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AID AND GOVERNMENT: A DYNAMIC MODEL OF AID, INCOME AND FISCAL BEHAVIOUR

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AID AND GOVERNMENT:

A DYNAMIC MODEL OF AID, INCOME AND FISCAL BEHAVIOUR

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Abstract

A recent advance in the analysis of the impact of aid inflows on domestic savings has been models that focus specifically on the response of public savings to higher aid. The theoretical consensus of this new literature is that aid displaces taxes and that the increment to government expenditure is less than the value of the aid inflow. This paper presents a simple model that replicates this result and then shows that the result need no longer hold once we allow for feedback effects through higher income. Whether or not aid adversely affects taxes is shown to depend, inter alia, on the impact of aid on private investment.

1 INTRODUCTION

Griffin's (1970) argument that aid inflows would displace domestic savings, thus undermining their impact on growth, has spawned a substantial, if inconclusive, empirical literature.[1] More recently, Heller (1975) modelled the impact of aid on taxation and government expenditure - and, thus, on public savings. The theoretical conclusion of his model (made explicit by Gang and Khan, 1986) is that aid will offset taxes and that government expenditure will rise by less than the value of the inflow (i.e. aid is fungible). The impact of aid on recipient fiscal behaviour has now been extensively empirically examined.[2]

However, neither the empirical literature on aid and savings nor that more specifically on aid and public savings have arrived at any consensus.[3] I have argued elsewhere (White, 1992b and 1992c) that part of the reason for this lies in the poor theoretical underpinnings of these empirical literatures: they attempt to examine the impact of aid on savings in isolation from the wider macroeconomic impact of aid. Griffin's paper was criticised at the time (Eshag, 1971; and Kennedy and Thirlwall, 1971) for not allowing for the possibility that aid may lead to higher current income and thus higher savings.

Similarly, the original proponents of the two gap model (e.g. Chenery and Strout, 1966) supposed that aid would lead to higher future growth, thus increasing domestic savings in the future and closing the savings gap. Yet the impact of aid on current and future income and the consequent feedback into higher savings has not been incorporated into the savings literature.[4] In fact, there has been a general failure in the aid effectiveness literature to base the analysis on explicitly stated economic models: this applies both to the literature in the traditional savings debate and the more recent analyses of recipient government response to aid inflows.

Mosley, Hudson and Horrell (1987) incorporated Heller's model of recipient fiscal response into a wider model including a production function: examining how this response affects the economy's growth rate.[5] However, this model does not incorporate any of the feedback effects from aid, through higher income, mentioned above: there is no multiplier and the dynamic aspects of the model are not explored. This paper presents, in section 2, a simplified version of their model, in which aid can increase current income. It is shown that the conclusion that aid displaces taxes is a partial result that need not hold once feedback effects are considered. Further, even if aid does reduce taxes in the current period the situation is reversed in subsequent periods. Section 3 concludes and discusses implications for further research.

2 THE MODEL

The government is assumed to maximise the loss function:

$$U = -\frac{a_1}{2}(G-G^*)^2 - \frac{a_2}{2}(T-T^*)^2 \qquad (1)$$

subject to the budget constraint:

$$G = A + T \qquad (2)$$

where G is government expenditure, T tax revenue, starred variables (*) refer to desired levels and A is the aid inflow. All variables are current, with the time subscript not shown for notational convenience. The desired levels of G

and T are given by:

$$G^* = a_3 G_{t-1} \tag{3}$$

$$T^* = a_4 Y \tag{4}$$

Thus far this is a simplified form of the model developed by Heller, with two rather than five variables in the objective function.[6] The model is completed by three economic relationships. The first is the investment function, similar to that used by Mosley, Hudson and Horrell:

$$I = I_p = a_7 + a_8 A \tag{5}$$

where a_7 is an autonomous element in investment and the coefficient a_8 captures the relationship between aid and private investment - be it negative (crowding out) or positive (crowding in). This relationship will be shown to be crucial in determining aid's impact.

Mosley, Hudson and Horrell complete their model with a production function that leads to a Harrod-Domar equation. Here aid is modelled to affect current income, so the model is closed with a consumption function and national accounting identity:

$$C = a_5 + a_6(Y-T) \tag{6}$$

$$Y = C + I + G \tag{7}$$

Maximising equation (1) subject to equation (2) and substituting in equations (3) and (4) gives:

$$G = a_3 a_1 G_{t-1} + a_2 a_4 Y + a_2 A \tag{8}$$

$$T = a_1 a_3 G_{t-1} + a_2 a_4 Y - a_1 A \tag{9}$$

where the equation has been normalised so that $a_1+a_2=1$, which may be done with no loss of generality. These results shows that, for a given level of income (i.e. it is only a partial effect), an aid inflow partly funds an increase in

government expenditure and partly a reduction in the volume of taxes collected, a_2A being allocated for the former and a_1A for the latter. This result follows even though the budget constraint is written so that all aid is used to finance government expenditure: fungibility is a result of the model. This is the conclusion reported by Heller and tested in the subsequent empirical literature. However, it will be shown below, that it is a result that need not hold once the impact of aid on income is allowed for.

