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GOVERNMENT CONSUMPTION AND PRIVATE INVESTMENT IN CLOSED AND OPEN ECONOMIES

by

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Government Consumption and Private Investment
in Closed and Open Economies

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Abstract

A standard result in the literature on the equilibrium approach to fiscal policy is that temporary fiscal expansions reduce investment while permanent expansions leave it unchanged. It is shown here that the latter conclusion is invalid if labour supply is variable and production takes place under constant returns to scale. Under these circumstances a permanent expansion raises investment, since it raises both current and future labour supply, and the latter raises the expected marginal product of capital. The implication for a small open economy facing a given world interest rate is that both temporary and permanent fiscal expansions "crowd in" investment. That such an effect does not show up in Barro's empirical work on a large cross-section of countries must cast some doubt on the validity of the equilibrium approach.

1. Introduction

Traditional Keynesian analysis implied that fiscal expansions, even while crowding out private investment, could nevertheless stimulate aggregate production. That this appeared to many as an accurate depiction of how real economies responded to fiscal stimuli was perhaps the most important factor in popularising the Keynesian model.

Recent developments in macroeconomics have shown, however, that a purely equilibrium approach to the analysis of fiscal policy can replicate these results, though the factors driving economic behaviour are very different from those postulated in the earlier models. The "new view", pioneered by Barro (1981, 1989), Hall (1980) and Aschauer (1985, 1988), and drawing its inspiration from Bailey (1971), argues that the need to finance any increase in government consumption reduces the private sector's discounted disposable income and thereby reduces its consumption of all normal goods, including leisure. It is this impact on the labour/leisure decision that leads to the expansion in output.

Permanent increases in the size of the public sector are postulated to reduce private consumption by an equivalent amount both now and in the future, so that no excess demand emerges at the current interest rate; investment and the trade balance are therefore unaffected by these shocks. If the expansion is temporary, however, consumption-smoothing leads either to reduced investment (in a closed economy), or to

foreign borrowing and a reduced trade balance if the economy is open.

The present paper shows however that under the assumption of a wealth effect on labour supply, which is crucial for the ability of the neo-classical model to explain how fiscal spending can be expansionary, a permanent increase in spending will raise investment through its impact on the expected future marginal product of capital. This mechanism has been recognised (in a footnote) by Barro and King (1984) but they suggest that it implies merely that investment is reduced less for permanent fiscal expansions than for temporary changes.

The wealth effect on labour supply also plays a crucial role in the real business cycle model of Aiyagari, Christiano and Eichenbaum (1990) to which the present paper is closely related. It drives their "central result" that, in contrast to Hall's (1980) assertion, "persistent changes in government consumption always have contemporaneous employment and output effects which are larger than those due to transitory changes". Since their model is designed primarily for quantitative use, however, this and their other key qualitative results show up here in a more transparent fashion in the closed economy section of the paper. This more transparent structure also permits us, in contrast to them, to follow the literature in allowing government consumption to affect the marginal utility of private consumer spending and leisure¹. These authors do not consider the open-economy case.

Much of the literature to date however has remarked on how the trade-balance effects in an open economy facing a given world interest rate represent a mirror-image of the investment-effects that arise in the closed economy; this has been noted, for example, by Aschauer and Greenwood (1985), Kimbrough (1985), Ahmed (1986,1987) and Barro (1989). This seems to have deflected attention from the determinants of investment in the open economy. The present paper focuses directly on this, and shows that while temporary fiscal expansions crowd-out investment in the closed economy, they lead to crowding-in when interest rates are determined abroad; this arises because the open economy can adjust to a temporary period of excess demand by running a current-account deficit, so that the only factor impacting on investment is the wealth effect on labour supply. As will be seen, this means that the trade-balance effects no longer mirror the closed economy's investment-response to government spending.

The model is set up in the next section, where the basic results on the investment effects of government consumption in a closed economy are studied. The analysis is then extended to the open economy. Mathematical results are contained in the appendix.

2. Investment Effects in a Closed Economy

The points to be made here can be illustrated most easily in a two-period framework. Periods are subscripted 1 and 2.

