FOREIGN AID AND THE PUBLIC SECTOR: A SIMULATION APPROACH*

SOM theme 4: Economic and demographic development

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September 1995

*An earlier version of this paper was presented at the ESRC study group , London, May 1995. Some of the work was done while Gupta was a visitin g professor at the University of Groningen during parts of 1994 and 1995.

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Abstract

The aim of this paper is to examine the effects of foreign aid on government' s fiscal behaviour. We have tried to do this by using and simulating a model whic h explicitly allows for interactions between the non-bank private sector, th e government sector, the banking sector and the external sector and which als o allows for supply side effects. This is in marked contrast to the existing literatur e which only examines this issue by confining itself to the government sector.

Introduction

Recently there has been a considerable renewal of interest about the effects of aid on the public sector's fiscal behaviour (see White, 1994; Khan and Hoshino, 1992; Pack and Pack, 1990 and 1993: Gang and Khan, 1991 and 1994, among others). Almost all of these works take Heller's (1975) work as their starting point. While not all of them necessarily do this, basically this literature asks two questions. The first is about the "fungibility" of foreign aid assuming that all aid is allocated to the public sector. Foreign aid is said to be fungibil when governent investment does not increase by the inflow of aid notwithstanding that it is intended for government investment. The second relates to the total effect of aid on different public sector variables, particularly those entering the governmen t budget constraint.

These two questions have been generally examined within some variant of Heller's model. This has generally meant specifying and solving a model of government's behaviour in the presence of foreign aid and then estimating the model, using either country specific or cross-section data, for calculating the total impact of aid from the reduced form of the model on the variables of interest. As a by-product sometimes the estimated model also provides estimates of the parameters which can be used to examine the question about "fungibility".

This literature suffers from a number of shortcomings. The first one was pointed out by White (1993). Using a very simple example he showed that once we allow for the role of the behaviour of other economic agents in the economy, the effects of aid on the fiscal variables may well be quite different. Essentially what this means is that in order to estimate the total effect of aid on the behaviour of fiscal variables we should, as far as possible, use a model which not only includes the government sector but other sectors as well so that we can examine the implications of interactions between various parts of the economy for the effect of aid on government's behaviour. A second shortcoming is that this literature only examines the ex-post "fungibility" of aid from the actual data. But a more interesting question to ask is: what happens to the effect of aid on the government's behaviour if we change the degree of fungibility regardless of the type of model used? The importance of this question can hardly be overstressed given the fact that this is often one of the major concerns of the donors. The final shortcoming is the assumption of this literature that all aid is assigned to the

government sector. We might well ask: what if all or part of the aid was allocated to the private sector? The existing literature has virtually nothing to say on how to deal with these shortcomings.

Therefore the aim of this paper is threefold. First, it specifies a model which integrates the government sector along with the non-bank private, the banking and the external sector as well as allows for the supply side effects which are entirely ignored in this branch of the literature. Second, using this model we examine the implications of changes in the degree of fungibility of foreign aid in the public sector. Third, we examine the implications of allocating aid to the private sector as well as of changes in the degree of fungibility of aid in this sector. As already mentioned, since the existing literature only concentrates on the demand determined models, we also shed light on the implications of including the supply side effects. Unlike the existing literature, we simulate our model to examine these questions.

The scheme of the rest of the paper is as follows. In Section 1 we specify the model. Section 2 explains the simulations performed and the simulation strategy. In Section 3 we report and discuss the various simulations. The paper is concluded with a brief summary and policy implications.

1. The Model[1]

The model consists of four sectors: a government sector, a non-bank private sector, a banking sector and an external sector. The list of the notation and the definitions of the variables used is given in Table 1.

Table 1: Notations and Definitions used in the Model

All variables are in real terms, denoted in domestic currency, unless stated otherwise.

Δ represents change in the value of a variable, i.e., x = x-x(-1).

ENDOGENOUS VARIABLES

Π^e	expected (and actual) rate of domestic inflation
A	foreign aid (denoted in domestic currency)
b	government bonds
C_p	private consumption
C_g	government consumption
e	exchange rate (an increase represents a depreciation of the hom e currency)
e^e	expected (and actual) rate of depreciation of the home currency
f	foreign assets
f*	real foreign assets denoted in foreign prices
i_{lb}	lending rate of the formal banking sector
i_{lu}	lending rate of the informal banking sector
I_g	government investment
imp	imports
imp*	real imports denoted in foreign prices
IP_g	interest payments of the government
IP_p	interest payments of the formal private banks
IP_u	interest payments of the informal banks
IP_f	interest payments of the foreign sector
k	physical capital of the private sector
k_g	physical capital of the government sector
k_T	total stock of physical capital
L_p	private loans from the formal private banking sector
L_u	private loans from the informal banking sector
L_g	government borrowing from the formal private banking sector
L_{cb}	transfers from the central bank to the government
m	formal bank deposits
p	domestic price level
R	reserves of formal banks
R_u	reserves of informal banks
S_p	private savings
T	government tax revenue
u	informal bank deposits

W	net private wealth
x	exports
y	production
y_d	disposable income
Y^d	aggregate demand
Y^s	aggregate supply

EXOGENOUS VARIABLES

δ	rate of depreciation
Π*	expected (and actual) world rate of inflation
A*	(real) foreign aid denoted in foreign prices
h_f	the required reserve ratio of the formal banking sector
h_u	reserve ratio of the informal banking sector
i_b	nominal rate of return on bonds
i_m	nominal rate of return on formal bank deposits
i_k	nominal rate of return on private capital
i_u	nominal rate of return on informal bank deposits
p*	world price level

We start the presentation of the model by presenting the accounting framework for the entire model (Table 2). The columns of this table show the budget constraints of the different sectors.

