

**MACROECONOMIC MODELS AND THE DETERMINATION
OF CROWDING OUT**

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Abstract

The importance of crowding out has been an ongoing question in the Economics literature for many years. Some economists believe that deficits replace private spending while other economists feel that most of this crowding out is offset by Ricardian equivalence. In an attempt to resolve this controversy, many economists have formulated macroeconomic models and have used these models to empirically test the notion of crowding out. This paper revisits this methodology. It examines four useful macroeconomic models and shows the relationship between the model assumed, the empirical results obtained and the conclusions concerning crowding out. We demonstrate that the same empirical results may be obtained from different models, but can yield very different conclusions concerning crowding out. It is concluded that the answer to this controversy involves, in part, a more complete understanding of the structural foundations of the macroeconomic models being tested.

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I. INTRODUCTION

For many years economists have examined the impact of fiscal deficits on private spending and economic activity. Much of the attention has focused on two hypotheses - crowding out and Ricardian equivalence. Under crowding out, deficits lead to higher interest rates and result in decreases in interest sensitive variables, including investment. Under Ricardian equivalence, deficits lead individuals to increase their savings in order to pay future taxes stemming from the sales of government bonds. This extra saving will offset any interest rate increases and no crowding out occurs.

On the surface, this controversy seems to be a straightforward empirical question. However, it soon became apparent that there were many ways in which this controversy could be examined. For example, should crowding out be tested using an income, interest rate or consumption equation; how should one model price changes; and what is the role of the government's budget constraint.¹ As a consequence, more elaborate models have been formulated to get at such issues. This paper examines four of these models. Besides the simplified IS-LM model, used as a baseline model, we examine models based on the public capital hypothesis (Auschauer, 1989), private contributions to

¹ See Arestis (1985), Seater (1993), Saleh (2003), Bernheim (1987) and Carlson and Spencer (1973) for survey articles on this controversy. Interestingly, these articles do not necessarily come down on the same side with respect to the evidence. While not always citing the same articles, even given their date of publication, their reviews are extensive.

public goods (Berstrom et al, 1986), and the government's budget constraint (Blinder and Solow, 1974). In doing so, we ask two questions. First, do these models produce conditions that unambiguously yield crowding out, and second, is there a simple test to determine empirically whether this condition has been met? In answering these questions, we want to avoid quarrels such as has the deficit or the interest rate been measured properly; has the correct econometric technique been used; or what time frame is the most revealing. We assume, for the purpose of this examination, that all such problems have been overcome.

From this discussion, it can be seen that our focus is different from most papers concerning the crowding out/Ricardian equivalence controversy. Our goal is to revisit the conceptual framework of four macroeconomic models that yield conclusions concerning crowding out. It is found that, while these models often yield the same empirical results, the interpretation of these results may be very different depending on the macroeconomic model that has been assumed. It is concluded that the controversy is not just one of ensuring the proper econometric estimation is performed. Rather, the contention, here, is that much of the difficulty in resolving this controversy involves important questions concerning the structural equations underlying macroeconomic modeling. We start this investigation with a simplified version of the IS-LM model.

II. THE IS-LM MODEL

The goods market can be described by the following four equations:²

$$(1) \quad Y = C + I + D$$

² Clearly, this is a simple model. Taxes and prices are exogenous and fixed. All changes in the deficit are due to changes in government spending. We chose the simplest model which allows us to illustrate our conclusions. A more complete IS-LM model with Ricardo equivalence can be found in Fields and Hart (1990).