The distribution between these two uses is determined by the relative importance assigned to the two target variables. It is easiest to follow this by assigning a_2 a value of zero, so that a_1 is unity. Government only attaches importance to achieving its expenditure target, and the loss function is minimised (to zero) by setting G at its desired level. The aid inflow is then all used to decrease taxes to avoid disturbing G from this optimal value. In general, the higher the preference for meeting the expenditure target the greater the proportion of aid that will be used to reduce taxes.

These are only <u>partial</u> effects, the total impact of an aid inflow on government expenditure and taxes depend on how aid affects income. To analyse this it is necessary to complete the solution of the model. To obtain the reduced form for income, substitute equations (6), (8) and (9) into (7):

$$Y = \frac{1}{\Phi}\{(a_5 + a_7) + a\text{-}1a_3(1-a_6)G_{t-1} + (a_8 + a_1a_6 + a_2)A\} \qquad (10)$$

where $\Phi = (1 - a_6)(1 - a_2a_4)$, the inverse of which is the multiplier.

The impact of higher aid on current income is given by the coefficient of aid in this equation. The "direct impact", given in the final term of (10) (a_2/Φ), is the extent to which aid finances an increase in government expenditure (times the multiplier, $1/\Phi$). The second term (a_1a_6/Φ) reflects the effect of the consumption increase caused by the decrease in taxes financed out of the aid inflow. The effect of aid on income through the response of private investment is given by the first term (a_8/Φ).

It is only the last of these - the response of private investment - that may be negative. If aid has a <u>positive</u> impact on private investment then its impact

on income is unambiguously positive. Specifically, the condition for aid to increase income (dY/dA>0) is:

$$-a_8 < a_1 a_6 + a_2 \tag{11}$$

The higher is the MPC the closer will be the right-hand side of this expression to unity. Assuming, for illustrative purposes, that the government attaches equal weight to the two targets (a_1=a_2=0.5) and an MPC of 0.7, then a_8 would have to be less than -0.85 for aid to reduce income; i.e. the displacement of private investment by aid must be close to or greater than unity for an adverse impact on income to occur.

The response of government expenditure and taxes also depends on the sign and magnitude of a_8:

$$T = \frac{a_2 a_4 (a_5 + a_7)}{\Phi} + \frac{a_1 a_3}{1 - a_2 a_4} G_{t-1} + \{\frac{a_2 a_4}{\Phi}(a_8 + a_2 + a_1 a_6) - a_1\} A \tag{12}$$

$$G = \frac{a_2 a_4 (a_5 + a_7)}{\Phi} + \frac{a_1 a_3}{1 - a_2 a_4} G_{t-1} + \{\frac{a_2 a_4}{\Phi}(a_8 + a_2 + a_1 a_6) + a_2\} A \tag{13}$$

so (dT/dA) > 0 if

$$(1 + a_8) > \frac{a_1 (1 - a_6)}{a_2 a_4} \tag{14}$$

and (dG/dA) > 0 if

$$(1 + a_8) > (1 - a_8) \{\frac{a_1 + a_2 a_4 - 1}{a_2 a_4}\} \tag{15}$$

The relationship between aid and private investment is thus crucial in aid's overall macroeconomic impact and deserving of more detailed analysis (see White and McGillivray, 1992, for further discussion).[7]

These results show only the impact effect, a longer term effect will operate through the increase in government expenditure. By equation (3) an increase in G will raise the target and actual level of G in subsequent periods: by increasing government expenditure aid can initiate a multiplier process lasting beyond the period of the inflow.

If the increase in aid is permanent a new equilibrium will be established at which the total increase in income is given by:

$$\sum_{i=0}^{\infty} dY_{t+i} = c + \frac{ba_2(1+ca_4)}{1-e}\, dA_t \qquad (16)$$

where, $b = a_1a_3(1-a_6)/\Phi$; $c = (1/\Phi)\{a_8 + a_1a_6 + a_2\}$; and $e = a_1a_3/(1-a_4a_2)$.[8]

On the other hand, if the aid inflow is temporary, the economy must resettle to its initial equilibrium. These two cases are shown in Figures 1 and 2. Because of the necessity to assign "realistic values" to the parameters, the figures must be interpreted with caution.[9] Under the assumed values, the level of taxes rises in response to an aid inflow in both cases, since the increase in income is sufficient to offset the partial response observed in equation (9). When the inflow is temporary taxes nonetheless continue to rise in the second period, after the inflow has halted, before falling to their former value. Since aid must always account for the difference between taxes and government expenditure, rising taxes mean that government expenditure will rise by more than the value of the aid inflow.