Table 2: The accounting framework of the model

	1. GS	2. PS	3. CB	4. PB	5. UB	6. ES	Total
1. Non-financial trans.	$C_g+I_g-T+IP_g$	$C_p+\Delta k-y_d$		IP_p	IP_u	$x-imp+IP_f$	0
2. Bonds	$-\Delta b$	Δb					0
3. Deposits		$\Delta m+\Delta u$		$-\Delta m$	$-\Delta u$		0
4. Foreign Assets/Aid	$-(1-\theta)A$	$\Delta f-\theta A$				$-\Delta f+A$	0
5. Loans	$-\Delta L_g-\Delta L_{cb}$	$-\Delta L_p-\Delta L_u$	$\Delta L_{cb}-\Delta R-\Delta R_u$	$\Delta L_p+\Delta L_g+\Delta R$	$\Delta L_u+\Delta R_u$		0
Total	0	0	0	0	0	0	0

GS stands for government sector; PS stands for non-bank private sector; C B stands for central bank; PB stands for formal private banks: UB stands fo r informal private banks and ES stands for the external sector.

The Government Sector

The government's expenditure consists of expenditure on consumption, invest - ment and interest payments on outstanding government debt and stock of loan s from the formal private banking sector. These expenditures are financed by taxes, by transfers from the central bank, by borrowing from the public (bond issue) and from the private formal banking sector and by foreign aid.

In order to explain the derivation of the government equations in ou r model we start by specifying the utility function used by Heller (1975)

$$U = \beta_0 + \beta_1(I_g - I_g^*) - \frac{\beta_2}{2}(I_g - I_g^*)^2 - \beta_3(T - T^*) - \frac{\beta_4}{2}(T - T^*)^2 + \beta_5(C_g - C_g^*) - \frac{\beta_6}{2}(C_g - C_g^*)^2 - \beta_7(\Delta b - \Delta b^*) - \frac{\beta_8}{2}(\Delta b - \Delta b^*)^2$$

where the corresponding variables with the 'asterisk' represent target values. [2]

This utility function has been criticized by Binh and McGillivray (1993) . They show that the utility function implies that maximum utility for th e government is not achieved in the case where government consumption , government investment, taxes and borrowing are set at the target values, whic h was the basic justification for the utility function. Binh and McGillivray (1993) show that maximum government's utility is reached in the case wher e government consumption and investment overshoots the target values for thes e variables and when taxes and government borrowing are lower than their targe t values. Clearly, this implies that Heller's method leads to inconsistent results.

As a solution to the above-mentioned problem, Binh and McGillivra y (1993) propose to delete the additive terms in the public authorities utilit y function. Therefore the utility function we use in the model is given by: [3]

$$U = \eta_0 - \frac{\eta_1}{2}(I_g - I_g^*)^2 - \frac{\eta_2}{2}(C_g - C_g^*)^2 - \frac{\eta_3}{2}(T - T^*)^2 - \frac{\eta_4}{2}(\Delta L_g - \Delta L_g^*)^2 \qquad (1)$$

It should be pointed out that the utility function does not include governmen t bonds because in our model, as shown below, their supply is entirely determine d by the demand for government bonds of the non-bank private sector.

This utility function is maximized, subject to the following budge t constraints

$$C_g + IP_g = \rho_1 T + \rho_2 \Delta b + \rho_3 \Delta L_{cb} + \rho_4 \frac{ep^*}{p}(1-\theta)A^* + \rho_5 \Delta L_g \quad (2)$$

$$I_g = (1-\rho_1) T + (1-\rho_2)\Delta b + (1-\rho_3)\Delta L_{cb} + (1-\rho_4)\frac{ep^*}{p}(1-\theta)A^* + (1-\rho_5)\Delta L_g \quad (3)$$

where

$$IP_g = (i_{lb} - \pi^e) L_{g_{-1}} + (i_b - \pi^e) b_{-1} - \pi^e L_{cb,-1} \quad (4)$$

and

$$\Delta L_{cb} = \Delta R + \Delta R_u \quad (5)$$

Equation (4) allows us to take into account net real interest payments, includin g capital gains and losses, of the government, which are often ignored in th e literature dealing with the subject under consideration. But, as pointed out b y Blinder and Solow (1973) long time ago, this omission can have seriou s consequences. Equation (5) allows us to consider the implications of transfer s from the central bank to the government. These transfers consist of the reserve s of both the formal and informal banking sectors which are held at the centra l bank and distributed to the government in the form of a non-interest payin g transfer. The transfers are residually derived from the budget constraint of th e central bank (see Table 2) and are thus given by equation (5). It should be note d that in contrast to other work in this field (see Fry, 1989) we do not assume tha t these transfers are only used for unproductive government expenditures, but tha t they may also affect government investment.

According to these constraints (1-θ) determines the amount of foreign aid that is channelled via the government sector and $\frac{ep^*}{p}A^* = A$. It should be note d that we have taken into account that the real value of aid, denominated i n domestic currency, may change by movements in the real exchange rate even i f the real value of aid, denominated in foreign prices, stays constant. Two furthe r

aspects of these constraints are worth noting. First, that in virtually all studies ρ_2 is assumed to be zero, implying that the government does not borrow for consumption purposes. However, this assumption has been criticized by White and Luttik (1994) on the basis of empirical evidence. The above constraints incorporate this criticism, by letting ρ_2 to be a free parameter, varying between zero and unity. Second, all other models assume that θ is zero, thereby imposing the restriction that all aid is allocated to the government sector. The use of θ as a free parameter allows us to examine the implications of aid allocations to the private sector.

The issue of fungibility is examined by considering the value of ρ_4. If it is zero, foreign aid is said to be not fungible. It is being used precisely for the purpose it is being provided for, namely, to finance investment. If, however, ρ_4 is significantly greater than zero but less than unity, then partial fungibility is indicated. The closer the value of ρ_4 to unity, the greater the degree of fungibility.