The representative individual is assumed to maximise the following log-linear utility function²

$$(1) \quad U = [\alpha \ln C_1 + (1-\alpha) \ln (1-L_1)] \\ + B[\alpha \ln C_2 + (1-\alpha) \ln (1-L_2)]$$

which depends on leisure, $1-L_i$, and effective consumption, C_i ; $i=1,2$. The maximum amount of leisure is normalised at unity, L represents hours worked, and B is the discount factor. Effective consumption in period i consists of consumption goods purchased by the private sector, c_i , plus that proportion, β , of government consumption G_i which substitutes for private consumption:

$$(2) \quad C_i = c_i + \beta G_i.$$

In line with the existing literature, β is assumed to have a value of less than unity; this finds empirical support in the work of Kormendi (1983), Ahmed (1986) and Aschauer (1985).

Utility is maximised subject to the intertemporal budget constraint

$$(3) \quad C_1 + RC_2 = F(K_1, L_1) + RF(K_1+I, L_2) - I - T$$

which, taking (2) and the government budget constraint into account, can also be written

$$(4) \quad C_1 + RC_2 = F(K_1, L_1) + RF(K_1+I, L_2) - I \\ - (1-\beta)G_1 - R(1-\beta)G_2 \equiv A_0$$

where R is the interest factor (i.e. one divided by one plus the interest rate), T is the present discounted value of lump-sum taxes, and I is first-period investment. Capital must be installed one period in advance of use, and does not depreciate.

From (1) and (3) it is clear that Ricardian Equivalence holds, and how government spending is financed need not concern us further.

The first-order conditions for the solution of the maximisation problem are

$$(5) \quad C_2 = C_1 B/R$$

$$(6) \quad C_1 = F_{L1}(1-L_1)\alpha/(1-\alpha)$$

$$(7) \quad C_2 = F_{L2}(1-L_2)\alpha/(1-\alpha)$$

and

$$(8) \quad RF_{K2} = 1$$

where F_{L1} and F_{K1} represent the marginal products of labour and capital in period i . These conditions are standard and easily interpreted. Equations (5) and (8) are the intertemporal efficiency conditions for effective consumption and investment, while (6) and (7) are the intratemporal efficiency conditions relating effective consumption and leisure.

Equilibrium in the goods market each period entails:

$$(9) \quad F(K_1, L_1) = c_1 + I + G_1$$

and

$$(10) \quad F(K_1+I, L_2) = c_2 + G_2$$

Equations (2), (9) and (10) can be used to substitute for C_1 and C_2 in equations (5)-(7). If the system is then differentiated and (8) is used to substitute for dR in equation (5), we are left with three equations which determine the behaviour of the endogenous variables I , L_1 , and L_2 .

The determinant of this system is positive (its value is given in the appendix) and is denoted Ω^1 .

Consider first of all the effects of a temporary increase in government consumption³; $dG_1 > 0$, $dG_2 = 0$. Since $\beta < 1$, the benefit to the private sector is less than the cost in terms of taxation, and private discounted wealth falls⁴. This reduces consumption in both periods, and raises the period-one labour supply. It is also likely to raise labour supply in period two, but since the second-period wage falls (as can be seen from the fact that the interest rate rises) there is a substitution effect operating in the opposite direction to the wealth effect. (A sufficient condition for the latter to prevail is given in the appendix).

$$dL_1/dG_1 > 0, \quad dL_2/dG_1 ?$$

$$dL_1/dG_1 > dL_2/dG_1 \text{ for } R \geq B$$

Because the private-sector response to the temporary shock is smoothed excess demand would prevail in the goods market at the initial interest rate. This raises the interest rate and reduces investment:

$$(11) \quad \begin{aligned} dI/dG_1 = & \Omega(1-\beta) (B/R) [\alpha/(1-\alpha)^2] \times \\ & [F_{L1}\{F_{LL}(1-L_2)\alpha - F_{L2}\} + (1-L_1)F_{LL}\{F_{L2}-F_{LL}\alpha(1-L_2)\}] \\ & < 0 \end{aligned}$$

The temporary shock therefore raises first-period output, while second-period output falls since consumption is reduced

and government spending returns to its initial level. All of these results for the temporary expansion are standard.