Sensitivity analysis (which may also be done by reference to equation 14) suggests that, holding the other parameters constant, the following changes in parameters lead taxes to fall in the current period:

- a low private marginal propensity to consume (of less than 0.50);
- assuming that aid crowds out, rather than crowds in, private investment (taxes falling for values of a_8 of -0.25 or less); or
- low tax rates (of less than about 25%).

Finally some comment should be made on the macro model employed

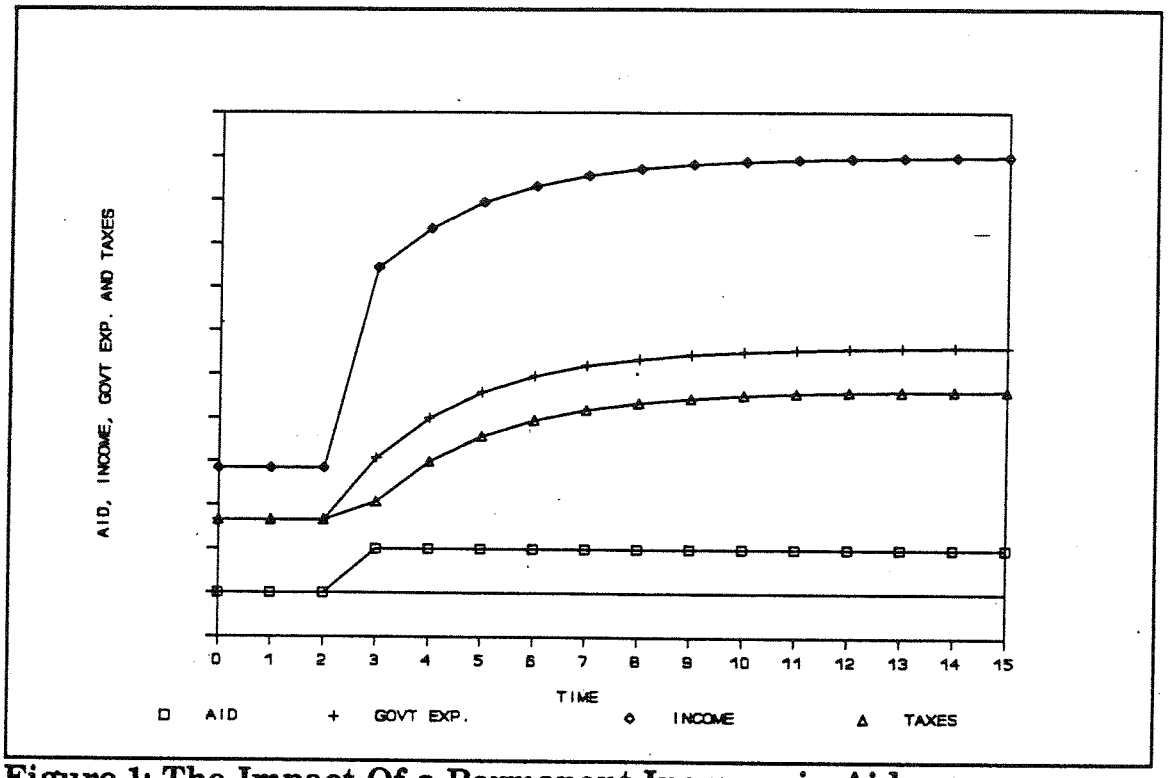

Figure 1: The Impact Of a Permanent Increase in Aid

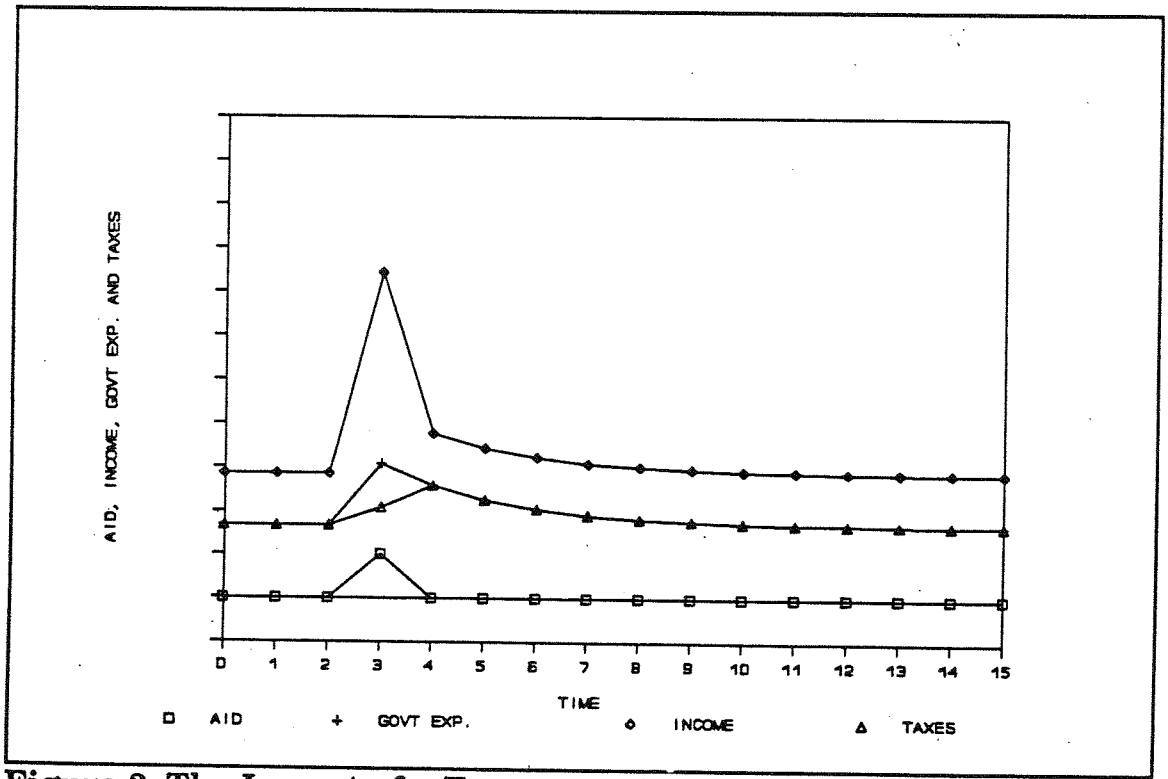

Figure 2: The Impact of a Temporary Increase in Aid

here, which is deliberately very simple. Some of its features, such as the expansionary nature of higher taxes, might be thought to be unrealistic. This expansionary impact, which results from the inclusion of a government budget constraint, may be taken to reflect (i) government's higher propensity to spend on domestic goods, and/or (ii) the "supply-driven" nature of government expenditure in developing countries. Perhaps a more central question is the appropriateness of a demand determined model over a Harrod-Domar growth model as the former accords no value to private savings. Even if a static macro model approach is adopted the suppression of the supply side must be considered unrealistic. It is almost certainly the case that output will not adjust to meet whatever is demanded and so supply side considerations and price movements must be incorporated. The marrying of a model with these more realistic features with a more complete expression of a Heller type model should be a direction for further research. This paper established the importance of such a direction: the currently prevailing theoretical consensus that aid displaces taxes has been shown to be incorrect once feedback effects are allowed for.

3 CONCLUSIONS AND FURTHER RESEARCH

The position that aid displaces savings has become widespread in the literature. Recent research has focussed more specifically on the impact of aid on public savings, through its impact on government revenues and expenditure. A model is presented here that replicates the theoretical result that aid reduces taxes and that the increment in government expenditure is less than the value of the aid inflow.