We can solve for I_g, C_g, ΔL_g and T by maximizing equation (1) subject to equations (2) and (3). For purposes of simulation, assuming that transfer payments from the central bank to the government, real interest payments of the government, the real exchange rate and demand for government bonds are exogenous for the government, the equations for these variables are given by equation (2) for C_g (with IP_g transferred to the righthand side), equation (3) for I_g, and equations (6) and (7) for T and ΔL_g, given below.

$$T = -\frac{\eta_2\rho_1}{\eta_3}(C_g - C_g^*) - \frac{\eta_1(1-\rho_1)}{\eta_3}(I_g - I_g^*) + T^* \qquad (6)$$

$$\Delta L_g = -\frac{\eta_2\rho_5}{\eta_4}(C_g - C_g^*) - \frac{\eta_1(1-\rho_5)}{\eta_4}(I_g - I_g^*) + \Delta L_g^* \qquad (7)$$

The next step in our approach is to specify the target variables. In line with *e.g.* Heller (1975), Khan and Hoshino (1992) and White (1994), they are, admittedly rather ad hoc, modelled as

$$I_g^* = \gamma_1 \Delta k + \gamma_2 y_{-1} \qquad (8)$$

$$C_g^* = \gamma_3 C_{g-1} \qquad (9)$$

$$T^* = \gamma_4 y_{-1} \quad (10)$$

$$\Delta L_g^* = \gamma_5 y_{-1} \quad (11)$$

Finally, the evolution of the stock of government loans from the formal banking sector and the evolution of the stock of physical capital of the government are specified as follows

$$L_g = L_{g-1} + \Delta L_g \quad (12)$$

$$k_g = k_{g-1} + I_g - \delta k_{g-1} \quad (13)$$

This completes the modelling of the government sector.

Non-bank private Sector

The non-bank private sector is assumed to be a consolidated sector consisting of households and firms. The non-bank private sector holds five assets: government bonds, physical capital, deposits of the formal banking sector and those of the informal banking sector and an inflation hedge, say foreign currency. [4] The private sector, which is considered to be credit constrained, receives credit from the formal and the informal banking sectors as well as grants in the form of foreign aid. The real budget constraint from the non-bank private sector, which can be derived from column 2 in Table 2, reads

$$y_d + \Delta L_p + \Delta L_u + \frac{ep^*}{p}\theta A^* - C_p - \Delta b - \Delta k - \Delta m - \Delta u = \frac{ep^*}{p}\Delta f^* \quad (14)$$

where $\frac{ep^*}{p}\Delta f^* = \Delta f$; $\frac{ep^*}{p}\theta A^* = \theta A$.

The asset demand equations and the consumption equation of the non-bank private sector are derived by using a multivariate adjustment function for an integrated model of portfolio selection and consumption-savings decision, proposed by Owen (1981). Owen's model is based on the works of Brainard and Tobin (1968), Purvis (1978), Smith (1978) and Pissarides (1978), among others. For reasons of convenience and since parameter values were not available, we assume that all cross adjustment coefficients are zero. The asset demand equations of the non-bank private sector, taking into account the implications of the assumption that this sector is credit constrained, are then given by:

$$\Delta m = \alpha_1 y_d + \alpha_2 W + \alpha_3 \Delta L_p + \alpha_4 (i_m - \pi^e) - \alpha_5 (i_k - \pi^e)$$
$$- \alpha_7 (e^e - \pi^e) - \alpha_8 (i_u - \pi^e) + \alpha_9 \Delta L_u + \alpha_{10} \theta$$

(15)

$$\Delta k = \alpha_{11} y_d + \alpha_{12} W + \alpha_{13} \Delta L_p - \alpha_{14} (i_m - \pi^e) + \alpha_{15} (i_k -$$
$$- \alpha_{17} (e^e - \pi^e) - \alpha_{18} (i_u - \pi^e) + \alpha_{19} \Delta L_u + \alpha$$

(16)

$$_1 y_d + \alpha_{22} W + \alpha_{23} \Delta L_p - \alpha_{24} (i_m - \pi^e) - \alpha_{25} (i_k - \pi^e) + \alpha_{2}$$
$$- \alpha_{27} (e^e - \pi^e) - \alpha_{28} (i_u - \pi^e) + \alpha_{29} \Delta L_u + \alpha_{30} \theta A -$$

(17)

$$_1 y_d + \alpha_{32} W + \alpha_{33} \Delta L_p - \alpha_{34} (i_m - \pi^e) - \alpha_{35} (i_k - \pi^e) - \alpha_{3}$$
$$- \alpha_{37} (e^e - \pi^e) + \alpha_{38} (i_u - \pi^e) + \alpha_{39} \Delta L_u + \alpha_{40} \theta A -$$

(18)

The consumption function is given by:

$$C_p = \alpha_{41} y_d + \alpha_{43} \Delta L_p - \alpha_{44} (i_m - \pi^e) - \alpha_{45} (i_k - \pi^e) - \alpha_{46} (i_b - \pi^e)$$
$$- \alpha_{47} (e^e - \pi^e) - \alpha_{48} (i_u - \pi^e) + \alpha_{49} \Delta L_u + \alpha_{50} \theta A + \epsilon_{41} W_{-1} \quad (19)$$

Note that the consumption equation does not include current wealth. This is because in Owen's model (1981) it is explicitly assumed that the end of period wealth is a consequence of the consumption-savings decision and not a determinant of it. With respect to the interest rates it is assumed that the negative substitution effect exceeds the positive income effect. It should be pointed out that all nominal rates of return, except for the expected rate of depreciation, are assumed to be exogenously given, but not the real rates of return since inflation is

treated as being endogenously determined (see below). With respect to the asset demand equations, it is assumed that the coefficients of disposable income and wealth are positive, implying that all assets are normal goods. The asset demand are assumed to be positively affected by the own rates of return and negatively by the alternate ones, implying that the assets are gross substitutes.

The inclusion of private credit and foreign aid in the asset and the consumption equation warrants some explanation. These terms are meant to represent liquidity constraints for firms as well as for households. There is considerable evidence that households face such constraints in developing countries caused by the presence of incomplete credit markets (see, for example, Rosenzweig and Wolpin, 1993 and Jappelli and Pagano, 1994). The presence of the credit and foreign aid variables in the consumption equation is meant to capture the role of such market imperfections. A somewhat analogous argument may be advanced for the asset demand equations.

