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ABSTRACT

This paper analyzes the ways in which substituting a consumption tax for the existing personal and corporate income taxes would affect equilibrium pretax interest rates. The analysis indicates that whether the pretax rate of interest rises or falls depends on the strength of the personal saving response, the nature of the capital market equilibrium between debt and equity yields, and the response of the owner-occupied housing sector. A formal two-sector model with endogenous saving, housing and corporate capital is presented. With plausible parameter values, the analysis suggests that the shift from an income tax to a consumption tax is more likely to raise rates than to lower them.

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The Effect of a Consumption Tax on the Rate of Interest

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Although there is substantial professional and public interest in the recent proposals to replace the existing personal and corporate income taxes with a consumption tax , there has been little attention to the effect of such a tax change on pretax interest rates and other pretax factor incomes. Despite the general absence of formal analyses, some economists have concluded that shifting to a consumption-type tax would, because such a tax would exempt interest income and encourage additional saving, lead to lower pretax interest rates[1]. In this paper, I show that the opposite may well be true: substituting a consumption tax for the existing personal and corporate income taxes may raise pretax interest rates. The analysis indicates that whether the pretax rate of interest rises or falls depends on the strength of the personal saving response, the nature of the capital market equilibrium relation between debt and equity yields, and the response of the owner-occupied housing sector. With plausible parametric values, the analysis suggests that the shift from an income tax to a consumption tax is more likely to raise rates then to lower them.

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[1] Hall and Rabushka (1995) say that long-term interest rates would decline by 20 percent if the existing U.S. tax system were replaced by a consumption tax of the type that they advocate. Toder (1995) also concludes that any shift to a consumption type tax would be likely to reduce real interest rates. Hall (1995) presents the only formal analytic model of the effect on the interest rate of shifting to a consumption tax. He notes that in an economy of infinitely lived individuals the net of tax interest rate would be constant. Eliminating the interest income tax would therefore reduce the pretax interest rate. Bradford (1995) notes that the effect of a consumption tax depends on the relative elasticies of the suppy of capital and the demand for capital. Neither Hall nor Bradford deals with the effect of eliminating the corporate income tax which is a critical focus of the current paper.

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Two very different types of consumption taxes are now being discussed. The consumed income tax permits a deduction for all net saving but continues to include investment income in the individual's tax base.[2] The alternative consumption-type tax has no deduction for saving but excludes investment income from the tax base.[3] Although these appear to be conceptually quite different, once a transition phase is completed they are exactly equivalent in the sense that they define the same lifetime budget constraint for each individual.[4] This paper begins in section 1 by demonstrating this equivalence and then proceeds to analyze the effect on the rate of interest of shifting from the existing income tax system to a tax that excludes investment income from the tax base. Section 2 extends the analysis to a growing economy with an endogenous saving rate. The third section examines the implications of an alternative model of the relation between debt and equity yields. Section 4 introduces the role of inflation. The fifth section then brings together these separate analyses to discuss the effects of changing the tax structure in a growing economy with inflation and endogenous capital intensity. Section 6 extends the analysis to a two-sector

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[2]A proposal of this type has been made by Senators Pete Domenici and Sam Nunn; see "USA Tax System" (Tax Notes, 1995). An earlier and somewhat different form of a consumed income tax is discussed in U.S. Treasury (1977) and in Bradford (1986). The idea of such a consumed income tax among economists goes back at least to Kaldor (1955). A pure value added tax or national sales tax would also have the effect of excluding net saving.

[3] Congressman Richard Armey has recently proposed such a tax based on the collection mechanism described in Hall and Rabushka (1995). The Armey tax collects a fixed fraction of wages and salaries above a deductible amount from individuals through withholding or subsequent direct payments. The same fraction of all nonwage compensation paid by firms (i.e., fringe benefits, deferred compensation, etc.) is collected directly from the firms.

[4]Transition rules in the consumed income tax that avoid taxing the dissaving of amounts accumulated under the existing income tax system could make the two systems similar from the start. The long-run equivalence assumes that both systems have equivalent untaxed excluded amounts and that the tax rate in each system remains unchanged during the individual's life.

model of the economy that includes an owner-occupied housing sector as well as a corporate business sector. There is a brief concluding section that comments on the generalization of this analysis to recognize international capital flows and different types of domestic borrowers and lenders.

1. The Effect of a Consumption Tax with a Fixed Capital Stock

This section first establishes the equivalence of the two types of consumption taxes (a consumed income tax that excludes net saving and a labor income tax that excludes net investment income) and then proceeds to show the effect on the level of interest rates of switching from the current system of income taxes to a tax on labor income in an economy with a fixed capital stock.[5]

I start with a consumed income tax under which the individual deducts net saving in calculating the tax base. Consider how such a tax works in a simple life cycle model in which the individual works a fixed amount in the first period and retires in the second period. The individual earns wage income W in the first period and chooses to save S. The tax paid at that time is t(W-S) and first period consumption is therefore $C_1 = (1-t)(W-S)$. The savings earn a rate of return of R and therefore grow to $(1+R)S$. In the second period the individual pays tax on the dissaved original principle (S) as well as on the investment income (RS). Second period consumption is therefore $C_2 = (1-t)(1+R)S$. Since $C_1 = (1-t)(W-S)$ implies that $(1-t)S = (1-t)W - C_1$, the lifetime budget constraint with a consumed income tax is

$$C_2 = (1+R)[(1-t)W - C_1]. \quad (1)$$

[5]The two types of taxes may or may not be equivalent during the transition period. On the issue of transition rules and effects more generally, see Bradford (1995).

Consider now a tax system in which there is no special treatment of savings per se but in which the interest and dividends earned on savings are untaxed. The first period tax is therefore tW and the savings are $(1-t)W-C_1$. Since there is no tax on the return to that saving, the second period consumption is again given by

$$C_2 = (1+R)[(1-t)W-C_1]. \tag{2}$$

This establishes that each individual's lifetime budget constraint is the same under both taxes. The individual will therefore choose the same path of consumption. Since the pretax income and consumption are the same, the value of the taxes is also the same. The intuition for the equivalence is clear: the savings deduction in the consumed income tax is really only a postponement of tax since the dissaving must be included in retirement income and the advantage of the postponement is offset (relative to the interest exclusion rule) by taxing the interest on the saving.