However, like Griffin's original presentation of the argument that aid displaces domestic savings, such models do not consider how the impact of aid on income may feed back into higher savings. The model here is therefore supplemented by a simple Keynesian macroeconomic model. This results in the possibility that aid will lead to an increase in taxes and an increase in government expenditure in excess of the value of the aid inflow. The impact of aid on these variables (and, indeed, income itself) depends crucially upon the

relationship between aid and private investment. If aid crowds out private investment then there is a greater possibility that aid will reduce taxes and it may even reduce national income.

The model used here is a very simple one: simplifying both Heller's framework and the recipient macroeconomy. Future work should elaborate both blocks of the model in order to provide a firmer basis for empirical research.

Notes

1. Papanek (1972, 1973), Weisskopf (1972), Grinols and Bhagwati (1976), Mosley (1980), Gupta and Islam (1983), Morisset (1989) and Snyder (1991), to name but a few.

2. For example, McGuire (1987), Cashel-Cordo and Craig (1990), Gang and Khan (1991), Khilji and Zampelli (1991), and Pack and Pack (1991).

3. For reviews of the former see Cassen et al. (1986), Riddell (1987) and White (1992b); for the latter see (White, 1992b) and White and McGillivray (1992).

4. There are three notable exceptions to this. Grinols and Bhagwati (1976) were explicitly concerned with measuring how long it would take domestic savings to "catch up" with what they would have been in the absence of aid. Gupta and Islam (1983) model a simultaneous relationship between savings and growth (with aid as an exogenous variable in each). Neither of these however examined whether aid may increase current income. This was incorporated into the model of Levy (1984) who, however, ignores longer-run effects.

5. Mosley, Hudson and Horrell solve their model incorrectly, for a correct solution see White (1992a).

6. The five variables used by Heller are government investment, developmental and non-developmental government expenditure, taxes and borrowing. His specification also has a linear term in his objective function (as have later models, e.g. Gang and Khan, 1991). However, as shown by Binh and McGillivray (1991) this is an incorrect specification, since it is not maximised by achieving the target values.