Now let us turn to the effects of a permanent expansion in government consumption; ($dG \equiv dG_1 = dG_2 > 0$). Intertemporal disposable wealth again falls, leading to reduced consumption and increased labour supply in each period. (There is no ambiguity about second-period labour supply in the present case).

The results reported on this experiment are based on an initial equilibrium in which the time preference and interest rates are equal ($B=R$), as in the steady-state equilibrium of dynamic optimisation models. A wide range of effects is possible if this condition does not hold, and, as Aschauer and Greenwood (1985) remark, "concrete predictions outside of (this) benchmark case seem hard to obtain".

The impact on investment of a permanent increase in government consumption is given by:

$$(12) \quad dI/dG = \Omega(1-\beta)C_1B[(1/(1-\alpha)]F_{KL} [F_{L1} - \alpha F_{LL}(1-L_1)] \\ > 0$$

Investment rises because of the wealth effect on future labour supply. Ceteris paribus this would generate excess demand in the present, so the interest rate must rise in this case also⁵. With the interest rate rising along with investment and future labour supply, it is clear that the second-period

capital-labour ratio must decline, while output rises.

$$dL_1/dG, dL_2/dG > 0, \text{ with } dL_1/dG > dL_2/dG$$

$$dR/dG < 0$$

(The interest rate moves in the opposite direction to the interest factor). Furthermore, with investment rising in the case of a permanent fiscal expansion and falling when the expansion is temporary, while consumer spending falls less than one-for-one with government consumption, it is clear that output can rise more in the case of the permanent expansion, and it is indeed easily verified that this occurs⁶.

These results contrast with those of Barro (1989) and Aschauer and Greenwood (1985), who find that a permanent increase in government consumption should leave investment unchanged. The present result arises for very straightforward reasons, though: government consumption raises hours worked in both periods, and an expansion in future hours worked, through its impact on the expected future marginal product of capital, stimulates current investment.

What then accounts for the earlier results that $dI/dG = 0$? In Barro (1989) it arises because in the section of that paper in which the effects of temporary and permanent fiscal expansions are compared the supply of labour is held fixed. Since the present result arises because of the wealth effect on future labour supply it clearly will not emerge from that model. Aschauer and Greenwood (1985) allow labour supply to vary, but

work with an unusual specification of the production function, one in which the second-period marginal product of capital depends on investment rather than on the capital-labour ratio as it would under constant returns to scale⁷. This is equivalent to setting F_{KL} equal to zero in the present model, in which case, as equation (12) above reveals, the mechanism driving our results does not operate⁸.

3. Investment Effects in an Open Economy

The open economy literature as mentioned earlier has tended to ignore investment in order to compare the response of the current account to the investment effects derived for the closed economy. Thus Kimbrough (1985) works with a fixed capital stock while Aschauer and Greenwood's analysis is restricted by their unusual investment function.

The last result derived above however has a particularly strong implication for a competitive economy facing a given world interest rate, since the wealth effect on labour supply is now the only factor that affects how investment responds to government consumption.

In the open economy case, the first-order conditions (5)-(8) continue to hold, but goods market equilibrium as specified in equations (9) and (10) need not hold in each period, since the economy can run a current account surplus or deficit.

The open-economy model can be solved as follows. Using the

intertemporal budget constraint (4) we can write (6) and (7) as

$$(13) \quad F_{L1}(1-L_1) = [(1-\alpha)/\alpha] [1/(1+B)] A_0$$

$$(14) \quad F_{L2}(1-L_2) = [(1-\alpha)/\alpha] [B/(1+B)R] A_0$$

while (7) becomes

$$(15) \quad R^* F_{K2} = 1$$

where R^* is now constant due to the fixed foreign interest rate. Plugging the value of L_1 from (14) into (13) yields three equations in the three unknowns A_0 , L_2 and I .

The determinant of this system is denoted Θ^{-1} , and is positive.

