more appropriate solution would be to reduce the deficit while stimulating investment through a lower tax rate and a depreciation method based on current rather than historic costs.

I have argued in a previous paper that the United States should increase its saving rate to take advantage of the high social rate of return on additional investment.[1] Such an increase in the private saving rate could be achieved by reducing the growth of social security benefits or by tax reforms that make the personal income tax more like a consumption tax. These proposals implicitly assumed that such extra saving would result in greater capital intensity rather than in a fall in aggregate demand. Section 3 implies that this assumption is warranted. With appropriate fiscal inventives and accomodating monetary policies, an increase in saving can be absorbed in greater capital intensity without any change in the rate of inflation.

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[1] Feldstein (1976). See also Feldstein (1977).

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