7. The model in White and McGillivray (1992, also reproduced in this Working Paper) shows that the sign of the aid-private investment relationship depends, through credit markets or rationing, on government response to the aid inflow. Therefore that relationship and the one examined in this paper should be modelled simultaneously in future research.

8. The stability condition is $1-e < 1$. If this is not met than lagged government expenditure has an explosive effect on current government expenditure (see equation 13). For the condition not to be met government would have to set a very high desired growth rate of expenditure.

9. The assumed parameter values for the simulations were as follows. Equal weight was given to each target ($a_1=a_2=0.5$), desired values were 3% for growth of government expenditure ($a_3=1.03$) and 40% for the tax rate ($a_4=0.4$). Parameters in the behavioral relationships were $a_5=20$,

MPC=a_6=0.7, a_7=0 and a_8=0.25. This latter figure was taken from estimates in Mosley (1987). The economy was in equilibrium before the aid inflow.

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AID, THE PUBLIC SECTOR AND CROWDING IN

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Abstract

This paper examines the relationship between foreign aid and private investment in less developed countries (LDCs) in a simple macroeconomic framework. Using standard behavioural assumptions, a causal relationship under which aid leads to crowding in of private investment is demonstrated. The conditions under which this result emerges are linked to previously unexplored implications of results discussed by econometric analyses of public sector fiscal behaviour in LDCs. Some evidence of crowding in is presented.

I. INTRODUCTION

The macroeconomic impact of foreign aid on less developed countries (LDCs) has attracted considerable attention in the literature.[1] A number of recent econometric studies have emanated from this literature, including the seminal work of Heller (1975) and later studies by McGuire (1987), Cashell-Cordo and Craig (1991) and Gang and Khan (1991). These studies have analysed LDC public sector fiscal behaviour in the presence of aid inflows. The key macroeconomic variables under consideration were public investment, taxation and various categories of recurrent public consumption. Issues central to, and explicitly recognised by these analyses are the possibilities that aid reduces taxation effort and is substituted between public investment and public consumption. These phenomena, or "fungibility" as they are more popularly known, have been more closely examined by Pack and Pack (1991) and Khilji and Zampelli (1991). While some interesting conclusions have emerged, a criticism of both groups of studies is that they stop short of the more important issue of the wider macroeconomic impact of aid. In tackling this issue, Mosley et. al. (1987) embedded Heller's original framework in a Harrod-Domar growth

model. While the results emerging from this study demonstrate the importance of the relationship between aid, public investment and private investment for aid's overall impact on the economy, the model from which they are derived incorporates few economic behavioural relationships. Indeed, the aid effectiveness literature in general may be criticised for not adequately capturing the effect of aid on LDCs on these grounds.[2] This paper attempts to partially redress this situation. Using a simple macroeconomic model, it provides a direct causal mechanism by which aid inflows can lead to crowding in of LDC private investment. Estimates of parameters contained within this model are then obtained from previously overlooked information provided by the results of the above mentioned studies of LDC fiscal response to aid inflows.

II THE MODEL

Our model is derived from three LDC behavioural relationships:

(i) a private sector investment function;

(ii) the effect of the public sector borrowing requirement (PBSR) on domestic interest rates; and

(iii) the impact of aid flows on the PBSR.

For the first of these relationships we assume the simplest possible investment function, in which private investment is a declining function of the interest rate, that is:

$$I_p = I_p(r) \qquad I_p' < 0 \tag{1}$$

where I_p is private investment and r is the interest rate.[3] This relationship is shown in quadrant (i) of Figure 1. Now consider quadrant (ii). It relates the PSBR to the interest rate. The PSBR is defined as:

$$PSBR = G - (T + A) \tag{2}$$

where G is government expenditure T is taxes and other domestic revenue (sales of monopoly items, custom and excise duties and so on) and A is aid. If a government's spending is fully financed by its revenue, comprised by T and A, then the level of this spending is assumed to have no affect on interest rates. In