A common feature of all the current consumption tax proposals is to eliminate the tax on corporate profits. Corporations would continue to pay tax, but the tax collected from the corporations would become either a tax on the firm's noncash labor compensation or a consumption type value added tax.[6] Since a consumption type VAT is equivalent to a sales tax on consumption[7], the initial first period saving under such a VAT is given by $S = W-(1+v)C_1$ where v is the rate of

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[6]As noted in footnote 3, the Hall-Rabushka tax paid by companies is a tax on noncash labor compensation.

[7]This simplifies by assuming that all consumption is included in the VAT base. In practice, most countries with value added taxes exclude certain types of consumption (e.g., medical care, education, some types of food, housing) or tax them at lower rates. See Feldstein and Krugman (1990) for a discussion of the implication of this in an open economy.

value added tax. The funds available for spending on second period consumption are therefore (1+R)S. But since that consumption is also subject to a value added tax at rate v, actual second period consumption (C_2) satisfies $(1+v)C_2 = (1+R)S$ or $(1+v)C_2 = (1+R)[W - (1+v)C_1]$. Dividing both sides by (1+v) implies

$$C_2 = (1+R)[(1+v)^{-1}W - C_1]. \tag{3}$$

With v selected so that $(1+v)^{-1} = (1-t)$, this defines the same lifetime budget constraint as equations (1) and (2). More generally, adding a value added tax to the direct personal consumption tax does not alter the form of the lifetime budget constraint.

Having established the equivalence of the various types of consumption taxes, we can now consider how shifting from the existing personal and corporate income taxes would alter the equilibrium rate of interest and the net return to savers. This section simplifies by assuming a fixed capital stock employed in the corporate sector and a zero rate of inflation[8]. The fixed capital stock in this one sector economy implies that the corporate borrowers earn a fixed pretax marginal product of capital f'.[9] A fraction b of capital is debt on which the firm pays an interest rate of i. The equity investors receive a return of e per dollar of equity capital. If the corporate tax rate is τ, the firm's budget constraint is given by:

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[8] The analysis also simplifies by ignoring the special tax rules that now apply to pensions and individual retirement accounts. For many taxpayers and for a much larger share of net investment income, this can be justified by the fact that these are intramarginal transactions. I return in section 6 to discuss the special tax rules that apply to the interest paid on owner-occupied house mortgages.

[9] This analysis assumes that all borrowing is done by corporate businesses and all lending and portfolio equity investment is done by households.

(4) $$(1-\tau)f' = (1-\tau)bi + (1-b)e.$$

This reflects the fact that the interest payments are deductible in calculating taxable profits while the return to equity investors is not.[10]

If the representative individual has marginal tax rate θ, that individual's net return is:[11]

(5) $$r_N = (1-\theta)[bi + (1-b)e].$$

The relation between the interest rate and the equity return depends on the preferences of portfolio investors who hold debt and equity and on the preferences of firms that issue debt and equity capital. Rather than develop an explicit model of these preferences and the resulting market equilibrium, I consider two limiting cases. In the first case, the relation between debt and equity yields depends solely on the preferences of households. In effect, the relative demand for debt and equity are infinitely elastic at a fixed equity premium, ϕ, between the households' net-of-tax return on equity and the corresponding net-of-tax rate of interest:

(6a) $$(1-\theta)e = (1-\theta)i + \phi$$

The alternative extreme assumption is that the gap between the equity yield and the rate of interest is determined solely by the preferences of firms. In this case, the relative supplies of debt and equity

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[10]Assuming that the marginal product of capital is taxed at the same statutory rate that applies to interest deductions implicitly assumes that economic deprecation is allowed for tax purposes. This assumption is relaxed as part of the more general analysis of section 4.

[11]This ignores the special tax treatment of capital gains. This is considered in section 4.

are infinitely elastic at a fixed equity premium, ψ , between the firms' net-of-tax cost of equity and debt capital:

(6b) $$e = (1-\tau)i + \psi.$$

Note that equations 6a and 6b differ not only in the tax that is relevant but also in the fact that both equity and debt are taxed to portfolio investors while the corporate tax deduction applies only to the interest payments.

This section examines the implications of assuming that household preferences determine the equity premium (equation 6a) while section 3 returns to examine the implications of assuming that the relative equity and debt yields depends on corporate preferences (equation 6b).

Combining (4) and (6a) and differentiating with respect to τ, θ and i yields:

(7) $$-f'd\tau = [(1-\tau)b + (1-b)]\, di - b\, i\, d\tau + (1-b)\, \phi\, (1-\theta)^{-2}\, d\theta.$$

Therefore

(8) $$\frac{di}{d\tau} = -\frac{f' - bi}{1 - \tau b}$$

and

(9) $$\frac{di}{d\theta} = -\frac{(1-b)\, \phi\, (1-\theta)^{-2}}{1 - \tau b}$$

Since $f' - b\, i > 0$ and $1 - \tau\, b > 0$, it follows that $(di/d\tau) < 0$ so that a reduction of the corporate tax

rate causes the pretax interest rate to rise. Similarly $b < 1$ and $\theta < 1$ imply $di/d\theta < 0$ so that a reduction of the personal tax on investment income also raises the pretax interest rate. Since the shift to a consumption tax would eliminate the corporate tax ($d\tau = -\tau$) and the personal tax on investment income ($d\theta = -\theta$), it would raise the rate of interest by $di = [(f' - bi)\tau + (1-b)\phi(1-\theta)^{-2}\theta] / (1 - \tau b)$.

