RICARDIAN EQUIVALENCE WITH A TAX ON INTEREST INCOME

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1. Introduction

Consider the following two propositions concerning the effects of a deficit-financed tax cut:

1) Unless there is a change in the interest rate, any individual can restore his original net asset position by purchasing government bonds. Thus, except insofar as it affects the interest rate, government debt is a matter of indifference to every individual.

2) Every individual will in fact choose to lend as in 1); therefore the market interest rate will remain unchanged. (In short, "Ricardian equivalence holds".)

Proposition 1) simply describes a budget constraint. It says nothing about optimization or equilibrium, which is to say that it has no economic content. The laws of arithmetic imply that Proposition 1) is true. Nevertheless, virtually all journalists believe that Proposition 1) is false, thereby illustrating the maxim that economic content is sufficient but not necessary to confuse a journalist. [1]

Proposition 2), by contrast, does have economic content. It is well known to be true under certain ideal conditions, including the assumption that all taxes are lump sum. A deficit-financed cut in *non*-lump-sum taxes, by contrast, can cause Ricardian equivalence to fail for reasons which are well understood.

This note concerns the intermediate case in which only lump- sum taxes are cut, but

[1] Actually, Proposition 1) is false, because an individual's share of the aggregate tax burden may vary with time or circumstances. This, the only legitimate objection to Proposition 1), has never been cited by any journalist.

not all taxes are lump-sum. In particular, I will assume that there is a tax on interest income.

There is nothing difficult about this exercise; I would not hesitate to pose it as a homework assignment to a class of first-year graduate students, and I would be disappointed if they failed to find answers at least as good as those offered here. Therefore I should explain what motivated me to write it up.

When I was in graduate school, a wise professor told me that if you can't explain your thesis to your mother, you don't understand your thesis. [2] Later in life, and all on my own, I discovered a related truth: If your parents cannot understand your expository writing, nobody else can either. My faith in this maxim has on more than one occasion saved me from thrusting some truly egregious prose before the public.

I recently wrote a column for the online magazine Slate which had the sole purpose of explaining Proposition 1), while ducking completely the subtler issues raised by Propsition 2). (http://slate.msn.com/Economics/96-08-02/Economics.asp.) I happened to be visiting my parents when I completed the final draft, and I asked my father to look at it. He immediately raised the following objection:

Suppose the government finances a tax cut by borrowing $1000 on my behalf at a 10% interest rate. I try to offset this debt by purchasing a government bond for $1000. But if

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[2] Admittedly, this maxim would be hard to falsify, owing to the extremely small number of graduate students who understand their theses.[2.1]

[2.1] The prominent mathematician George Mackey was reportedly once overheard to mutter "Okay, I'll *write* his thesis for him, but I'll be damned if I'll *explain* it to him!"[2.1.1]

[2.1.1] I have had to invent style specifications for a footnote to a footnote, as the standard reference work[2.1.1.1]fails to anticipate this contingency.

[2.1.1.1] K. Turabian, *A Manual of Style*, University of Chicago Press.

I'm in a 40% tax bracket, then the after-tax return on the bond will be only 6%. So I'm borrowing at 10% and lending at 6%, which means I'm worse off than I was before the tax cut.

I offered a response to this objection which was so embarrassingly wrong that I'm not going to tell you what it was. I'm also not going to tell you how many of my colleagues agreed with my response. But the number was sufficiently large to convince me that recording the *correct* response for an audience of economists would not be a complete waste of resources.

Here then is the correct response: The objection is wrong, because you're not being taxed to cover a 10% pre-tax return to bondholders; you're being taxed to cover a 6% post-tax return to bondholders. If Ed the bondholder earns $100 in interest this year and returns $40 in taxes, then Fred the general taxpayer must cough up only $60 to cover the difference. Fred can recover that entire $60 by purchasing a $1000 bond. [3]

Now you might think that's the end of the story, but it's not. If you think long enough about that response, you discover that it breeds a second objection, and one that is much harder to dismiss. The key to the new objection is that government debt allows borrowers to substitute 6% (post-tax) government debt for 10% (pre-tax) private debt. This enriches borrowers and so must indirectly impoverish lenders.