$$(2) \quad C = C_0 + C_Y Y - C_D D \quad 0, C_Y, C_D < 1$$

$$(3) \quad I = I_0 - I_r r \quad I_r > 0$$

$$(4) \quad D = D_0 = G_0 - T_0$$

where C, I and D are consumption, investment and the deficit. The subscript "0" indicates an exogenous variable. Y and r are income and the interest rate, and all variables are in real terms. If C_D is one, then there is complete Ricardian equivalence. If C_D is zero, then households are myopic concerning future taxes. Equations (1) - (4) are solved to obtain the following IS curve:

$$(5) \quad Y = [C_0 + I_0 + (1 - C_D)D_0]/[1 - C_Y] - [I_r]/[1 - C_Y].$$

The money market can be described by

$$(6) \quad M^D/P = L_0 + L_Y Y - L_r r \quad 0 < L_Y < 1, \quad L_r > 0$$

$$(7) \quad M^S/P = M_0/P$$

$$(8) \quad M^D/P = M^S/P$$

where money (M) is in nominal terms. The LM curve is

$$(9) \quad r = [L_0 + L_Y Y - M_0/P]/L_r.$$

Using equations (5) and (9), one can solve for Y and r as follows:

$$(10) \quad Y = [C_0 + I_0 + (1 - C_D)D_0 - A/L_r]/[1 - C_Y + I_r L_Y/L_r],$$

and

$$(11) \quad r = [A(1 - C_Y)/L_r + L_Y/L_r(C_0 + I_0 + (1 - C_D)D_0)]/[1 - C_Y + I_r L_Y/L_r],$$

where $A = L_0 - M_0/P$.

Differentiating equation (11) with respect to D_0 yields

$$(12) \quad \frac{\partial r}{\partial D_0} = C_D/H,$$

where H equals $1 - C_Y + I_r L_Y/L_r$.

If C_D is less than one, then complete Ricardian equivalence is absent. Since I_r is less than zero, a positive sign for $\partial r/\partial D_0$ unambiguously indicates that crowding out has occurred. Thus, we have answered our first question - the simple IS-LM model does provide a test for crowding out.

To answer our second question, it would seem natural to test this proposition by using an interest equation similar to the following:

$$(13) \quad r_t = a_0 + a_1 D_t + A_2 (M_0/P)_t + \dots + e_t^3.$$

If a_1 is positive and significant, it would indicate the presence of crowding out. However, one must be careful when making this claim. First, we are assuming that the IS-LM model presented here is an actual description of the economy. There are many other models that can yield the same functional form for the reduced form equation in which a_1 cannot be interpreted similarly. Furthermore, the amount of crowding out will depend on the interest rate elasticities of the marginal efficiency of investment and the demand for money. Therefore, it is also inappropriate to use the size of the deficit coefficient as a measurement of the degree of crowding out.⁴

Another problem with this estimation is that the IS-LM model does not reveal when the crowding out occurs with respect to the change in the deficit. Since this problem also occurs with the next three models discussed, it is useful to discuss it here in a simpler context.

Suppose the government wants to pursue a pure fiscal policy. Such a policy shifts the IS curve to the right and increases both income and the interest rate. There are two explanations of how

³ We will use an interest rate equation for most of this paper since it is often used in the empirical crowding out research. See Cebula (1987), Darrat (1990), Hoelscher (1983), Laumas (1989), Makin (1983), and Zahid (1988).

⁴ In the extreme case of a vertical IS curve, an increase in the interest rate would be associated with zero crowding out. For a more thorough discussion of this problem, see Spector and Van Cott (1988).

this adjustment occurs. We designate the more popular view the money demand approach (MDA), while we call the less popular view the bond market approach (BMA).⁵ According to the MDA, when the government pursues a bond financed fiscal expansion, income rises first. The increase in income, in turn, leads to an increase in the demand for money and a higher interest rate. This higher interest rate crowds out interest sensitive private expenditures.⁶

The BMA approach stems from the principle that the government cannot increase its expenditures unless it acquires the money to do so. Thus, it must first enter the bond market, and when the supply of bonds increases, so will the interest rate.⁷ The funds made available to the government come from decreased private spending and the willingness of the public to hold a smaller quantity of money due to the higher interest rate. The increase in the interest rate leads to crowding out and the decrease in the quantity of money demanded is the source for any increase in income.⁸

In the BDA, the increase in the interest rate occurs before the increase in the deficit, while

⁵ A survey of current Intermediate Macroeconomics textbooks on our shelves (about 25 of them) indicates that the money demand approach is by far the most popular.