It is noteworthy to underline a special feature of our model, which makes it different from all other models in this field. Our model allows for aid to be channelled through the government sector or through the private sector. There are some other studies which have taken into account that foreign aid may not only have a direct effect on government expenditures but also on private expenditures (see e.g. Mosley, 1987; Mosley et al. 1987 and White, 1993). However, in these studies it is incorrectly assumed that the total amount of foreign aid enters both the government equations and the equations for the private sector. Hence, in these studies both $(1-\theta)$ in the government equations and θ in the equations for the private sector are set at one. It seems as if these studies confuse the structural and the reduced form effects of foreign aid. To explain this somewhat more we may consider the effects of aid on the private sector. If foreign aid is allocated to both the public and the private sectors, the private sector may be affected by both types of aid, but probably not in the same way. Foreign aid which is allocated via the private sector has a direct effect on private sector's behaviour, e.g. via its budget constraint which includes aid. Foreign aid which is allocated via the public sector only indirectly affects the privates sector through private disposable income which is affected by taxes which in their turn are affected by foreign aid to the government. Thus the effect of aid to the private sector represents a structural effect, whereas that of the aid to the government sector a reduced form

effect. In any case even if both types of aid have a direct effect, to use total aid as the appropriate variable in the equations for the private sector (and of the government sector) implies that both types of aid have the same effect on the private variables, an assumption which should be a testable hypothesis rather than an imposed restriction.

A word is in order here about how we deal with fungibility of aid in the private sector. We assume that there is no fungibility of aid if $\alpha_{10} = \alpha_{30} = \alpha_{50} = \alpha_{60} = 0$ and $\alpha_{20} = 1$. In that case foreign aid has only a direct effect on private investment. The closer the value of α_{20} to zero, the greater the degree of fungibility.

Private savings and wealth are defined as:

$$S_p = y_d - C_p \tag{20}$$

$$W = W_{-1} + S_p - \delta k_{-1}^{5} \tag{21}$$

The adding-up restrictions of the above submodel for the non-bank private sector can be easily derived following the procedure given in Owen (1981). We do not specify them here since they were used in the simulations only for deriving the numerical values of some of the parameters involved, rather than formally imposed on the model in simulations. In the simulations the demand for foreign currency is derived from the budget-constraint. Therefore, an explicit equation for the demand for foreign currency is not specified.

Disposable income is defined as:

$$\begin{aligned} y_d = {} & y - T + (i_b - \pi^e) b_{-1} + (i_m - \pi^e) m_{-1} + (i_u - \pi^e) u_{-1} \\ & + (e^e + \pi^* - \pi^e)\, f_{-1} - (i_{lb} - \pi^e) L_{p_{-1}} - (i_{lu} - \pi^e) L_{u_{-1}} \end{aligned} \tag{22}$$

Finally, the evolution of the stocks demanded can be formulated as follows:

$$b = b_{-1} + \Delta b \tag{23}$$

$$k = k_{-1} + \Delta k - \delta k_{-1} \quad (24)$$

$$m = m_{-1} + \Delta m \quad (25)$$

$$u = u_{-1} + \Delta u \quad (26)$$

$$f^* = f^*_{-1} + \Delta f^* \quad (27)$$

The Banking Sector

This sector consists of three subsectors: the central bank, the formal private banks and the informal credit markets. The formal private bank lends to the non-bank private sector and the government. Liabilities of the formal private bank consist of bank deposits of the non-bank private sector. The informal bank lends only to the non-bank private sector. Liabilities are in the form of informal deposits held by the non-bank private sector. Both types of banks are assumed to hold reserves at the central bank. The budget constraint of the central bank is already given above (see also column 3 in Table 2). The budget constraints of the formal private bank and the informal private bank can be derived by column 4 and 5 in Table 2. The supply of formal and informal loans is residually determined by these budget constraints, hence

$$\Delta L_p = \Delta m - \Delta R - IP_p - \Delta L_g \quad (28)$$

$$\Delta L_u = \Delta u - \Delta R_u - IP_u \quad (29)$$

It should be noted that the budget constraint for the formal banking sector is an important channel in our model by which the government sector may affect the non-bank private sector. If government loans from the banking sector increase, ceteris paribus, available credit for the non-bank private sector declines. This e.g. negatively affects private investment. Otherwise, if government's demand for formal loans declines, for instance due to an increase in foreign aid, credit available for the non-bank private sector increases.

Reserves of both banking sectors are assumed to be equal to a fixe d percentage of bank deposits, hence

$$\Delta R = h_f \Delta m \tag{30}$$

$$\Delta R_u = h_u \Delta u \tag{31}$$

Having determined the flow of loans the evolution of the stock is given by

$$L_p = L_{p-1} + \Delta L_p \tag{32}$$

$$L_u = L_{u-1} + \Delta L_u \tag{33}$$

$$L_{cb} = L_{cb,-1} + \Delta L_{cb} \tag{34}$$

Taking into account capital gains (losses) on reserves net real interest payment s of both types of banks are specified as:

$$IP_p = (i_m - \pi^e) m_{-1} - (i_{lb} - \pi^e)(L_{p-1} + L_{g-1}) + \pi^e h_f m_{-1} \tag{35}$$

$$IP_u = (i_u - \pi^e) u_{-1} - (i_{lu} - \pi^e)\, L_{u-1} + \pi^e h_u u_{-1} \tag{36}$$