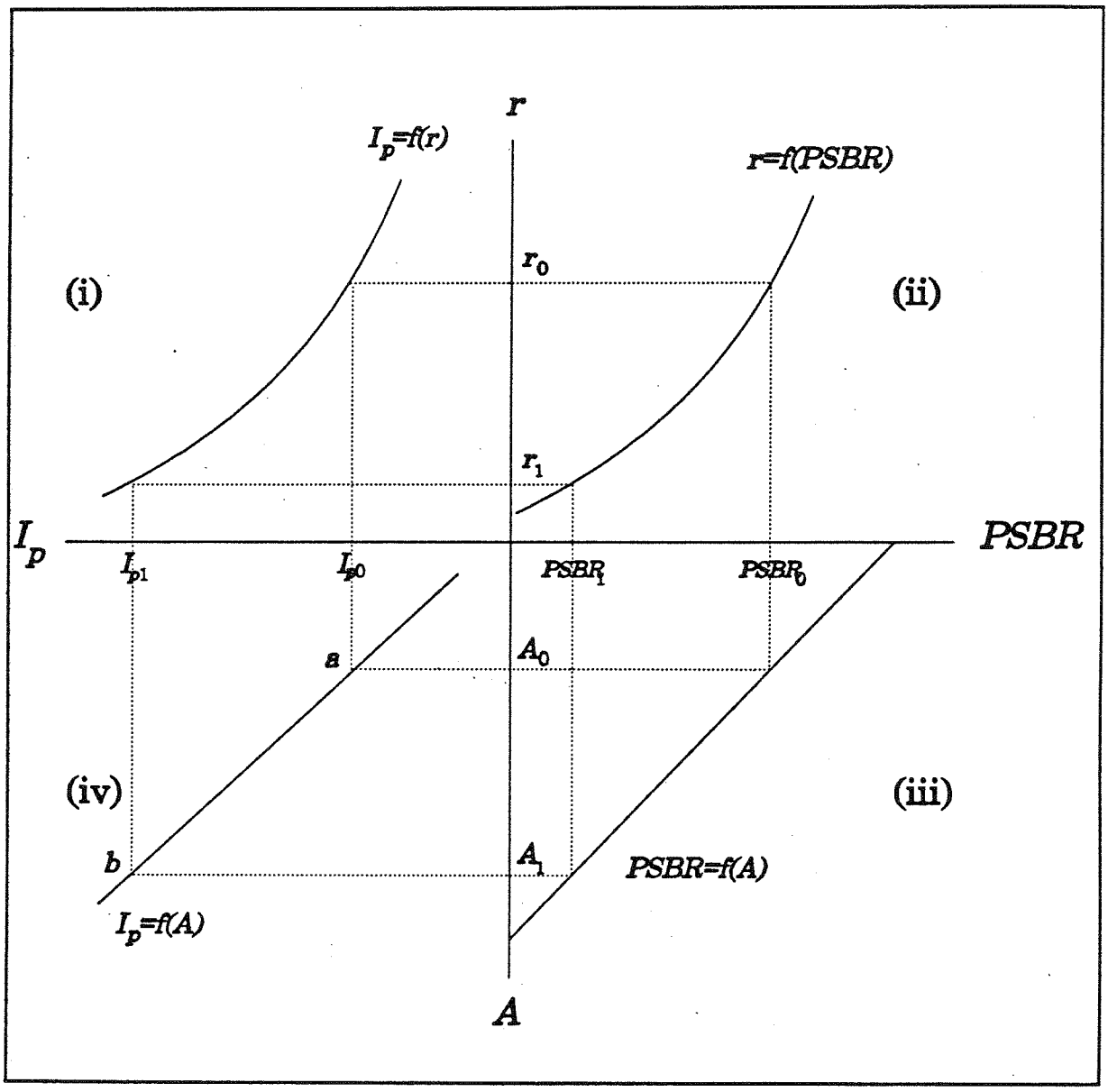

Figure 1

the event of spending exceeding income, the government must raise funds to cover this deficit. For given levels of T and A, this may be facilitated by a number of means, including printing money, domestic borrowing, foreign private loans, asset sales, bond sales and so on. If the government chooses either bond sales or domestic borrowing, upward pressure on interest rates will occur, moving the economy along the schedule given in quadrant (ii).[4] If the government resorts to foreign borrowing, printing money or asset sales, this

schedule will shift to the right. Quadrant (iii) relates the PSBR to aid inflows. Initially, let us for simplicity assume that the LDC government simply adds aid to reduce its PSBR without increasing its spending nor changing taxes. Thus:

$$\frac{dPSBR}{dA} = -1. \tag{3}$$

Now consider the implications of equations (1) to (3) for the relationship between aid and private investment. Initially the PBSR is $PSBR_0$, aid inflows are A_0, the interest rate is r_0 and the level of private investment is I_p. A_0 and I_{p0} are consistent with point a in quadrant (iv). Now assume that the level of aid increases from A_0 to A_1. Using equation (3), the resulting fall in the PBSR from $PSBR_0$ to $PSBR_1$, with unchanged government spending and taxes, reduces interest rates from r_0 to r_1, which then leads to a rise in private investment from I_{p0} to I_{p1}. A_0 and I_{p0} are consistent with point b and thus the upward sloping schedule in quadrant (iv): aid crowds in private investment. This scenario is summarised in Table 1 as Case 1.

Now consider some alternative scenarios. The first is one in which all aid is used to increase government expenditure. In this situation, dG = dA which dictates that:

$$\frac{dPSBR}{dA} = 0. \tag{4}$$

In Figure 1 this would dictate that both the PBSR schedule in quadrant (iii) and the aid-private investment schedule in quadrant (iv) would be vertical. Additional aid therefore, by not altering the PSBR and thus interest rates, does not impact on private investment. This is summarised in Table 1 as Case 3.