⁶ See Hall and Taylor (1997), pp. 190 - 191.

⁷ One could make the case that the government could buy the goods on credit and might not enter the credit market until later. However, if the government doesn't have to borrow until later, then some firm down the line must borrow in order to produce these new goods. In either case, it is the government that has precipitated the borrowing, and the borrowing occurs before the spending takes place since the government can only buy goods that have been produced.

⁸ Note that in the MDA, actions taking place in the money market (the increase in the demand for money) inhibit the growth of income, while in the monetarist approach, actions taking place in the money market (the decrease in the quantity of money demanded) are actually responsible for the increase in income. See Warburton (1945), p. 80 and Kolluri and Giannaros (1987).

in MDA, the increase in the interest rate occurs after the increase in the deficit. This potentially creates a timing problem when estimating equation (13). Suppose, we assume the BMA is accurate. The interest rate increases in period t and the deficit increases in period $t + 1$. An interest rate equation where the interest rate in time t (or $t + 1$) is a function of the deficit in time t will leave out the initial interest rate effect occurring in time $t - 1$. This will cause the deficit's effect to be understated.⁹ This calls for a more careful examination of the dynamic multipliers associated with an increase in the deficit.¹⁰

Given these caveats, the baseline IS-LM model performs very well with respect to our criteria. It provides an unambiguous case for the presence of crowding out and provides a simple empirical test. And if this model truly represented the actual behavior of macroeconomic variables, it would be easier to solve the crowding out/Ricardian equivalence controversy. The next three models indicate why this is not the case.

III. CROWDING OUT VS. CROWDING IN

Recently, a body of literature has been developed suggesting that deficits might “crowd in” investment. This literature goes by the name of the public capital hypothesis. It suggests that government investment is likely to be a complement, rather than a substitute, to private investment.¹¹ Of course, the idea that government spending could raise private sector productivity is not new.

⁹ Both Thomas and Abderrazek (1988) and Wachtel and Young (1987) find empirical evidence of a relationship between interest rates and future government deficits. It must be admitted that these findings do not stem from the problem stated above. However, it is an example of how the same evidence can support two different propositions.

¹⁰ See Dalamagas (1987) and Arestis, Frowen and Karakitsos (1978) for research concerning the dynamic multipliers of the deficit.

¹¹ See Auschauer (1989), Eberts and Duffy-Deno (1989) and Munnell (1990) for examples of this literature.

Government spending on infrastructure, as a means of economic growth, can be found in Keynes (1936; pp. 376 - 378) and Harrod (1964; pp. 908 - 909). It is also discussed in the public finance literature with respect to the government's role in preserving property rights. To simplify these arguments, suppose the present value of a long-term investment is

$$(14) \quad PV = \sum (R_t / (1+r)^t)$$

where R_t is the expected annual income of the investment.¹² To the degree that R_t is a function of D_t , for whatever reason, then investment will also be a function of D and will equal

$$(15) \quad I = I_0 - I_r r + I_R W_D D_0,$$

where W_D is the percentage of the deficit that is devoted to public investment and I_R is positive, under the public capital hypothesis.

Solving the baseline IS-LM model with this new formulation for investment yields

$$(16) \quad \partial r / \partial D_0 = (1 - C_D + I_R W_D) / H \text{ and}$$

$$(17) \quad \partial I / \partial D_0 = [-I_r(1 - C_D) + (H I_R W_D - I_{rR} W_D)] / H.$$

It is easy to see that the higher is W_D , the greater is the impact of deficits on the interest rate. On the other hand, from equation (17), the greater is W_D , the smaller will be the decrease in aggregate investment. In fact, the IS curve moves to the right, even with perfect Ricardian equivalence, when $I_R W_D$ is greater than zero. Therefore, a positive coefficient in an estimated interest rate equation will not ensure crowding out. We can only be assured of crowding out if $(1 - C_D) > [H I_R W_D - I_{rR} W_D] / I_r$. Thus the public capital hypothesis requires a more restrictive condition for the assurance of crowding out than does the baseline IS-LM model. In the baseline model, crowding out is assured when