The lending rates are determined by the zero-profit condition for the bankin g system (see *e.g.* Montiel, *et al.* 1993):

$$i_{lb} = (1/(1-h_f))\; i_m \tag{37}$$

$$i_{li} = (1/(1 - h_u))\; i_u \tag{38}$$

External sector

In rate of change, real exports and real imports denoted in foreign prices ar e specified as a function of the real exchange rate:

$$\frac{\Delta x}{x_{-1}} = -\eta_6(\pi^e - e^e - \pi^*) \tag{39}$$

$$\frac{\Delta imp^*}{imp^*_{-1}} = -\eta_7(\pi^e - e^e - \pi^*) \quad (40)$$

The level of exports and imports is then given by

$$x = -\eta_6(\pi^e - e^e - \pi^*)x_{-1} + x_{-1} \quad (41)$$

$$imp^* = -\eta_7(\pi^e - e^e - \pi^*)imp^*_{-1} + imp^*_{-1} \quad (42)$$

In real domestic prices imports are defined as:

$$imp = \frac{ep^*}{p}imp^* \quad (43)$$

Real foreign interest payments, denoted in domestic prices, are defined as

$$IP_f = (e^e + \pi^* - \pi^e)f_{-1} \quad (44)$$

Note that real interest payments on foreign currency only refer to capital gains o r losses. The change in foreign assets is determined by portfolio behaviour of th e non-bank private sector. Development aid (denoted in foreign currency) i s exogenous.

Aggregate demand, aggregate supply, inflation and exchange rates

With private investment, private consumption, government consumption , government investment and imports and exports already determined, we ca n write aggregate demand as:

$$y^d = C_p + C_g + \Delta k + I_g + x - imp \quad (45)$$

Assuming that firms are operating in a labour surplus economy and using a Leontief type technology, aggregate supply is determined by

$$y^s = y = \lambda k_T \quad (46)$$

where

$$k_T = k + k_g \tag{47}$$

and λ is the marginal capital output ratio (which also represents the average capital output ratio in our case) assumed to be constant. It should be noted that equation (46) implies that the productivity of the public and private capital is identical. Although we do not do this, this restriction can be easily relaxed.

The goods market is closed by price changes. We assume that goods prices are determined by the equilibrium condition on the goods market, *i.e.* from the following condition:

$$y^s = y^d \tag{48}$$

Inflation is then given by the relative change of prices, i.e.

$$\pi^e = \pi = \frac{p - p_{-1}}{p_{-1}} \tag{49}$$

It should be noted that the balance of payments (the budget constraint of the external sector: column 6 in Table 2) is automatically in equilibrium in the case where aggregate demand equals aggregate supply and the budget constraints of the other sectors hold. This implies that there are no changes in foreign reserves that might affect domestic money supply.

With respect to the expected devaluation of the exchange rate, we assume that it gradually adjusts to purchasing power parity. This implies:

$$e^e = \eta_8(\pi^e - e^e_{-1} - \pi^*) + e^e_{-1} \tag{50}$$

By assuming different values for η_8 we are now able to simulate with a fixed exchange rate regime, or a flexible exchange rate regime in which exchange rates are formed by purchasing power parity. Finally, the level of the exchange rate is specified as follows:

$$e = e_{-1}(1 + e^e) \tag{51}$$

Parameters

The above model is simulated using coefficients from available econometric studies on developing countries. If available, the coefficients are based on econometric studies for India done by Gupta (1993a and 1993b). The remaining coefficients are mainly based on studies for Asian developing countries. This implies that they do not pertain to a specific country. Estimates with respect to the coefficients in the equation of demand for informal deposits and with respect to the coefficients for informal credit in the asset demand and consumption equations are not available. Admittedly rather ad-hoc, we assumed that formal and informal credits affect asset demand and consumption alike. Further, we assume that the composite coefficients in the asset demand equations have the property of symmetry, i.e. $\alpha_5 = \alpha_{14}$; $\alpha_6 = \alpha_{24}$ etc.

Table 3 gives the parameters of the asset demand equations as well as the parameters for private consumption.

Table 3: Parameters of the asset demand equations and private consumption

F. Deposits	Capital	Bonds	I. Deposits	Cons.
α_1=0.03	α_{11}=0.03	α_{21}=0.005	α_{31}=0.03	α_{41}=0.7
α_2=0.08	α_{12}=0.2	α_{22}=0.107	α_{32}=0.02	α_{43}=0.255
α_3=0.2	α_{13}=0.258	α_{23}=0.035	α_{33}=0.2	α_{44}=0.005
α_4=0.04	α_{14}=0.061	α_{24}=0.087	α_{34}=0.087	α_{45}=0.005
α_5=0.06	α_{15}=0.1	α_{25}=0.002	α_{35}=0.005	α_{46}=0.005
α_6=0.009	α_{16}=0.02	α_{26}=0.043	α_{36}=0	α_{47}=0.255
α_7=0.018	α_{17}=0.011	α_{27}=0.018	α_{37}=0.027	α_{48}=0.255
α_8=0.087	α_{18}=0.0005	α_{28}=0	α_{38}=0.041	α_{49}=0.255
α_9=0.2	α_{19}=0.258	α_{29}=0.035	α_{39}=0.2	ε_{41}=0.015
ε_1=0.5	ε_{11}=0.18	ε_{21}=0.3	ε_{31}=0.5	

Sources: Morisset (1993), Gupta (1993a), Ogawa *et al* (1994).

Table 4 presents the parameters for the government equations, the initial values and the exogenous variables.