To see this more clearly, consider the initial impact of a deficit-financed tax cut (holding the market interest rate fixed). Lenders purchase government bonds to restore their original net asset positions. Borrowers substitute the tax cuts for private borrowing, get-

[3] On the other hand, the objection is right, because some bondholders—such as retirement funds and foreign nationals—may be exempt from taxes. I shall ignore the fact that the objection is right.

ting a better interest rate and thereby *improving* their net asset positions. As private borrowing and lending is replaced by public borrowing and lending, the government's revenue from the tax on interest income falls. Holding fixed the path of government spending, this revenue must be replaced by some other tax which presumably falls on both borrowers and lenders.

Thus a fall in current lump-sum taxes affects lenders' future tax burden in two ways. First, future taxes must rise to cover the deficit; this exactly offsets the benefits of the tax cut. Second, current or future taxes must rise to cover lost revenue from the tax on private borrowing; this is an additional burden on lenders which is not offset by any benefit.

Borrowers are also burdened by the second tax increase, but this is more than offset by their gains from being able to borrow through the public sector at post-tax rates. Thus the bottom line is that a deficit-financed tax cut transfers income from lenders to borrowers. Note that the direction of the transfer is exactly opposite to that which is anticipated by all journalists. [4]

The correct objection to Propositon 1) is not: "If I have to buy government bonds, I'll be taxed on the interest." The correct objection is: "If someone else can avoid buying private bonds, I'll have to pay some of the taxes he's avoiding in the process."

Having discussed Proposition 1), let me turn to the more interesting Proposition 2).

[4] George F. Will writes that via the national debt, "tax revenues are being collected from average Americans and given to the buyers of US government bonds—buyers in Beverly Hills, Lake Forest, Shaker Heights and Grosse Point, and Tokyo and Riyadh."

2. Ricardian Equivalence

Suppose that the government levies a percentage tax on interest income, as well as lump sum taxes in the present and the future, in order to finance a fixed path of wasteful spending. What are the effects of a cut in current lump-sum taxes, accompanied by an offsetting increase in future lump- sum taxes?

By the arguments in Section 1, the initial impact is to transfer wealth from lenders to borrowers. As borrowers are made richer, their demand for current goods increases; as lenders become poorer, their demand for current goods falls. The net effect on the demand for current goods can be in either direction; hence the interest rate can move in either direction.

I will show in the next section that in equilibrium lenders consume less (and borrowers consume more) in both the present and the future, with just one exception.

The exception is this: If lenders have a sufficiently high income elasticity of demand for current goods, the market demand curve for current goods can slope upward. In this case, a deficit-financed tax cut certainly causes a fall in demand for current goods and hence an increase in the interest rate, which ends up more than offsetting the initial wealth effect, so that lenders gain at the expense of borrowers. In this extreme case, lenders now consume more (and borrowers consume less) in both the present and the future.

The remainder of the paper is devoted to justifying the assertions in this section.

3. A Model

There follows a simple two-period model with two individuals, one of whom has all his income in the present and one of whom has all his income in the future. The extreme assumption on endowments has the advantage of making it easy to keep track of who is the borrower and who is the lender. The offsetting disadvantage is that it makes it impossible to consider the effects of deficits on people who switch from borrowing to lending when the deficit rises.

3.1 Basic Setup

There are two individuals who live for the same two periods.

All income is from endowments. The first individual has endowment $(2, 0)$ and the time-separable utility function U, taking as its arguments consumption in both periods. The second individual has endowment $(0, 2)$, and the time separable utility function utiliy function V, taking as its arbuments consumption in both periods.

The government wastefully spends 1 unit of output per period.

Taxes consist of a lump-sum tax equal to T_0 per individual in the first period, a lump-sum tax equal to T_1 per indiviudal in the second period, and a flat-rate tax on interest income, at rate t.

I take the interest income tax rate t as given. Thus any change in tax policy must consist of a change in T_0 accompanied by an offsetting change in T_1.

3.2. The lender

In the first period, individual 1 pays a lump-sum tax of T_0, consumes an amount x, and therefore lends an amount $2 - T_0 - x$, at a market interest rate r.