¹² This argument follows that of Spector and Van Cott (1992).

$$(1 - C_D) > 0.$$

How does this effect crowding out empirics if a positive coefficient no longer guarantees crowding out? The difficulty is that the reduced form equation for the public capital hypothesis model is the same as that of the simple baseline IS-LM model. The two reduced form equations are observationally equivalent and will yield the same empirical result. As a result, knowledge of the reduced form deficit coefficient will not be sufficient to make conclusions concerning crowding out. When this is the case, one must determine the structural parameters in order to determine whether crowding out is occurring. Luckily, in this case, C_D and $I_R W_D$ can be retrieved by employing two-staged least squares. Thus, while it is more difficult to test the proposition of crowding out within a model that assumes the public capital hypothesis is correct, it is certainly plausible.

IV. PRIVATE CONTRIBUTIONS TO PUBLIC GOODS

The idea that government spending and deficits might replace private spending on seemingly public or quasi-public goods has also received much attention in recent years.¹³ Researchers in this area examine whether households will contribute less, and by how much, to such goods as cancer research, education, poverty relief or disaster relief if the government also contributes substantially. For example, Warr (1982), Roberts (1984) and Berstrom et al (1986) construct models where there is one hundred percent crowding out of private contributions. The empirical research in this area,

¹³ This is the resurrection of a fairly old proposition. For example, Adam Smith (1976 edition) stated, "The endowments of schools and colleges have, in this manner, not only corrupted the diligence of public teachers, but have rendered it almost impossible to have any good private ones." (pt. III, art. II, p. 283). Likewise M. Friedman (1962) asserts "One of the major costs of the extension of governmental welfare activities has been the corresponding decline in private charitable activities." (pp. 190-191).

however, fails to substantiate this result.¹⁴ Even Andreoni (1993), who finds 71 percent crowding out in his experimental paper, readily admits that this result is exceedingly high compared to the econometric studies. Finally, Dasgupta and Itaya (1992) present a model which allows for heterogeneous agents who may treat such public contributions as inferior goods. In doing so, they create a model in which the equilibrium can converge to other solutions besides complete crowding out. While the amount of crowding out of private contributions is still uncertain, and while this research has taken place within a microeconomic framework, one implicit conclusion of this research is that the composition of the deficit can have an important impact on interest rates and macroeconomic crowding out.^{15 16}

The baseline IS-LM model can be amended in a straightforward manner to examine the crowding out of private contributions to public goods and its impact on macroeconomic crowding out. Let D_p be the dollar value of the deficit that is allocated to public goods in which the private sector also contributes, and let D_N be the dollar value of all other goods in which the government purchases. If the proportion of the deficit D_N represents is Z , and C_N and C_p represent the percentage of D_N and D_p that households save to take care of future tax liabilities, then the consumption function will take on the following form:

$$(18) \quad C = C_0 + C_Y Y - C_N Z D_0 - C_p (1-Z) D_0. \quad 0 \leq C_N, C_p, Z \leq 1$$

Such a consumption function is quite general. If C_p and C_N both equal one, we have perfect

¹⁴ See Abrams and Schmitz (1978), Schiff (1985) and Kingma (1989).

¹⁵ Since crowding is being used in two contexts, we use the term macroeconomic crowding out, when necessary, to refer to the controversy with respect to Ricardian equivalence.

¹⁶ Compositional effects of the government's deficit are also discussed in Turnovsky and Fisher (1995) and Andreoni (1989).

Ricardian equivalence, no matter what proportion of the deficit is allocated to D_p . An increase in the deficit lowers consumption dollar for dollar. If C_p and C_N both equal zero, then consumers are completely myopic. The deficit has no impact on consumption. Finally, if private agents treat government expenditures on public goods differently from other government expenditures, then it is C_N will be different from C_p . A change in Z leads to changed in consumption, interest rates, investment and income.