To understand why this shift to a consumption tax raises the rate of interest, note first that reducing or eliminating the corporate tax reduces the tax on corporate profits ($f' - bi$) directly. Since interest payments are fully deductible, there is no direct effect of a change in τ on i.[12] But if the reduced tax on corporate profits were allowed to increase the return on equity while the return on debt remained unchanged the equity premium would widen inappropriately. The actual outcome is therefore an increase in both e and i in a way that maintains the original equity premium. In addition, the elimination of the personal tax on investment income widens the net equity premium, requiring a further rise in the rate of interest to maintain the same net equity premium.

The magnitude of the rise in the interest rate in this simplified model is quite large. Consider the following realistic parameter values: a corporate tax rate of $\tau = 0.35$, a personal tax rate on investment income of $\theta = 0.30$, a marginal product of capital of $f' = 0.10$, a debt to capital ratio of $b = 0.4$ and an initial interest rate of $i = 0.04$. With these assumptions, equations 4 and 6a imply that shifting to a consumption tax ($\tau = \theta = 0$) nearly doubles the interest rate, increasing it from 0.04 to 0.079[13].

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[12]Note that with 100 percent debt finance at the margin (i.e., with $b = 1$) equation 4 becomes $(1 - \tau) f' = (1 - \tau) i$ and a change in τ has no effect on i.

[13]With those parameter values, equations 4 and 6a imply that the equity premium is $\phi = 0.0357$.

Combining this result with equation 5 and 6a implies that the net return to the individual rises from $r_N = 0.049$ to $r_N = 0.10$. Less than half of this rise is due to the direct effect of eliminating the personal tax on investment income. With $\tau = 0.35$ and $\theta = 0$, equations 4 and 6a imply that $i = 0.051$ and, with b and ϕ constant, it follows that $r_N = 0.072$.

Before considering alternative assumptions, including the portfolio equilibrium condition of equation 6b and the possibility of a positive initial rate of inflation, I extend the analysis to consider how the likely response of savings to the increased net interest rate would change the equilibrium capital stock and therefore the pretax rate of interest.

2. Endogenous Saving and the Equilibrium Interest Rate

Although the assumption of a fixed capital stock and therefore of a constant marginal product of capital may be a reasonable approximation in the short run, the very long-run equilibrium will reflect the effect of the consumption tax on the rate of saving and therefore on the equilibrium capital stock and the associated marginal product of capital.[14] This section shows that the shift from an income tax to a consumption tax would raise the long-run equilibrium pretax rate of interest under the assumptions of section 1 even if savings respond positively to the higher net interest rate unless the saving response is much greater than suggested by previous research.

Equation 10 is the standard neoclassical growth equilibrium condition with a gross saving rate of σ, equilibrium real income and capital per unit of labor of y and k, and a combined labor force growth and capital depreciation rate of g:

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[14] Even in the short run before the capital stock has changed the anticipation of these long-run changes in capital intensity would affect long-term interest rates and asset prices.

(10) $$\sigma y = gk.$$

To simplify the calculations, I assume a Cobb-Douglas technology so that $y = ak^{\alpha}$ and therefore

(11) $$f' = \alpha \; ak^{\alpha-1}.$$

Combining (10) and (11) implies $f' = \alpha g/\sigma$. Substituting this into the firm's equilibrium condition of equation 4 implies a long-run equilibrium condition:

(12) $$(1 - \tau)\, \alpha g/\sigma = (1 - \tau) b\, i + (1 - b)[i + \phi/(1 - \theta)].$$

Totally differentiating equation 12 with respect to τ, i and σ yields:

(13) $$-f'd\tau - (1-\tau)f'd\sigma/\sigma = -bid\tau + (1-\tau)bdi + (1-b)di + (1-b)\phi(1-\theta)^{-2}d\theta.$$

Setting $d\tau = -\tau$ (to reflect the elimination of the traditional corporate income tax) and $d\theta = -\theta$ (to reflect the elimination of the personal tax on investment income) yields

(14) $$di = \frac{(f'-bi)\tau}{1-\tau b} + \frac{(1-b)\phi(1-\theta)^{-2}\theta}{1-\tau b} - \frac{(1-\tau)f'}{1-\tau b}\frac{d\sigma}{\sigma}.$$

Equation 14 implies that the pretax rate of interest would be reduced by the shift to a consumption tax only if

(15) $$\frac{d\sigma}{\sigma} > \frac{(f' - b\,i)\tau + (1-b)\phi(1-\theta)^{-2}\theta}{(i-\tau)\,f'}.$$

With the parameter values presented at the end of section 1, this implies that the pretax rate of interest declines only if $d\sigma/\sigma > .65$.[15] This would raise the gross saving rate from 20 percent to 33 percent. To put this increase in perspective, note that the gross saving rate in the United States averaged 19 percent of GDP from 1970 to 1992 while the gross saving rate in Japan during those years averaged 32 percent. Moreover, most of gross saving represents capital consumption and the net U.S. saving rate is now less than 5 percent of GDP. A rise of 13 percentage points in the gross saving rate would imply that the net saving rate rises from less than 5 percent of GDP to more than 15 percent.

Although a large enough increase in the return to saving might conceivably induce such an increase, the condition that the pretax rate of interest does not increase implies that the overall rise in the reward to saving is relatively small. Equation 5 and 6a imply that $r_N = (1-\theta)\,i + (1-b)\,\phi$. With $di = 0$, $dr_N = -\,i\,d\theta$. Switching to a consumption tax implies $d\theta = -\,\theta$. With $i = 0.04$ and $\theta = 0.3$, $dr_N = 0.012$. For comparison, the initial value of r_N is 0.049. A 65 percent rise in the saving rate in response to a 1.2 percentage point increase in the rate of return is much greater than implied by previous research on the sensitivity of saving to the net rate of return.[16] With $d\sigma/\sigma < .65$ when

[15]The linear approximation of equation 15 is very good for this purpose. An exact calculation using equations 10 through 12 (instead of the linear approximation of equation 14) implies that the pretax interest rate declines if $d\sigma/\sigma > 0.63$.