Table 4: Parameters of the Government equations, Initial Values and Exogenous Variables

Utility function	Budget constraints	Target Variables	Exog. Variables	Exog. Vari-ables	Start Values	Start Values	Start Values
η_1=2.4	ρ_1=0.8	γ_1=0.04	i_m=0.05	A*=0.0119	f*=0.746	W=3	b=0.12
η_2=1.6	ρ_2=0.2	γ_2=0.05	i_k=0.05	h_f=0.05	l_p=0.27	k_g=1	m=0.4
η_3=2.7	ρ_3=0.6	γ_3=0.95	i_b=0.05	h_u=0.05	l_u=0.081	k=2	C_g=0.14
η_4=0.8	ρ_4=0.6	γ_4=0.2	i_u=0.06	δ=0.05	l_g=0.11	u=0.085	y, y_d=1
	ρ_5=0.6	γ_5=0.01	p*=1	π*=0	imp*=0.24	x=0.22	p,e,p*=1

Sources: Utility function parameters: Gupta 1993b. Budget constraint parameters: ρ_1 and ρ_4 from Gupta (1993b); ρ_2, ρ_3 and ρ_5 are exogenously set. ρ_2 is assumed to be low, in line with other studies (in many studies this variable is set at 0.0). For ρ_3 and ρ_5 we have assumed the same value as for ρ_4. Target variables: from Gupta (1993b) and Heller (1975). γ_5 is exogenously set. With respect to the starting variables we took averages for a group of Asian countries (IMF, IFS and World Bank, World Tables). Where figures for the whole group of Asian countries were not available, figures for India are used (IMF, IFS). The remaining non-available starting values are constructed in a way that they are consistent with the budget constraints. Note, that all initial values are given as percentages of GDP (y).

Some other assumptions: λ in the aggregate supply equation is set at 0.33, η_6 and η_7 in the equation for exports and imports are set at 0.85 and -0.85, respectively (based on Marquez, 1990). η_8 in the exchange rate equation is set at 0. Hence, we simulated with a fixed exchange rate regime. However, note that the real exchange rate is not constant since inflation is endogenous. In fact this implies that the goods market is cleared by changes in the real exchange rate. Finally, the value of θ, the distribution of foreign aid, is exogenously set at zero, or at one, depending on the specific simulation (see below). The coefficients with respect to foreign aid in the private sector (the asset demand equations and the consumption equation) are explained below.

3. The Different Simulations and the Simulation Strategy

To examine the effects of foreign aid on the public sector our model can be simulated in a variety of ways. However, we confine our simulations to the three questions posed in the introduction, namely, are the effects of foreign aid on fiscal behaviour different: 1) if feedback effects with other sectors in the model are taken into account; 2) if there is a change in the degree of fungibility of foreign aid; and 3) if foreign aid is channelled through the private sector or through both sectors.

The first question is examined by comparing three simulations. In this set of simulations we have assumed that all aid is channelled through the government sector (i.e. the value of θ is assumed to be zero) and that the degree of fungibility in the government sector, as determined by ρ_4, is as given in Table 4. Hence, there is partial fungibility. We start by simulating effects of an increase in foreign aid on government expenditures (investment and consumption), taxes and borrowing from the formal banking sector when feedback effects with the other sectors are not taken into account. This is done by considering the endogenous variables in the equations for the government sector, which are related to the other sectors, as exogenous variables. For our model this implies that Δk, y, e, p, Δb, Π^e, ΔL_{cb} and IP_g are assumed to be exogenous. We have used the following values for these variables: y, e and p are set at 1; Π^e is set at 0 (for these variables we have used the start values used in the full model); ΔL_{cb}, Δb and IP_g are assumed to be 0 and finally, Δk is set at 0.15.

In the second simulation we examine the effects of an increase in foreign aid on fiscal behaviour, taking into account the feedback effects with the other sectors, but assuming that the country operates in a demand determined economy. This is done by abstracting from the supply side of the model, and hence by assuming that inflation is zero and that GDP is determined by the demand side of the model (i.e. by equation 45).

In the third simulation we assess the effects of aid on fiscal behaviour using our full model, i.e. by taking into account all feedback effects and the supply side of the model. The second question is examined by two simulations. Also for these simulations we have assumed that all foreign aid is channelled through the government sector. Moreover, we have used our full model,

including the supply side, in these simulations. The two simulations differ with respect to the degree of fungibility. We examine two extreme cases: 1) when aid is totally fungible, which in our model implies that $\rho_4 = 1$ and 2) when there is no fungibility at all, i.e. $\rho_4 = 0$.

The third question is examined by three simulations. In this set of simulations it is assumed that all foreign aid is channelled through the private sector, i.e. the value of θ is assumed to be one, and we have used the full model, including the supply side. With respect to the way how foreign aid affects the private sector, we distinguish three cases. First, it is assumed that foreign aid affects the private sector in exactly the same way as it is affected by credit from the domestic banking sectors. This implies that $\alpha_{10} = \alpha_3$; $\alpha_{20} = \alpha_{13}$; $\alpha_{30} = \alpha_{23}$; $\alpha_{40} = \alpha_{33}$ and $\alpha_{50} = \alpha_{43}$. We may call this a situation of partial fungibility for the private sector. Second, it is assumed that all foreign aid is used for private investment, i.e. $\alpha_{20} = 1$ and $\alpha_{10} = \alpha_{30} = \alpha_{40} = \alpha_{50} = 0$, which implies no fungibility for the private sector. Third, it is assumed that foreign aid is only used for private consumption, i.e. $\alpha_{50} = 1$ and $\alpha_{10} = \alpha_{20} = \alpha_{30} = \alpha_{40} = 0$.[6] This simulation represents full fungibility for the non-bank private sector.

For all simulations we compare a baseline simulation in which foreign aid (denominated in foreign prices) has the value as specified in Table 3, with a simulation in which foreign aid has a value ten times the value as given in Table 3. Thus, we examine the effect of a sustained increase in aid rather than the effect of a transitory increase in aid.

In principle we can simulate the effect on each one of the variables included in the government budget constraint. However, to save space and for sharper focus we only concentrate on three variables, namely C_g, I_g and T. In each figure we present the value of the variable before the increase in aid (denoted with a zero after the variable), the value of the variable after the increase in aid (denoted with a 1 after the variable) and the difference between the two, i.e. the effect of the increase in aid (denoted with a D after the variable). On the horizontal axes of all figures the simulation periods are given.

3. The Simulation Results

The implications of feedback effects

The results for the first simulation are given by figures 1-3. Figure 1 gives th e effect on government consumption (CG), figure 2 gives the effect on government investment (IG) and figure 3 gives the effect on taxes (T).