The second scenario is one in which aid is fungible; that is, where aid does not result in a one-for-one increase in government spending. More specifically,in equation (3) both G and T are functions of aid. It follows that:

$$\frac{dPSBR}{dA} = \frac{dG}{dA} - \frac{dT}{dA} - 1. \tag{5}$$

Provided that the increase in aid does not increase the

Table 1
LDC Fiscal Response to Foreign Aid Inflows

Case	Conditions	Description	Effect on
1	$\frac{dT}{dA} = \frac{dG}{dA} = 0$ $\rightarrow \frac{dPSBR}{dA} = -1$	Government uses aid to finance planned expenditure, taking opportunity to reduce PSBR (i.e., reducing future government expenditure); present value of reduction equals the value of aid inflow.	Crowding In
2	$\frac{dT}{dA} = 0, \quad 0 < \frac{dG}{dA} < 1$ $\rightarrow \frac{dPSBR}{dA} < 0$	Weaker version of case 1 in which (1-dG/dA) is used to reduce PSBR, with remainder used to increase government expenditure.	Crowding In
3	$\frac{dT}{dA} = 0, \quad \frac{dG}{dA} = 1$ $\rightarrow \frac{dPSBR}{dA} = 0$	No fungibility with all aid used to finance increased expenditure.	None
4	$\frac{dT}{dA} = 0, \quad \frac{dG}{dA} > 1$ $\rightarrow \frac{dPSBR}{dA} > 0$	Government increases expenditure by more than the value of aid inflows (as in, for example, counterpart funding requirement); PSBR increases.	Crowding Out
5	$\frac{dT}{dA} = 0, \quad \frac{dG}{dA} < 0$ $\rightarrow \frac{dPSBR}{dA} < -1$	Government reduces expenditure in response to aid inflows on belief that aid expenditure is more efficient than domestically financed expenditure.	Crowding In
6	$\frac{dG}{dA} = 0, \quad 1 < \frac{dT}{dA} < 0$ $\rightarrow \frac{dPSBR}{dA} < 0$	Aid inflows used to both to offset PSBR and reduce taxes.	Crowding In
7	$0 < \frac{dG}{dA} < 1, \quad \frac{dT}{dA} < 0$ $\rightarrow \frac{dPSBR}{dA} < 0$ *if* $\frac{dG}{dA} - \frac{dT}{dA} >$	Aid inflows partly used to finance increased expenditure and partly to reduce taxes, net result being a decrease in PSBR.	Crowding In

Table 1 (continued)
LDC Fiscal Response to Foreign Aid Inflows

Case	Conditions	Description	Effect on
8	$0 < \frac{dG}{dA} < 1, \quad \frac{dT}{dA} < 0$ $-\frac{dPSBR}{dA} > 0$ *if* $\frac{dG}{dA} - \frac{dT}{dA} <$	Aid inflows partly used to finance increased expenditure and partly to reduce taxes, net result being an increase in PSBR.	Crowding Out
9	$\frac{dG}{dA} > 0, \quad \frac{dT}{dA} < 0$ $-\frac{dPSBR}{dA} = 0$ *if* $\frac{dG}{dA} + \frac{dT}{dA} =$	Aid inflows partly used to increase expenditure and partly to reduce taxes, net result being no change in PSBR.	None
10	$\frac{dG}{dA} > 1, \quad \frac{dT}{dA} > 0$ $-\frac{dPSBR}{dA} > 0$	Government increases expenditure by more than the value of aid inflows, taxation revenue increases due to an income multiplier effect.	Crowding Out

PSBR, that is, if

$$\frac{dG}{dA} - \frac{dT}{dA} > 1, \tag{6}$$

the aid-PSBR schedule will remain upward sloping but with a gradient of less than -1. The positive relationship between aid and private investment will still be observed, but will not be of the magnitude of that in Case 1. Alternatively, if

$$\frac{dG}{dA} - \frac{dT}{dA} < 1 \tag{7}$$

aid results in an increase in the PSBR and the schedule in quadrant (iii) will be positively sloped. Aid therefore serves to increase interest rates and to crowd out private investment as would be depicted by a negatively sloped schedule in quadrant (iv). These scenarios are summarised in Table 1 as Cases 3, 7 and 8 respectively. A number of other possible scenarios are also

summarised in Table 1.[5]

III ESTIMATES OF FISCAL RESPONSE TO FOREIGN AID

From the preceding analysis it is clear that the derivative values of the expression on the right hand side of equation (5) are crucial to our discussion. Values for a number of countries can be directly calculated from the results of the econometric studies referred to earlier in this paper; those of Heller (1975), McGuire (1987), Cashell-Cordo and Craig (1991), Gang and Khan (1991), Pack and Pack (1991) and Khilji and Zampelli (1991), each of which looked at cross section data for Africa, Israel, cross section data for 46 non-European LDCs, India, Indonesia and Pakistan respectively.[6] Estimates of the relationship between aid and LDC PSBRs have not previously been obtained from these studies.