[16]See among others Boskin (1978), Hall (1987) and the discussion in Feldstein (1995).

di = 0, the shift to a consumption tax would raise the rate of interest.

Even if the gross saving rate increases by a very substantial 30 percent (from 0.20 to 0.26), equations 10 through 12 imply that the rate of interest would rise from an initial i = 0.040 to i = 0.055.

3. An Alterative Capital Market Equilibrium

The analysis of section 1 and 2 assumed that the relation between the equity yield and the rate of interest is determined by the preferences of households alone. Equation 6a showed a constant equity premium based on the after-tax returns to individual investors. In order to bracket the outcome that would reflect the interaction of the preferences of investors and of firms, the current section examines the implications of the extreme alternative assumption that the relation between the equity yield and the rate of interest is determined by the preferences of the firms alone. Equation 6b showed a constant equity premium based on the after-tax cost of funds to the firms that raise debt and equity capital.[17]

Combining equations (4) and (6b) yields:

(16) $$i = f' - (1 - b)\,\psi/(1 - \tau)$$

This implies that reducing the corporate tax rate would raise the rate of interest and, in particular, that eliminating the corporate tax in the process of switching to a consumption tax ($d\tau = -\tau$) would cause the rate of interest to increase from 0.04 to 0.061.

With the asset yield equilibrium given by equation 6b, the growth equilibrium condition

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[17]The parameter values presented at the end of section 1 imply that the equity premium as viewed by the firm is $\psi = 0.065$. This of course implies the same net equity premium of $\phi = 0.0357$ for the individual investor.

corresponding to equation 12 of section 2 now becomes

(17) $$(1 - \tau)\,\alpha\, g / \sigma = (1 - \tau)\, b\, i + (1-b)\,[(1-\tau)\, i + \psi].$$

With fixed values of α, g and b, this implies that the pretax rate of interest would rise unless σ rises by at least 27 percent. Although this is not as large as the increase required in the case examined in section 2, it is quite large relative to the increased net return to savers. Equations 5 and 6b together imply that

(18) $$\begin{aligned} r_N &= (1-\theta)\, b\, i + (1-\theta)(1-b)\,[(1-\tau)\, i + \psi] \\ &= (1-\theta)\, i + (1-\theta)(1-b)[\psi - \tau i]. \end{aligned}$$

With i unchanged at i = 0.04, eliminating the corporate and personal income taxes would raise the net return to savers from $r_N = 0.049$ to $r_N = 0.079$. This is substantially larger than the 1.2 percentage point increase in the net return implied by the alternative model of capital market equilibrium in section 2. If this 3.0 percentage points rise in the net rate of return would raise the gross saving rate by 27 percent (e.g., from 20 percent to 25.4 percent) the shift to a consumption tax with this section's mode of capital market equilibrium would lead to a lower equilibrium pretax rate of interest. Since such a rise in the gross saving rate would initially more than double the net saving rate, it is of course problematic that such an increase in the US saving rate would actually occur.

4. Inflation, Consumption Taxes and the Rate of Interest

To permit a clearer exposition, the analysis until now has assumed that there is no inflation and that tax depreciation is equal to economic depreciation. This section presents a more complete specification that incorporates a positive rate of inflation and a more realistic analysis of tax depreciation.

The interaction between inflation and tax rules is important because the personal and business income taxes are based on nominal interest income and expenses, on nominal capital gains and on nominal depreciation.[18] To incorporate inflation, and to allow also for a difference between economic depreciation and tax depreciation that is not related to inflation (δ_0), the firm's budget constraint (equation 4) must be changed to:

(19) $$f' + \pi - \tau(f' - \delta_0 + \delta_1\pi - bi) = bi + (1-b)e.$$

Equation 19 states that the nominal return that the firm can give to the providers of debt and equity capital (per unit of capital before personal taxes) is the sum of three components: the real return per unit of capital [f'] plus the rise in the nominal value of the capital stock (π per unit of capital) minus the tax paid by the corporations. The corporate tax base is the sum of four components: (i) the marginal product of capital; (ii) the value of accelerated depreciation per unit of capital, δ_0; (iii) the reduced depreciation allowance caused by inflation, $\delta_1\pi$; and (iv) the deduction for the nominal interest payments. With $\pi = 0$ and economic depreciation ($\delta_0 = 0$), equation 19 reduces to equation 4.

Because the individual provider of debt capital pays tax on the nominal rate of interest (i), the real net-of-tax rate of interest is $(1-\theta)i - \pi$. The equity investor receives a total pretax nominal return of e per unit of equity capital. A portion of this corresponds to the payout of real earnings and

[18]See Feldstein (1983) for several papers on the interaction of inflation and tax rules.

the rest to the inflationary appreciation of the capital stock.[19] The part that corresponds to a nominal capital gain of $\pi/(1-b)$ per unit of equity capital is taxed only on a deferred basis and only if realized. The present value effective tax on this inflation gain can therefore be written as $\gamma\,\theta\,\pi\,/\,(1-b)$ with $\gamma < 1$. The remaining return to equity capital is $e - \pi/(1-b)$ and is subject to tax at rate θ. The net of tax nominal return per unit of equity capital is therefore $(1-\theta)\,[e - \pi/(1-b)] + (1-\gamma\theta)\pi/(1-b) = (1-\theta)\,e + \theta\,(1-\gamma)\pi/(1-b)$.

The portfolio equilibrium condition of a constant net-of-tax equity premium of ϕ requires that equation 6 be replaced by:

(20) $$(1-\theta)\,e + \theta(1-\gamma)\,\pi/(1-b) = (1-\theta)\,i + \phi.$$

Using equation 20 to eliminate e from equation 19 yields the equilibrium condition:[20]

(21) $$f' + \pi - \tau\,(f' - \delta_0 + \delta_1\,\pi - bi) = i + (1-b)\,\phi\,/\,(1-\theta) - \theta\,(1-\gamma)\,\pi\,/\,(1-\theta).$$

Consider now the effect of shifting to a consumption tax in this more realistic context. Totally differentiating equation 21 with respect to τ, θ and i implies:

(22) $$\frac{di}{d\tau} = -\frac{f' - \delta_0 + \delta_1\,\pi - bi}{1 - \tau b}$$

and

(23) $$\frac{di}{d\theta} = -\frac{(1-b)\,\phi - (1-\gamma)\,\pi}{(1-\tau b)(1-\theta)^2}.$$

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[19]This assumes that there are no retained earnings.