Solving the baseline IS-LM model with the above consumption function, and assuming W_R , from the previous model equals zero, yields the following interest rate equation:

$$(19) \quad r = [(1-C_Y)/L_r]A + (L_Y/L_r)C_0 + (L_Y/L_r)I_0 + (L_Y/L_r)VD_0]/H$$

where $V = 1 - C_N Z - C_p(1-Z)$.

Then

$$(20) \quad \partial r / \partial D_0 = (L_Y/L_r)V/H$$

and

$$(21) \quad \partial I / \partial D_0 = (\partial I / \partial r)(\partial r / \partial D_0) = [-I_r (L_Y/L_r)V]/H.$$

The signs of $\partial r / \partial D_0$ and $\partial I / \partial D_0$ will depend on whether $C_N Z + C_p(1-Z) \leq 1$.

1. If $V = C_N Z + C_p(1-Z) = 1$, the IS curve shifts right and left by the same amount (the deficit times the multiplier) and there is complete Ricardian equivalence. There is no change in investment.
2. If $0 < C_N Z + C_p(1-Z) < 1$, the IS curve does not return to its original position and there is crowding out..

Condition 2 ensures crowding out, and it is the same condition that yields a positive increase in the interest rate. Therefore, while this model is observationally equivalent to the baseline model, a significantly positive coefficient for the deficit in an interest rate equation will ensure crowding

out, no matter which of these two models is used. On the other hand, two stage least squares does not provide us a methodology to recover all the structural parameters. Only $C_N Z + C_P(1-Z)$ is recoverable, unless one assumes that $C_N = C_P$. While the restriction $0 \leq C_N, C_P, Z \leq 1$, makes the recovery of C_N and C_P unnecessary to test the crowding out proposition, the inability to recover these parameters leads to another problem.

If Z is not constant, one can not use the estimated equation to forecast future amounts of crowding out. Since $C_N Z + C_P(1-Z)$ is in the numerator of the interest rate equation, the deficit coefficient will change whenever Z changes. Because there is no reason to expect that Z is the same for each deficit, any forecast requires a knowledge of both C_N and C_P , which are not recoverable. That the deficit coefficient can change from period to period is pointed out quite strikingly by Swamy, Kolluri and Singamsetti (1990). Using a variable coefficient model to take into account non-stationarities, Swamy, Kolluri and Singamsetti find “the effect on interest rates of increasing the deficit is not fixed over time and doesn’t even have the same sign throughout our sample period.”

V. THE GOVERNMENT’S BUDGET CONSTRAINT

In recent years, many researchers have included the government’s budget constraint in their macroeconomic models. Perhaps the most famous of these models is Blinder and Solow’s (1974), but the work of Christ (1968), Ott and Ott (1965) and Turnovsky (1975) have all played important roles in developing this concept.¹⁷ These papers are important since they allow one to examine the impact of a change in the deficit over time; question the stability of long term bond financing, and provides another rationale for accepting the Keynesian proposition of crowding out. Of particular

¹⁷ See Arestis (1985) for instructive criticism of some of these models.

importance in this literature is the work of Schioppa (1984). Schioppa derives a model with a government budget constraint that also allows prices to be both flexible and endogenously determined. In doing so, he shows that many of the conclusions of these models are uncertain.¹⁸

We do not reproduce Schioppa's results here. Instead, we wish to focus on two features of this research: 1) these models don't explicitly consider the possibility of Ricardian equivalence, and 2) the demand for money is generally specified as being a positive function of government bonds. Furthermore, we wish to discuss these features within the context of our simple model.