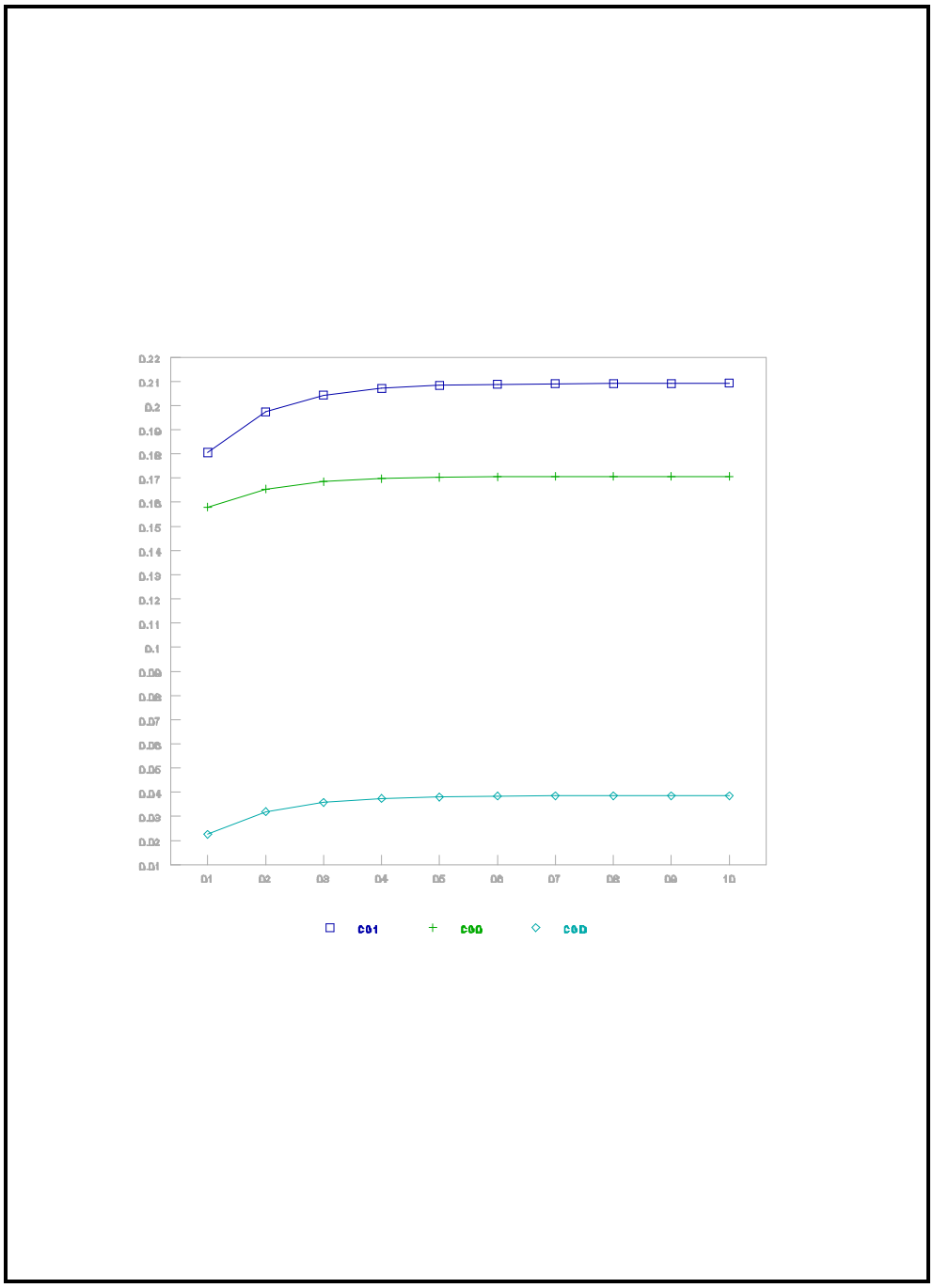

figure 1: no feedbacks, effects on government consumption

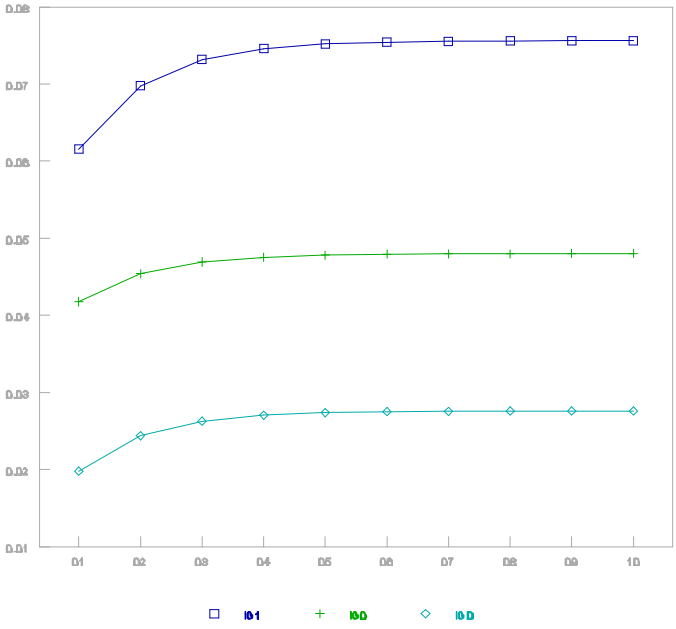

figure 2: no feedbacks, effects on government investment

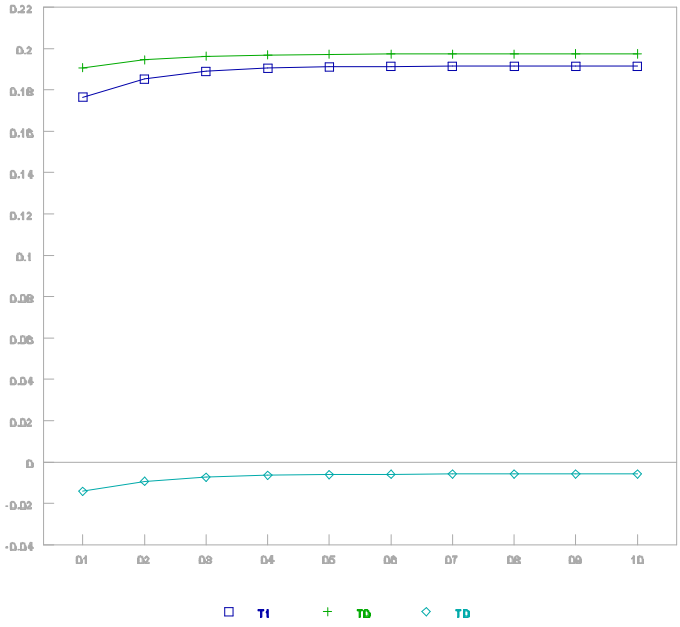

figure 3: no feedbacks, effects on taxation

The figures show that, when feedback effects with the rest of the economy are not taken into account, foreign aid has a positive effect on government consumption and investment and a negative effect on taxes.

The results for the second simulation are given by the figures 4-6.

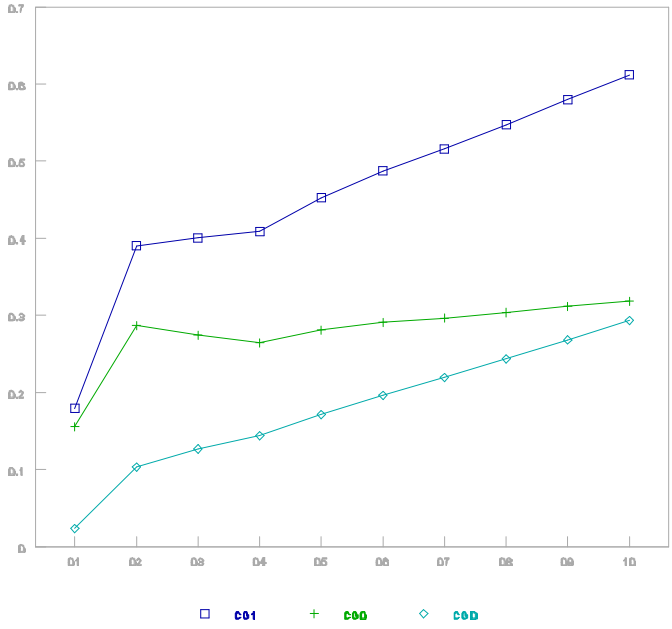

figure 4: demand determined model, effects on government consumption

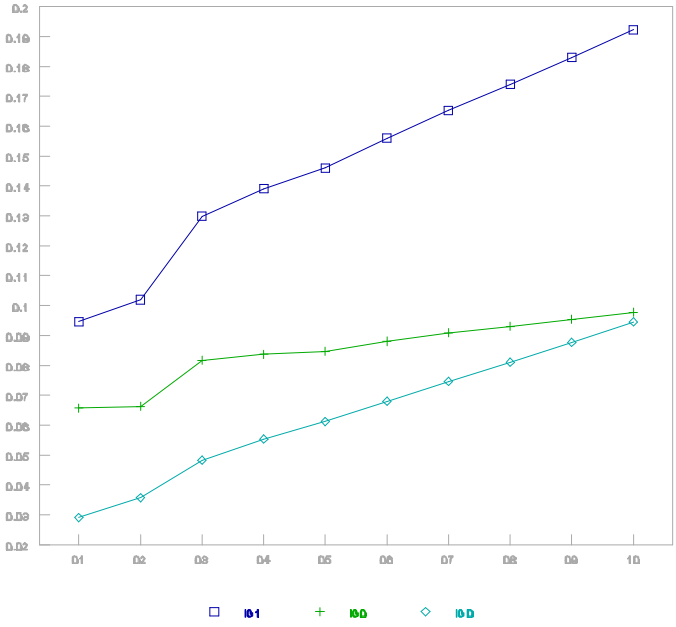