[20]Note that with economic depreciation and no tax on nominal capital gains, equation 19 implies the familiar result that $di/d\pi = 1/(1-\tau)$.

Since $\delta_1\pi > 0$ is the extra tax paid because of historic cost depreciation, a positive rate of inflation makes $di / d\tau$ absolutely larger than it was with no inflation (equation 8). That follows economically from the fact that an increase in the rate of inflation raises the effective tax rate at the corporate level because the historic cost method of calculating depreciation allowances reduces the present value of depreciation. Eliminating the corporate income tax therefore raises net-of-tax profits more when there is inflation.

In contrast, a positive rate of inflation makes $di/d\theta$ absolutely smaller than it was with no inflation (equation 9). This effect of inflation on $di/d\theta$ occurs because inflation reduces the net yield on equities by taxing nominal capital gains. Market equilibrium therefore requires that the net yield on fixed income securities also decline. This effect could in principle make $di/d\theta > 0$, implying that eliminating the taxation of personal interest income could lower the rate of interest.

Despite this theoretical ambiguity, realistic numerical values indicate that switching to a consumption tax causes a larger increase in the real pretax interest rate when there is inflation. In addition to the assumptions of section 1, let the rate of inflation be four percent. Although the effect of inflation on the real rate of interest is ambiguous in an economy with a complex set of non-neutral tax rules, the evidence suggests that these effects interact in practice in a way that keeps the real pretax rate of interest approximately unchanged when the rate of inflation changes.[21] With the real rate of inflation unchanged at four percent, the initial value of the nominal interest rate is $i = 0.08$. Assume also that in the absence of inflation there is accelerated depreciation that is equivalent to adding one percent to the pretax rate of return ($\delta_0 = 0.01$) and that the historic cost method of

[21]See e.g., Feldstein (1983) and Mishkin (1992).

depreciation causes each percentage point of inflation to reduce net profits per unit of capital by 0.2 percent; i.e., $\tau\delta_1 = 0.2$ or $\delta_1 = 0.57$.[22] Finally I take the capital gains adjustment parameter γ to be 0.25, implying that an accrued capital gain of one dollar only raises the present value of future taxes by one-fourth of the statutory personal tax rate, a refection of the deferral, the stepped up basis at death and the lower statutory tax rate on capital gains than on other capital income.[23]

The condition that $di/d\pi = 1$ implies that the risk parameter varies with the rate of inflation. For the current parameter values, $d\phi/d\pi = 0.3$. Thus inflation raises the risk premium from $\phi = 0.0398$ at $\pi = 0$ to $\phi = 0.0518$ at $\pi = 0.04$.[24]

These values and equations 22 and 23 imply that $di/d\tau = -0.094$ and $di/d\theta = -0.0026$. Thus eliminating the personal interest income tax has a smaller potential effect on the equilibrium interest rate than in the previous case. Explicit evaluation of equation 21 implies that shifting from the current tax system to a consumption tax raises the real interest rate from 0.04 to 0.069.[25]

Before considering the effect of an endogenous capital stock, consider the alternative capital market equilibrium in which the real cost of equity capital to the firm exceeds the real net cost of

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[22]See Feldstein, Green and Sheshinski (1978) for analytic discussions of the effect of inflation on the value of depreciation allowances. The number 0.2 used in the text is based on the calculation by Alan Auerbach presented in his appendix to that paper.

[23]These assumptions and equation 25 imply that the equity premium is $\phi = 0.0520$.

[24]The risk premium of $\phi = 0.0398$ differs from the value of 0.0357 of section 1 only because of the current assumption of accelerated depreciation; if $\delta_0 = 0$, the implied values are $\phi = 0.0357$ at $\pi = 0$ and $\phi = 0.0477$ at $\pi = 0.04$.

[25]As an alternative to the assumption that inflation does not alter the real pretax interest rate, I have also considered the implication of keeping the risk premium ϕ unchanged at the value implied by $\pi = 0$. With this assumption, shifting to a consumption tax implies that the real interest rate rises from 0.058 to 0.076.

debt capital by a constant differential ψ. The analog of equation 6b is now

(24) $$e = (1 - \tau)\, i + \psi\ .$$

Substituting this into equation 19 yields

(25) $$f' + \pi - \tau[\, f' - \delta_0 + \delta_1 \pi - b\, i\,] = b\, i + (1\text{-}b)\,[(1-\tau)\, i + \psi\,].$$

A change in the personal tax rate therefore has no effect in this context. The condition $di/d\pi = 1$ implies $d\psi/d\pi = 0.25$ so that a four percent rate of inflation raises the risk premium by one percentage point from $\psi = 0.0708$ at $\pi = 0$ to $\psi = 0.0808$ at $\pi = 0.04$. Shifting from the existing tax structure to a consumption tax would raise the interest rate from 0.08 to 0.0915.

Comparing this to the result with the alternative capital market equilibrium implies that, with a fixed capital stock, the rise in the real interest rate is from 0.04 to between 0.052 and 0.069.