Again, suppose the government wishes to undertake a deficit financed fiscal policy. To convince an individual to purchase a bond, the government must pay her a high enough interest rate to give up some of her money holdings. If the necessary interest rate is 5% and the bond is a \$100 bond, the individual now has a \$100 bond that pays 5% instead of \$100 in money and her wealth has increased.¹⁹

The key question is how will this individual's behavior change. First, consider the wealth effect on the demand for money. Suppose the individual's portfolio is made up of liquid and illiquid assets where value of her liquid assets, L , equals the value of her money + the value of her bonds ($M + B$). Further, suppose she wants to keep 40% of the value of her portfolio in L . When she bought more bonds, the value of L has increased. (This has to be the case for there to be a wealth effect). Thus, she has too much of her portfolio in L . If she takes some of her M out of L and purchases the non-liquid asset, then her money demand is negatively related to wealth. On the other

¹⁸ With respect to these models, Schioppa's work is somewhat analogous to ours since he shows that the results one obtains depends vitally on the model used, its assumptions, and its structural equations.

¹⁹ She has also gained some wealth because she has made a voluntary exchange. This wealth gain will not be considered in the analysis below.

hand, if bonds are a closer substitute to the third asset in her portfolio, she would decrease this third asset and hold more money. In this case, money demand would be positively related to wealth. Thus, in this portfolio balance approach, the relative substitutability of assets is the key. And if this substitution effect dominates, then the demand for money could very well be negative.²⁰

These foundations, as well as the wealth effect on consumption, can also be placed into our simple model.²¹ The consumption function becomes

$$(22) \quad C = C_0 + C_Y Y + C_W D. \quad -1 \leq C_W \leq 1$$

C_W is positive if the debt entails a wealth effect on consumption. It is negative if there is Ricardian equivalence (it will equal -1 if the Ricardian equivalence is perfect). In the baseline model without crowding out, C_W is equal to zero. The money demand function will be

$$(23) \quad M^D/P = L_0 + L_Y Y + L_D D. \quad -1 \leq L_D \leq 1$$

L_D can be positive or negative depending on whether or not government bonds are a closer substitute to money or the third asset in the portfolio. If $L_D = 0$, then there is no wealth effect on the demand for money. Inserting these equations into the baseline IS-LM model, the impact of the deficit on the interest rate and investment are

$$(24) \quad \partial r / \partial D_0 = [(L_Y/L_r)(1 + C_W) + (1 - C_Y) L_D/L_r]/H \text{ and}$$

$$(25) \quad \partial I / \partial D_0 = -I_r [(L_Y/L_r)(1 + C_W) + (1 - C_Y) L_D/L_r]/H,$$

²⁰ This is simplified version of B. Friedman (1977). Also see Tobin and Buiter (1986) and Arestis (1985). Barro (1974), Komendi (1983) and Aschauer (1985) postulate other reasons for a negative wealth effect on the demand for money.

²¹ We assume a simple budget constraint where $G_0 + \Delta M_0 = \Delta B + r \Delta B + T_0$. If the change in the money supply is held constant, then the deficit equals the change in bonds plus any interest that has to be paid. In our simple model, we assume that there is no dynamic interest rate effect. While this does not allow us to analyze the stability conditions in this model, this simplification does not hinder the forthcoming analysis.

with the condition for unambiguous crowding out being

$$(26) \quad L_Y(1 + C_W) + L_D(1 - C_Y) > 0.$$

While a positive coefficient in an interest rate equation ensures equation (26) holds, what can be said about a zero coefficient? If $L_Y(1 + C_W) + L_D(1 - C_Y) = 0$, the deficit coefficient will also be zero.

There are at least two cases in which this can occur. First, if $C_W = -1$ and $L_D = 0$, then there is no change in the interest rate, investment or income. Ricardian equivalence is present. However if

$L_D < 0$, and $L_Y(1 + C_W) + L_D(1 - C_Y) = 0$, then the positive wealth effect on consumption will be completely offset by the negative wealth effect on the demand for money. Interest rates and investment will remain constant, but income will increase. Ricardian equivalence assumes not only no wealth effects, but also no changes in income. This is clearly not the case in this latter example.