A permanent increase in government spending has the same qualitative effect as in the closed economy, for the reasons identified above.

$$(16) \quad dI/dG = \Theta F_{KL} [(1-\alpha)/\alpha] [B/(1+B)R^*] (1-\beta) (1+R) > 0$$

The main result in the open economy case however is that since the interest rate is fixed, and the economy can adjust to a temporary period of excess demand through running a current account deficit, as a closed economy cannot do, the only factor impacting on investment in the case of a temporary fiscal expansion is the wealth effect on labour supply. A temporary fiscal expansion also therefore raises investment:

$$(17) \quad dI/dG_1 = \Theta F_{KL} [(1-\alpha)/\alpha] [B/(1+B)R^*] (1-\beta) > 0$$

Because the negative wealth effects of a temporary expansion

are smaller, future labour supply rises less than when the expansion is permanent, and the investment effects are accordingly less also.

This has interesting implications for the current account as well, represented in the following equation:

$$(18) \quad BT_1 = F(K_1, L_1) - C_1 - I - G_1$$

The conventional wisdom is that temporary expansions worsen the trade balance while permanent expansions leave it unchanged. The investment effects identified here however mean that permanent expansions also worsen the trade deficit⁹. In fact, although it appears unlikely, the impact of a permanent shock may exceed that of a temporary one.

4. Concluding Comments

The wealth effect on labour supply plays the key role in the equilibrium analysis of how fiscal expansion raises output. One implication of this mechanism has been downplayed in the literature to date however: this is that a fiscal expansion which raises future labour supply thereby enhances the expected marginal product of capital and so provides a stimulus to investment.

For the closed economy, a temporary fiscal expansion creates excess demand at the prevailing interest rate; the interest rate must therefore rise sufficiently to dominate this effect, and so investment falls. For a permanent expansion however the greater downward pressure (through the wealth effect) on

consumption and leisure allows investment to rise, while still forcing up interest rates.

For a small open economy facing a fixed world interest rate this mechanism has even more dramatic effects. The only factor driving investment is now the wealth effect on future labour supply, so that both temporary and permanent fiscal expansions must "crowd-in" investment. This means that permanent as well as temporary expansions will generate current account deficits in the short run. The conventional view that the behaviour of the current account of a small open economy replicates the response of investment to fiscal spending in the closed economy is therefore invalid.

One further contrast between the closed and open economy cases is worth drawing out; while a temporary fiscal expansion in the former should reduce future output (through the crowding-out effect on investment), according to this approach it should raise both present and future output in a small open economy.

Finally, then, we must ask whether these crowding-in effects implied by the equilibrium approach occur in practice. Empirical work undertaken by Barro (1989b, 1989c) on a large cross-section of countries suggests that the ratio of real government consumption expenditure to real GDP has a negative association with private investment. Since most of the more than 70 countries included in his analysis would be classed as

open rather than closed economies, his results, from the viewpoint of the present paper, must be interpreted as casting doubt on the validity of the equilibrium approach.

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APPENDIX

Closed-Economy Results

The determinant of this system is:

$$\begin{aligned} \Omega^1 = & [\alpha/(1-\alpha)^2] F_{L1} \{ F_{L2} F_{K2} + F_{L2} (B/R) - \alpha(1-L_2) F_{LL} (B/R) \} \\ & + \{ [F_{L2} F_{KK}/(1-\alpha)] - F_{K2} F_{KL} \} [C_1 B/(1-\alpha)] [\alpha F_{LL} (1-L_1) - F_{L1}] \\ & - \{ [(1-L_2) F_{L1}/(1-\alpha)] \} F_{LL} F_{K2} \alpha/(1-\alpha) \\ & + [F_{KL} F_{L1} (1-L_2)] [\alpha/(1-\alpha)^2] F_{L2} \\ & - F_{LL} F_{K2} [\alpha/(1-\alpha)]^2 F_{L2} (1-L_1) \\ & - \{ [F_{L2}/(1-\alpha)] - [(1-L_2) F_{LL} \alpha/(1-\alpha)] \} (B/R) F_{LL} (1-L_1) \{ \alpha/(1-\alpha) \} \\ & + [F_{LL} F_{K2} - F_{KL} F_{L2}] (1-L_1) (1-L_2) [\alpha/(1-\alpha)]^2 F_{LL} \\ & > 0 \end{aligned}$$