In the second period, individual 1 collects after-tax interest income of $(2-T_0-x)(1+r-tr)$ and pays a lump sum tax of T_1, thus consuming an amount

$$y = (2 - T_0 - x)(1 + r - tr) - T_1 \tag{3.2.1}$$

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The individual chooses x, taking T_0, T_1, t and r as given, to satisfy

$$U_1(x, y) = (1 + r - tr)U_2(x, y) \tag{3.2.2}$$

3.3. The borrower

In the first period, individual 2 pays a lump-sum tax of T_0 and consumes an amount u, necessarily borrowing $T_0 + u$.

In the second period, individual 2 pays $(1+r)(T_0+u)$ in debt service and a lump-sum tax of T_1, thus consuming an amount $v = 2 - T_1 - (1 + r)(T_0 + u)$.

The individual chooses u, taking T_0, T_1, t and r as given, to satisfy

$$V_1(u, v) = (1 + r)V_2(u, v) \tag{3.3.1}$$

3.4 The government budget constraint

The present value of government spending must equal the present value of taxes; this requires

$$T_1 = 1 + \frac{r}{2} - (1 + r)T_0 - \frac{tr}{2}(2 - T_0 - x) \tag{3.4.1}$$

Plugging (3.4.1) into (3.2.1) gives individual 1's second- period consumption

$$y = 1 - x + Ar + Brx \tag{3.4.2}$$

where

$$A = \frac{3}{2} - t + \frac{T_0 t}{2} \qquad \text{and} \qquad B = \frac{t}{2} - 1 \tag{3.4.3}$$

For later use, I record the following:

Lemma 3.4.4

a) $A + Bx \geq 0$

b) $1 - Br > 0$

Proof. For (a) note that $2(A + Bx) = 3 + t(T_0 - 2) + x(t - 1)$. Because $t \leq 1$ and $T_0 \geq 0$, we have $t(T_0 - 2) \geq -2$. Because $x \leq 1$ and $t \geq 0$, we have $x(t - 1) \geq -1$, which suffices. (b) is trivial, as $B \leq 0$.

3.5. Equilibrium condition.

The equilibrium condition is

$$x + u = 1 \qquad (3.5.1),$$

where x and u represent first period consumption for the two individuals. (Remember that 1 of the 2 consumption units is wasted by the government.) Equivalently, we could write

$$y + v = 1 \qquad (3.5.2),$$

where y and v represent second period consumption.

3.6. Summary.

We use the government budget constraint (3.4.1) and the two forms of the equilibrium condition (3.5.1) and (3.5.2) to eliminate the variables T_1, u and v from the model. We take T_0 to be exogenous. Thus the model has three endogenous variables x, y and r, subject to the two first order conditions (3.2.2) and (3.3.1) and the accounting identity (3.2.1). Those equations can now be rewritten:

$$U_1(x,y) = (1 + r - tr)U_2(x,y) \tag{3.6.1}$$

$$V_1(1-x, 1-y) = (1+r)V_2(1-x, 1-y) \tag{3.6.2}$$

$$y = 1 - x + Ar + Brx \tag{3.6.3}$$

where A and B are as defined in (3.4.3).

4. Changes in tax policy

Now we are set up to evaluate the effect of a change in current lump-sum taxes (holding the path of government spending constant).

4.1. Solution.

Differentiating the equations in (3.6) gives

$$\begin{pmatrix} U_{11} & -(1-t)U_2 & -(1+r-tr)U_{22} \\ -V_{11} & -V_2 & (1+r)V_{22} \\ 1-Br & -(A+Bx) & 1 \end{pmatrix} \cdot \begin{pmatrix} dx/dT_0 \\ dr/dT_0 \\ dy/dT_0 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ tr/2 \end{pmatrix} \tag{4.1.1}$$

(To verify this, keep in mind that $dA/dT_0 = t/2$ and $dB/dT_0 = 0$.)

To solve this equation, put

$$F = -(1-t)(1+r)U_2V_{22} - (1+r-tr)V_2U_{22} \tag{4.1.2}$$

$$G = (1+r-tr)U_{22}V_{11} - (1+r)U_{11}V_{22} \tag{4.1.3}$$

$$H = -U_{11}V_2 - (1-t)V_{11}U_2 \tag{4.1.4}$$

Note that

$$F > 0 \qquad \text{and} \qquad H > 0 \tag{4.1.5}$$

but the sign of G is indeterminate.