Furthermore, it is certainly possible that a negative wealth effect on the demand for money could overshadow a positive wealth effect on the consumption. In this case, income would then rise and the interest rate would fall. Deficits would actually cause investment to rise.²² Thus, the impact of a pure fiscal policy, even with a budget constraint and a wealth effect on both the demand for money and consumption, is not very clear. The deficit coefficient is only partially illuminating. In particular, the sign and the magnitudes of the wealth effects, the size of the income parameter in the demand for money and the marginal propensity to consume will all have an impact on the results.

VI. A COMPOSITE MODEL

One can place all four of these models into a more general model. This yields a model with the following structure:

$$(27) \quad Y = C + I + G$$

²² These results are similar to those of Cohen and McMenamin (1978), but in a simpler context.

$$(28) \quad C = C_0 + C_Y Y - C_N Z D - C_P(1 - z)D$$

$$(29) \quad I = I_0 - I_r r + I_R W_D D$$

$$(30) \quad D = G_0 - T_0 = D_0$$

$$(31) \quad M^D/P = M^S/P$$

$$(32) \quad M^D/P = L_0 + L_Y Y - L_r r + L_D D$$

$$(33) \quad M^S/P = M_0/P.$$

For the baseline model, $C_N = C_P = I_R = L_D = 0$. With Ricardo equivalence, $C_N = C_P = 1$, while I_R and L_D still equal zero. To add crowding-in, $I_R > 0$. The private contributions of public goods model has I_R and L_D equaling zero and the budget constraint model has I_R equaling zero, $L_D \neq 0$ and

$$C_N Z + C_P(1 - Z) = -C_W.$$

To ensure deficits increase the interest rate, it is necessary that

$$(33) \quad (1 - C_N Z - C_P(1 - Z)) + (1 - C_Y)L_D + I_R W_D > 0,$$

and to ensure crowding out occurs, it is necessary that

$$(34) \quad -(I_r L_Y / L_r)(1 - C_N Z - C_P(1 - Z)) + (1 - C_Y)(I_R W_D - L_D I_r / L_Y) < 0.$$

When reviewing the interest rate condition, unless L_D is sufficiently large and negative, it is likely that an increase in the deficit will increase the interest rate. However, the investment condition is not that clear. The first term in equation (34) is either negative or zero. The second term can be either positive, negative or zero, depending on the sign and magnitude of L_D . Furthermore, $I_R W_D$ also exerts positive pressure on investment. Extrapolating from the interest rate equation to changes in investment can't be done. Likewise, Ricardian equivalence ($C_N = C_P$) doesn't ensure that there will be no changes in the interest rate. There are seven parameters, plus the sum of $C_N Z$ and $C_P(1 - Z)$ that need to be recovered in order to formulate conclusions concerning the crowding out/Ricardian

equivalence controversy.

VII. Conclusions

Many economists have attempted to determine the efficacy of either crowding out or Ricardian equivalence by empirically estimating a reduced form equation. We have demonstrated that a typical reduced form equation might stem from more than one model. In fact, we have shown that the same reduced form equation can be derived from four different models. We have also demonstrated that the information obtained from the estimation of a reduced form equation might yield very different conclusions depending on the underlying model that is being estimated. For example, in the crowding in model, Ricardian equivalence and increases in interest rates can coexist, while in the public contribution model this is not the case. Likewise, the absence of interest rate increases does not assure Ricardian equivalence. Unaffected interest rates imply Ricardian equivalence in the baseline model, but do not in the government constraint model. Finally, we have shown how conclusions about crowding out and Ricardian equivalence will depend on the magnitude and the direction of the wealth effects, the composition of the government budget, and the impact of government deficits on the marginal efficiency of investment. In the end, the essence of this paper is the suggestion that, even in the best of econometric conditions, resolving the crowding out/Ricardian equivalence controversy will require researchers to have a more complete understanding of the structural relationships that underlie macroeconomic models.

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