The following are the effects of a temporary change in government spending.

$$\begin{aligned} dL_1/dG_1 = & \Omega(1-\beta) \{ [\alpha/(1-\alpha)] \{ F_{L2} [F_{K2} + (1-L_2) F_{KL}] - F_{K2} F_{LL} (1-L_2) \} \\ & + C_1 B [F_{KL} F_{K2} - [1/(1-\alpha)] [F_{L2} F_{KK}]] \} > 0 \end{aligned}$$

$$dL_2/dG_1 = \Omega(1-\beta) (B/R) \{ [\alpha/(1-\alpha)] \{ F_{L1} - (1-L_1) F_{LL} \} \} [F_{K2} - \{ \alpha/(1-\alpha) \} (1-L_2) F_{KL}]$$

The final term in square brackets (and therefore the whole expression) is positive under the following condition; since F_{KL} is either constant or declining in L we have

$$F_K(L_x) \leq F_K(L_2) + F_{KL} \{ L_x - L_2 \}$$

The right hand side of this expression is equal to the term in square brackets for $L_x = [1/(1-\alpha)] [L_2 - \alpha]$; so a sufficient condition for dL_2/dG_1 positive is $F_K(L_x)$ positive.

The impact on the interest rate is

$$\begin{aligned} dr/dG_1 = & \Omega(1-\beta) (B/R) [\alpha/(1-\alpha)] \\ & \{ [F_{KK} F_{L2}/(1-\alpha)] [F_{LL} (1-L_1) - F_{L1}] \\ & + [F_{K2} F_{KL} \{ F_{L1} - F_{LL} (1-L_1) \}] \} > 0 \end{aligned}$$

The effects of a permanent shock are

$$\begin{aligned} dI/dG = & \Omega(1-\beta) \\ & \{ [1 - (B/R)] [1/(1-\alpha)]^2 [F_{L1} - (1-L_1) \alpha F_{LL}] [F_{L2} - \alpha(1-L_2) F_{LL}] \\ & + (B/R) F_{L1} [1/(1-\alpha)] [F_{L2} - \alpha(1-L_2) F_{LL}] \\ & - [F_{L2} - C_1 B F_{KL}] [1/(1-\alpha)] [F_{L1} - \alpha(1-L_1) F_{LL}] \} \end{aligned}$$

which is positive for $B=R$ (At this initial equilibrium the pre-shock values of L_1 and L_2 are also equal).

For $B=R$, $dL_2/dG = \Omega(1-\beta)$

$$\begin{aligned} & \{ (1+F_{K2}) [\alpha/(1-\alpha)] [F_{L1} - (1-L_1) F_{LL}] \\ & - C_1 B F_{KK} [1/(1-\alpha)] [F_{L1} - \alpha(1-L_1) F_{LL}] \\ & + F_{L1} [\alpha/(1-\alpha)] (1-L_2) F_{KL} \} > 0 \end{aligned}$$

$$dL_1/dG = dL_2/dG + C_1 B F_{KL} [1+F_{K2} - F_{KL} (1-L_2) \alpha/(1-\alpha)] > 0$$

A sufficient condition for the additional term to be positive and therefore for $dL_1/dG > dL_2/dG$ has been given above.