The determinant of the square matrix in (4.1.1) is

$$\Delta = (1 - Br)F - (A + Bx)G + H. \tag{4.1.6}$$

By Lemma 3.4.4 and (4.1.3), the first two terms in this expression are positive.

We can now solve for the following values:

$$\frac{dx}{dT_0} = \frac{F}{2\Delta} \cdot tr \tag{4.1.7}$$

$$\frac{dr}{dT_0} = \frac{G}{2\Delta} \cdot tr \tag{4.1.8}$$

$$\frac{dy}{dT_0} = \frac{H}{2\Delta} \cdot tr \tag{4.1.9}$$

This yields our first conclusion:

Theorem 4.1.10 *Ricardian equivalence holds if and only if $t = 0$.*

Proof. If $t = 0$, clearly all the expressions (4.1.7)-(4.1.9) are equal to zero, which is precisely the statement of Ricardian equivalence. Conversely, if $t \neq 0$, then (4.1.7) and (4.1.9) at least are nonzero by (4.1.5).

Next we want to sign, if possible, the derivatives appearing in (4.1.6)-(4.1.8).

4.2. Cases.

Write $J = \frac{(1-Br)F+H>0}{A+Bx}$. We have three cases.

4.2.1. Case I: $G > J$

In this case (4.1.6) shows that Δ is negative, so (4.1.7)-(4.1.9) give

$$\frac{dx}{dT_0} < 0 \tag{4.2.1.1}$$

$$\frac{dr}{dT_0} < 0 \tag{4.2.1.2}$$

$$\frac{dy}{dT_0} < 0 \tag{4.2.1.3}$$

4.2.2. Case II: $J > G > 0$

In this case, (4.1.6) shows that Δ is positive, so (4.1.7)-(4.1.9) give

$$\frac{dx}{dT_0} > 0 \tag{4.2.2.1}$$

$$\frac{dr}{dT_0} > 0 \tag{4.2.2.2}$$

$$\frac{dy}{dT_0} > 0 \tag{4.2.2.3}$$

4.2.3. Case III: $0 > G$

In this case, (4.1.6) shows that Δ is positive, so (4.1.7)-(4.1.9) give

$$\frac{dx}{dT_0} > 0 \tag{4.2.3.1}$$

$$\frac{dr}{dT_0} < 0 \tag{4.2.3.2}$$

$$\frac{dy}{dT_0} > 0 \tag{4.2.3.3}$$

4.2.4. Discussion.

The reader may verify that if the borrower's income elasticity of demand for current goods is large (1 being the upper bound in view of the assumed time separability) or if the lender's income elasticity of demand for current goods is small (0 being the lower bound) then $G < 0$, placing us in case 4.2.3. In this case, a deficit-financed tax cut, by transferring wealth to the borrower, increases the demand for current consumption and so raises the interest rate. (That is, a fall in T_0 raises r, so $dr/dT_0 < 0$).

If the lender's income elasticity of demand for current goods is large or the borrower's is small, then in "ordinary" circumstances we are in the opposite case 4.2.2. If the lender's income elasticity of demand for current goods is sufficiently large, we can find ourselves in the "anomalous" case 4.2.1, essentially because the market demand curve for current goods now slopes upward.

One special case is worth noting: Let us say that an individual has constant risk aversion if his utility is given by $F(c) + G(d)$ where c and d are consumption in the first and second periods and where $F''/F' = G''/G'$ is a constant. Then if both individuals have constant risk aversion (possibly with different constants), one calculates that $G = 0$ so that a deficit-financed tax cut, although it transfers wealth from lenders to borrowers, has no effect on the market interest rate.

5. Relevance.

I have assumed throughout that interest on both private bonds and government bonds is taxable. An alternative assumption would be that while interest on government bonds is taxable, interest on private bonds is tax-exempt. Under the alternative assumption, the entire problem becomes trivial and Ricardian equivalence is restored.

This raises the question of whether, in the real world, interest on private bonds is taxable. There's a good case to be made that the answer is no. Certainly corporate debt and home mortgages are tax-exempt, and therefore economic theory predicts that no taxable debt is ever issued.

It is therefore probable that this paper's primary applications will be to the construction of homework problems and the edification of its author. Thanks to Jim Kahn for his contributions to the latter cause.