Results are shown below in Table 2.[7] Where parameters have been reported as statistically insignificant at the five percent level, we have listed a value of zero. As can been seen from Tables 1 and 2 , the results of McGuire and Gang and Khan fall into cases suggestive of crowding in, those of Heller, Cashell-Cordo and Craig and Pack and Pack fall into cases of crowding out, while those of Khilji and Zampelli suggest no impact on private investment.[8]

Table 2
Estimates of LDC Fiscal Response to Foreign Aid Inflows

Study	dG/dA	dT/dA	dPSBR/dA	Case
Heller (1975)	0.96	-1.01	0.97	8
McGuire (1987)	-0.52	0.00	-1.52	5
Cashell-Cordo & Craig (1990)	3.60	0.00	2.74[a]	4
Pack & Pack (1991)	1.58	0.29	0.29	10
Gang & Khan (1991)	-0.55	0.00	-1.55	5
Khilji & Zampelli (1991)	0.26	-0.74	0.00	9

[a]: This figure is taken directly from original study and is thus is not calculated in the same manner as others since it includes an unreported impact on military expenditure and a statistically insignificant impact on taxation revenue.

IV FURTHER RESEARCH

The model defined by Figure 1 is greatly simplified. While it could be directly estimated by regressing private investment on aid, a satisfactory estimating equation would not only require exogenous variables in addition to aid, but a range of further endogenous relationships.[9] The model could also be extended to incorporate a more general macroeconomic framework, as suggested by White (1992b). The aid multiplier effects observed in such a model would reinforce the positive relationship between aid and private investment by relaxing the PSBR through higher income taxation revenue. One could also incorporate the following possible aspects of the aid-private investment relationship: (i) direct complementarity between government expenditure in general (including aid projects) and private investment (see Taylor, 1988) (ii) decreased levels of income and corporate tax revenue, in response to higher aid, further stimulating private investment; and (iii) aid-financed increases in government expenditure increasing the price of non-traded inputs, reducing the profitability of private investment (see Mosley, 1987, and the literature on aid as Dutch disease, for example, van Wijnbergen, 1986).

V CONCLUSION

This paper has presented a simple model which analyses the relationship between aid inflows and private investment in LDCs. This model demonstrates a direct causal relationship by which aid can lead to both crowding in and crowding out of LDC private investment. In short, if aid leads to a decrease in LDC public sector borrowing requirements, then crowding in occurs by reducing domestic interest rates. If public sector borrowing requirements increased in response to aid inflows, then crowding out occurs. After summarising a number of theoretical scenarios in which aid can either crowd in or crowd out private investment, this paper examined a previously unexplored area by building upon the results of existing econometric studies and finding that only in the minority of cases had aid positively stimulated private investment. Finally, we have offered a number of suggestions for future macroeconomic

modelling of the aid-private investment relationship, including taking into account possible aid multiplier effects.

NOTES

1. For the purpose of this paper, foreign aid is treated as all official foreign capital inflows (concessional or otherwise) to the official sector of the LDC under consideration.

2. For further discussion, see White (1992a, 1992b).

3. Since this is a fixed price model, r may be interpreted as either a real or nominal rate.

4. In most developing countries, the former is not usually an option. Financial markets may be repressed but the mechanism we show linking private investment and government borrowing will still be observed through credit rationing.

5. While not explored in this paper, it is obvious that private investment will be more sensitive to additional aid the flatter and steeper are the schedules in quadrants (i) and (ii) respectively and *vice versa*. Another possibility is a PSBR function in quadrant (iii) which is non-linear in aid flows.

6. In the cases of Heller (1975) and Gang and Khan (1991), these values where obtained by summing estimates of relevant structural equation parameters. For example, using Gang and Khan's taxation structural equation (see equation (6), p.361), $dT/dA = \beta_1(1-\rho_1)(-\{1-\rho_2\}-\{1-\rho_3\})$.

7. For Heller (1975), estimates have been based on results reported for total foreign aid (grants and loans) to Anglophone countries, while in the cases of Cashell-Cordo & Craig (1990) and Gang and Khan (1991), estimates are based soft multilateral loans and grants and loans respectively.

8. Khilji and Zampelli (1991) incorrectly impose the condition $dPSBR/dA = 0$ on their model, and calculate the value of dT/dA from their observed dG/dA. Results based on their estimates should therefore be interpreted accordingly.

9. Mosley (1987) has estimated the reduced form of our model, reporting results for eight LDCs. In all but one country, a positive relationship between aid and private investment was exhibited.

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