5. Inflation, Saving and Endogenous Capital Intensity

The results of section 4 can be extended to an economy with endogenous capital intensity by combining the analyses of sections 2 and 4 and sections 3 and 4. Combining the firm's equilibrium condition in the presence of inflation (equation 19) with the balanced growth condition ($f' = \alpha\, g/\sigma$) yields:

(26) $$\frac{(1-\tau)\alpha g}{\sigma} + (1 - \tau\delta_1)\pi + \tau\delta_0 = (1 - \tau)\, b\, i + (1-b)\, e.$$

With the capital market equilibrium based on investors preferences (equation 20), this becomes

(27) $$\frac{(1-\tau)\alpha g}{\sigma} = -(1-\tau\delta_1)\pi - \tau\delta_0 + (1-\tau)\, b\, i + (1-b)\,\phi\,(1-\theta)^{-1} - \theta\,(1-\gamma)(1-\theta)^{-1}\pi.$$

With a fixed capital intensity ($d\sigma = 0$), section 4 showed that shifting from the current tax rules to a consumption tax implies that the real interest rate would rise from 0.04 to 0.069. To offset this and

keep i unchanged requires (with the parameter values used in the previous section) an increase of saving of 41 percent.

The capital market equilibrium of equation 20 implies

(28) $$r_N = b\,[\,(1-\theta)\,i - \pi] + (1-b)\,[(1-\theta)\,i + \phi - \pi\,]$$

$$= (\,1-\theta\,)\,i + (\,1-b\,)\,\phi - \pi.$$

With a fixed nominal interest rate of $i = 0.08$ and $\phi = 0.0518$, r_N rises by 2.4 percentage points from $r_N = 0.047$ when $\theta = 0.3$ to $r_N = 0.071$ when $\theta = 0$. If this rise in the net rate of return is enough to increase gross saving by 41 percent (and therefore net saving by more than 100 percent), a shift to a consumption tax would reduce pretax interest rates.

Finally, there is a similar analysis with the capital market equilibrium based on the firms' preferences (equation 25). In this case, we obtain

(29) $$di = -\frac{f' - \delta_0 + \delta_1 \pi - i}{1-\tau}\,d\tau - f'\frac{d\sigma}{\sigma}.$$

Section 2 shows that the real interest rate would rise from 0.04 to 0.052 if the saving rate is unchanged when there is a change from the current tax system to a consumption tax. Equation 29 implies $di < 0$ if $d\sigma/\sigma > 0.13$. With an 13 percent increase in gross saving, the shift to a consumption tax would leave the nominal interest rate unchanged but would cause the real net return to savers to rise from 0.047 to 0.088. This combination is more plausible than the larger saving responses required under the alternative market equilibrium conditions and inflation assumptions discussed above. But it still implies a very large rise in net saving rise of nearly 50 percent would be needed to reverse the conclusion that the shift to a consumption tax would raise the pretax rate of interest.

6. Interest Rate Effects of Eliminating the Mortgage Subsidy

Until now, the analysis in this paper has ignored the special income tax treatment of owner occupied housing and has assumed that all capital is used in the corporate business sector. In actual practice, adoption of a pure consumption tax would eliminate the current favorable tax treatment of owner-occupied housing and cause capital to shift from the owner-occupied housing sector to the business sector. The shift would reduce the marginal product of capital in the business sector and therefore the equilibrium rate of interest. Since owner occupied housing represents about 35 percent of total private capital in the United States, it is natural to ask whether this effect is potentially large enough to modify the conclusions of the more aggregate analysis of the previous sectors and to support the conclusion that a shift to a consumption tax would cause a decline in the rate of interest.

This section presents a simple two sector model that can be used to analyze the effect of the tax system on the mix of housing and business capital.[26] The analysis begins with a stationary economy with a fixed total capital stock. I then consider what happens in a growing economy with a constant saving rate. In both economies, the analysis implies that shifting to a consumption tax would still lead to a rise in the rate of interest. I then calculate how much the saving rate would have to rise to keep the interest rate unchanged.

6.1 *A Two Sector Model with Corporate Capital and Owner-Occupied Housing*

Consider an economy with a fixed total capital stock, Q, to be divided between the

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[26]The analysis assumes that all production is either in the owner-occupied housing sector or in the corporate sector. Thus the analysis simplifies by assuming that rental housing is regarded as an activity of the corporate sector and that there is no unincorporated sector other than owner occupied housing.

business sector and the owner-occupied housing sector. Let K be the capital in the business sector and H be the capital used in the owner occupied housing sector . Because the focus of this analysis is on the long run equilibrium, no distinction is made between the prices of the two types of capital; both are assumed to be measured in the same price as the numeraire good produced by the business sector. Thus

(30) $$K + H = Q.$$

I will assume the simplest possible technology in the housing sector: the flow of housing services is proportional to the stock of housing capital and is produced without labor input. The flow of housing services is thus hH where h is the constant marginal product of housing capital net of depreciation and maintenance costs. If the implicit rental price per unit of owner occupied housing services (relative to the numeraire price of output of the business sector) is p, the aggregate value of housing services is phH.

In the business sector, aggregate output will be represented by a Cobb-Douglas production function similar to that assumed in sections 3 and 5:

(31) $$Y = aK^{\alpha}L^{1-\alpha}$$

where L is the total labor force of the economy. The coefficient on the capital stock will be assumed to be $\alpha = 0.25$. With this assumption of constant returns to scale, this implies the intensive form production function $Y/L = f(K/L) = ak^{\alpha}$ assumed in earlier sections of this paper. Shifting to a consumption tax leads to a decline in H and an increase in K, causing the marginal product of capital (f') to decline.

The equilibrium conditions of the corporate sector are the same as they were in section 4. The corporate sector budget constraint (equation 19 of section 4) is

(32) $f' + \pi - \tau [f' - \delta_0 + \delta_1 \pi - bi] = bi + (1-b) e$

where f' is no longer constant but depends on the division of the capital stock between the housing and business sectors. The portfolio equilibrium condition (equation 20 of section 4) is

(33) $(1 - \theta) e + \theta (1-\gamma)\pi/ (1 - b) = (1-\theta) i + \phi.$

Consider now the cost of providing owner occupied housing services. The current tax rules reduce this cost by permitting home owners to deduct mortgage interest payments and local property taxes in calculating their taxable incomes. Capital gains on owner occupied homes are essentially untaxed.[27] If the interest rate on the mortgage is i and the loan to value ratio of the mortgage is μ, the real cost per unit of owner occupied housing capital is $\mu (1-\theta) i + (1-\mu) (r_N + \pi) + (1-\theta)\tau_p - \pi$. Here r_N is the real net opportunity cost of the non-mortgage funds that the owner has invested in the house and τ_p is the rate of local property tax. The full rate of inflation is subtracted on the assumption that the housing capital appreciates at the same rate as prices in general and that the accruing gain is never subject to any capital gains tax.