The interest-rate effect is $dr/dG = \Omega(1-\beta)$

$$\begin{aligned} & \{ F_{KL}(1+F_{K2}) [\alpha/(1-\alpha)] [F_{L1} - (1-L_1)F_{LL}] \\ & + F_{KL}F_{L1} [\alpha/(1-\alpha)] (1-L_2)F_{KL} \} > 0 \end{aligned}$$

Open-Economy Results

The determinant of this system is

$$\Theta^{-1} = - [1+F_{L1}D] [F_{L2}F_{KK}] - [(1-\alpha)/\alpha] [B/(1+B)] F_{L2}F_{KK} > 0$$

$$\text{where } D = [(1-\alpha)/\alpha] [1/(1+B)] / [F_{L1} - F_{LL}(1-L_1)] > 0$$

$$dA_0 = \Theta [F_{KK}F_{L2}] (1-\beta) [dG_1 + R^*dG_2] < 0$$

Since $dL_1/dA_0 = -D$ it is immediately clear that A_0 falls more, and L_1 and Y_1 accordingly rise more, for a permanent compared to a temporary fiscal expansion.

$$dL_2 = -\Theta F_{KK} [(1-\alpha)/\alpha] [B/R(1+B)] (1-\beta) [dG_1 + R^*dG_2] > 0$$

$$dBT_1/dG_1 = \Theta(1-\beta)B/(1+B) \{ (F_{L2}F_{KK}/\alpha) - [(1-\alpha)F_{KL}/\alpha R] \} < 0$$

$$\begin{aligned} dBT_1/dG = & [\Theta(1-\beta) / \{ F_{L1} - (1-L_1)F_{LL} \}] [(1-\alpha)/\alpha] \\ & \{ -[F_{L1}F_{KL}^2(1-L_2)R/(1+B)] + F_{KL}[F_{LL}(1-L_1) - F_{L1}] \} < 0 \end{aligned}$$

$dBT_1/dG_1 - dBT_1/dG$ has the same sign as

$$\begin{aligned} & (F_{L1}F_{L2}F_{KK}/\alpha) \\ & - F_{KL} \{ (1-\alpha)/\alpha \} [(1-L_1)F_{LL} - F_{L1}] \\ & - F_{L1}(1-L_2)F_{KL}^2 \end{aligned}$$

which is ambiguous a priori, with most elements negative.

1. The numerical findings in Christiano and Eichenbaum (1988), they suggest, indicate that their results would be robust to this extension. The present paper provides a closed-form confirmation of this.

2. This analytically convenient functional form emphasises the wealth effects with which the present paper is primarily concerned. The log specification is sufficiently general that existing results on the investment effects of government spending show up as special cases of the present model.

3. Barro (1981) defines temporary changes in policy as changes in the timing of government purchases with the present value held constant; temporary changes therefore have no wealth effects. The present paper follows Aschauer and Greenwood's (1985) two-period formulation instead. The distinction clearly makes no difference to the results generated for permanent shocks, and it is easy to see how the effects of temporary shocks would change under Barro's formulation.

4. The term A_0 in equation (4) is a proxy for discounted wealth. The log specification allows us write C_t and $F_{L,t}(1-L_t)$ as linear functions of A_0 , though we only make use of this in the open-economy section of the paper.

5. This effect arises in Aiyagari, Christiano and Eichenbaum (1990) also. In their model the interest rate is above its steady state value whenever the capital stock is below its steady state, so a high interest rate will be associated with reduced investment if the fiscal shock is temporary and with increased investment if the fiscal shock is permanent.

6. Barro and King (1984) argue that "permanent and temporary movements in government purchases have identical effects on current quantities of work, production and consumption when preferences are time-separable". We see here that this applies only when the labour-supply effect on investment is ignored. A

multiplier can exist when this effect is taken into account, as Aiyagari, Christiano and Eichenbaum (1990) have pointed out, and the interest rate impact of permanent fiscal expansions can be larger than for temporary expansions. These possibilities can arise here, for particular parameter values, although a multiplier is less likely than in their model because of the direct crowding-out effects of government spending on private consumer spending that are taken into account in the present case; i.e. as $\beta \rightarrow 1$, $dF(K_1, L_1)/dG_1 \rightarrow 0$.

7. See their equation (7).

8. It is worth noting that the present result must also arise in an optimising version of the Solow growth model. The unique steady-state rate of return on capital in that model pins down the long-run capital-labour ratio. If a permanent fiscal expansion raises long-run labour supply it must also therefore stimulate capital accumulation; see Barry and Devereux (1991).

9. Ahmed's (1986) findings on UK data are inconclusive on the question of whether permanent government spending significantly affects the current account.