The implicit rental per unit of housing capital (ph) that the individual must earn on a unit of housing capital is equal to this real cost per unit of housing capital plus a risk premium, ξ (that can be either positive or negative, depending on the individual's perceived risk in owner-occupied housing relative to the alternative debt-equity portfolio):

(34) $p h = \mu (1-\theta) i + (1-\mu) (r_N + \pi) + (1-\theta)\tau_p - \pi + \xi.$

The net nominal return on portfolio capital can be written, using equation 33 to substitute for

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[27]No tax is due if the proceeds from selling a residence are reinvested within two years. Individuals age 55 and older who sell a residence pay no tax on the first $125,000 of gain. No gain is ever taxed if the residence is bequeathed at the death of the owner.

the equity return, as

(35) $r_N + \pi = b\,[(1-\theta)\,i - \pi] + (1-b)\,[(1-\theta)\,i + \phi - \pi] + \pi$

$= (1-\theta)\,i + (1-b)\,\phi.$

The model is closed by specifying the demand for housing services. To do so, I assume that the share of housing consumption in total spending is constant.[28] This implies

(36) $phH = \lambda Y$

where $\lambda / (1+\lambda)$ is the share of housing in total national income.

These seven equations (30 through 36) jointly determine the values of H, K, Y, p, i, e and r_N (since h is a constant technology parameter and L is the exogensously given aggregate labor force.)

6.2 *The Consumption Tax in a Stationary Economy with Owner-Occupied Housing*

To assess the effect of shifting from our current income tax to a pure consumption tax, I start with the same parameter assumptions under existing law that were used in section 4: $f' = 0.10$, $\pi = 0.04$, $i = 0.08$, $b = 0.40$, $q = 0.30$, $t = 0.35$, $d_0 = 0.01$, $\delta_I = 0.57$. The Federal Reserve Board's Balance Sheets for the U.S. Economy, 1945-93 indicate that in 1992 the value of owner occupied real estate was H = $6,709 billion and the value of other private capital (corporate and noncorporate equity) was K = $12,322 billion (Economic Report of the President for 1995, p. 404). The services provided by owner occupied housing in 1992 were phH = $232 billion, implying that

[28]This constant ratio assumption is not far from the observed price elasticity of housing demand of 0.8 reported in Rosen (1985). The stylized fact of a constant ratio is implied by a Cobb Douglas utility function and is analogous to the Harberger (1962) assumption that the corporate and noncorporate shares of GDP are constant.

the remaining national income is Y = $4598 billion.[29] I take the property tax rate to be $\tau_p = 0.025$ and use a ratio of mortgage debt to house value of $\mu = 0.4$.

With these parameter values, the households' asset equilibrium condition (equation 34) implies that owner occupied housing is regarded by individuals as less risky than a balanced debt-equity portfolio. More specifically, the implied value of ξ in equation 34 is -0.0217.[30]

The shift from the income tax to the consumption tax sets $\theta = \tau = 0$. This removes the current advantage of the tax deductibility of mortgage interest and property taxes from owner occupied housing as well as removing the disadvantage of corporate and personal taxes on the return to business capital. Solving equations 30 through 37 numerically for the parameter values described above implies that replacing the existing tax system with a consumption tax causes a shift of capital

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[29]According to the national income accounts, the output of owner occupied housing in 1992 was $418 billion. The intermediate goods and services consumed in the production of all housing output was $71 billion. Since separate information is not given for the goods and services consumed in the production of the output of owner occupied housing, I assume that the share of the $71 billion total that is used in owner occupied housing is the same as the share of owner occupied housing in total housing output, 72.4 percent. I subtract the implied $51 billion from the $418 billion of output to obtain $366 billion as an estimate of the gross housing output of the owner occupied housing. Subtracting depreciation of 2 percent of the $6709 billion of owner occupied housing capital yields net owner occupied housing product of $232 billion. Since total national income in 1992 was $4830 billion, the portion of national income not represented by owner occupied housing services was Y = $4598. This implies that owner occupied housing services are 5.0 percent of other national income, i.e., $\lambda = 0.05$.

[30] Recall that the equity premium is $\phi = 0.052$, implying that the real net yield on equities exceeds the real net yield on debt by 5.2 percentage points. The weighted average of the debt and equity portfolio thus has a yield that is 3.1 percentage points higher than the yield on debt. The estimate of $\xi = -0.0217$ implies that the return on owner occupied housing is 2.2 percent less than the weighted average cost of funds used to finance housing. There may, of course, be reasons other than perceived risk differences that cause individuals to prefer owner occupied housing to other types of investment, e.g., the pure desire to be a home owner or to live in the type of community or neighborhood where only owner occupied housing exists.

from the owner occupied housing sector to the business sector equal to 27 percent of the initial level of business capital (and a corresponding 50 percent reduction of the stock of owner occupied housing). This increase in the stock of business capital is sufficient to reduce the pretax marginal product of capital from $f' = 0.10$ to $f' = 0.083$. Nevertheless, the reduction of the corporate and personal tax wedges causes the equilibrium real interest rate to rise from $i - \pi = 0.04$ to $i - \pi = 0.052$. This increase is less than the rise in the real interest rate (to $i - \pi = 0.069$) derived in section 4 for the same model and parameter values but without a separate housing sector. The smaller rise in the interest rate is what would be expected to result from recognizing the role of owner-occupied housing and the magnitude of the difference is quantitatively significant. It nevertheless leaves unchanged the conclusion that the shift to a consumption tax in a stationary economy would raise the equilibrium interest rate.

6.3 *The Effect of the Consumption Tax with Endogenous Saving and Housing*

The analysis of a growing economy with endogenous saving in section 5 can be extended to the two sector economy to analyze the combined effect of the change in saving and the reallocation of the resulting capital stock between the housing and business sectors. In place of the assumption of a fixed capital stock, we now have the steady state growth equilibrium

(37) $$\sigma (Y + phH) = g Q$$

i.e., total gross saving (the product of the fixed saving rate, σ, and the sum of the two components of national income) equals gross investment (the sum of depreciation and the net increase of the capital stock.)[31]

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[31] Thus $g = d + n$ where d is the rate of depreciation of the capital stock and n is the rate of growth of the effective labor force (including the effect of labor augmenting technical

Equation 37 implies that the ratio of σ/g can be estimated as the ratio of the capital stock to national income. For 1992, the value of the capital stock is $Q = H + K = \$19{,}031$ billion and the value of national income is $Y + phH = \$4830$ billion. The implied value of $\sigma/g = 3.94$. This would, for example, be consistent with a gross U.S. saving rate of 20 percent and a combination of effective labor force growth and depreciation of 5.1 percent.[32]

A shift to a consumption tax (with $\theta = \tau = 0$) with an unchanged saving rate would cause the stock of business capital to rise by 38 percent, reducing the pretax marginal product of business capital from 0.10 to 0.079. This is a larger relative increase in the stock of business capital and therefore a larger fall in the marginal product of capital than in the stationary economy even though the saving rate remains unchanged. Nevertheless, even with this substantial fall in the pretax marginal product of capital, the elimination of the corporate and personal income taxes causes the real interest rate to rise form $i - \pi = 0.04$ to $i - \pi = 0.047$.

To prevent the interest rate from rising, the rate of saving would have to rise by enough to drive down the pretax marginal product of capital to a level compatible with a real interest rate of $i - \pi = 0.04$ with $\theta = \tau = 0$. Solving the model with this constraint implies that the gross saving rate must rise by eleven percent, i.e., $d\sigma/\sigma = 0.11$. This is slightly less than the 13 percent increase

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progress). In equilibrium, the capital stock must grow at the same rate as the effective labor force: $Q^{-1}\, dQ/dt = n$ and therefore the increase of the capital stock is $dQ/dt = nQ$.

[32] The value of 5.1 is slightly less than would be implied by adding a direct estimate of depreciation to the rate of growth of the labor force and the rise in productivity. The national income and product account estimate of capital consumption for 1992 of \$658 billion represents 3.5 percent of the total capital stock of \$19.0 trillion. Employment grew at a rate of 1.8 percent during the previous 20 years and output per employee hour during this same period rose at 1.1 percent. There are of course many reasons why the simple steady state equilibrium condition of equation 37 might not correspond exactly to the observed values at a recent point in time.

required in the one sector model since the pretax return on business capital is now lowered by the shift of capital from the housing sector to the business sector as well as by the increase in the total capital stock.

The eleven percent increase in the gross saving rate required to prevent a rise in the rate of interest is equal to approximate 2.2 percent of GDP or about 40 percent of the current net private saving rate. The inducement to such a large increase in saving would be the higher real return available under the consumption tax. With a constant nominal interest rate of $i = 0.08$, the real net of tax rate of interest rises from $(1-\theta)\, i - \pi = 0.016$ under the income tax to 0.04 under the consumption tax. Whether a 2.4 percentage point increase in the real rate of interest would be enough to raise the private saving rate by 2.2 percent of GDP is unclear on the basis of past statistical evidence. Unless savings are that responsive, the shift to a consumption tax would still leave the interest rate higher than it is under the income tax.

7. Concluding Comments

The analysis in this paper has used very simple models of business and household borrowers and investors. In reality there are several other types of borrowers and investors in quite different tax situations. The actual change in the interest rate will depend on their role in the overall capital market equilibrium.

There are four primary participants in the capital market other than the corporate and mortgage borrowers and taxable portfolio investors that have been the focus of the current analysis: the federal government; foreign borrowers and investors; tax exempt portfolio investors; and state and local government borrowers. Although incorporating these in a formal analysis lies beyond the scope of the current paper, some brief comments on their likely effect on the equilibrium interest rate

can be made.

The federal government is an intramarginal borrower that is clearly not directly sensitive to -changes in tax rates and that can be assumed to be insensitive to changes in interest rates. The presence of government bonds should therefore not alter the basic effect of the tax change discussed in this paper.

Foreign borrowers and investors who are not subject to U.S. tax rules would dampen the magnitude of any interest rate change. If capital moved among national capital markets to equalize real rates of return, there could be no response of U.S. real interest rates to the change in tax rules. Instead of a rise in the rate of interest, the dollar would rise and capital would flow into the United States, depressing the pretax marginal product of capital until the equilibrium U.S. interest rate is at the world level. In practice, capital movements are more limited and an increased demand for corporate capital in the United States would be expected to change the level of U.S. interest rates.[33]

A large fraction of bonds are held by pension funds an other tax exempt portfolio investors. For them, the shift to a consumption tax would involve no change in tax rates. The current analysis could be applied to an economy in which all investors are tax exempt by assuming that $d\theta = 0$. Even with this condition, eliminating the corporate tax would lead to a rise in the rate of interest. The return to tax exempt investors would therefore rise even though they are not directly affected by the change in tax rules.

State and local government bonds are currently untaxed. Under a consumption tax they

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[33]On the limited net movement of capital among national capital markets, see the substantial literature cited in Mussa and Goldstein (1994) and Feldstein (1994). See also Hartman (1979) for a discussion of tax induced international capital arbitrage.

would lose their relatively favored status since no interest income would be taxed. Interest rates on these obligations would therefore rise relative to other interest rates. To the extent that states and local government borrowing is interest sensitive, this would reduce the demand for credit and therefore reduce the overall rise in interest rates.

Although it would be useful to have a formal analysis with this broader class of borrowers and lenders, it appears from this informal discussion that doing so would not alter the basic conclusion that shifting to a consumption tax is likely to raise pretax interest rates.

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