figure 5: demand determined model: effects on government investment

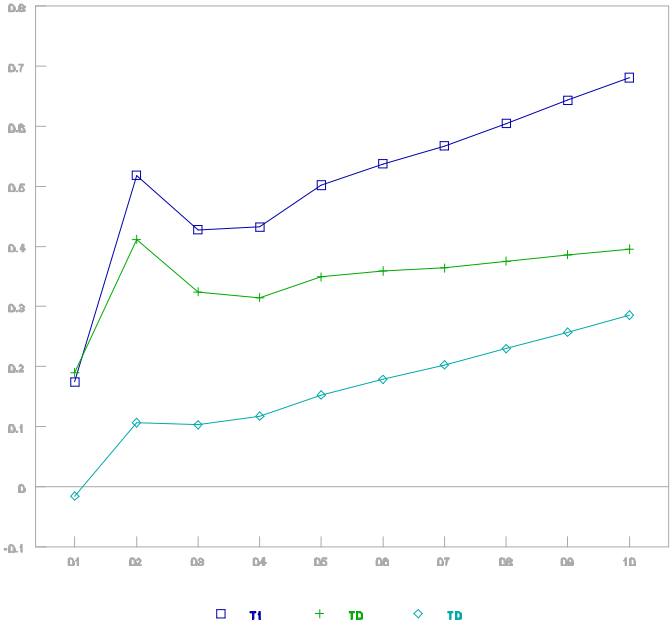

figure 6: demand determined model, effects on taxation

Also for this simulation foreign aid has a positive effect on governmen t consumption and taxes. However, whereas in the model without feedback effect s an increase in foreign aid has a negative effect on taxes the effect is positive i n the case where the feedback effects are taken into account. The reason for this i s obvious. The increase in foreign aid has a positive effect on GDP (y), as can b e seen in figure 7, which indirectly stimulates taxes via the target level of taxes and the target level of government investment.

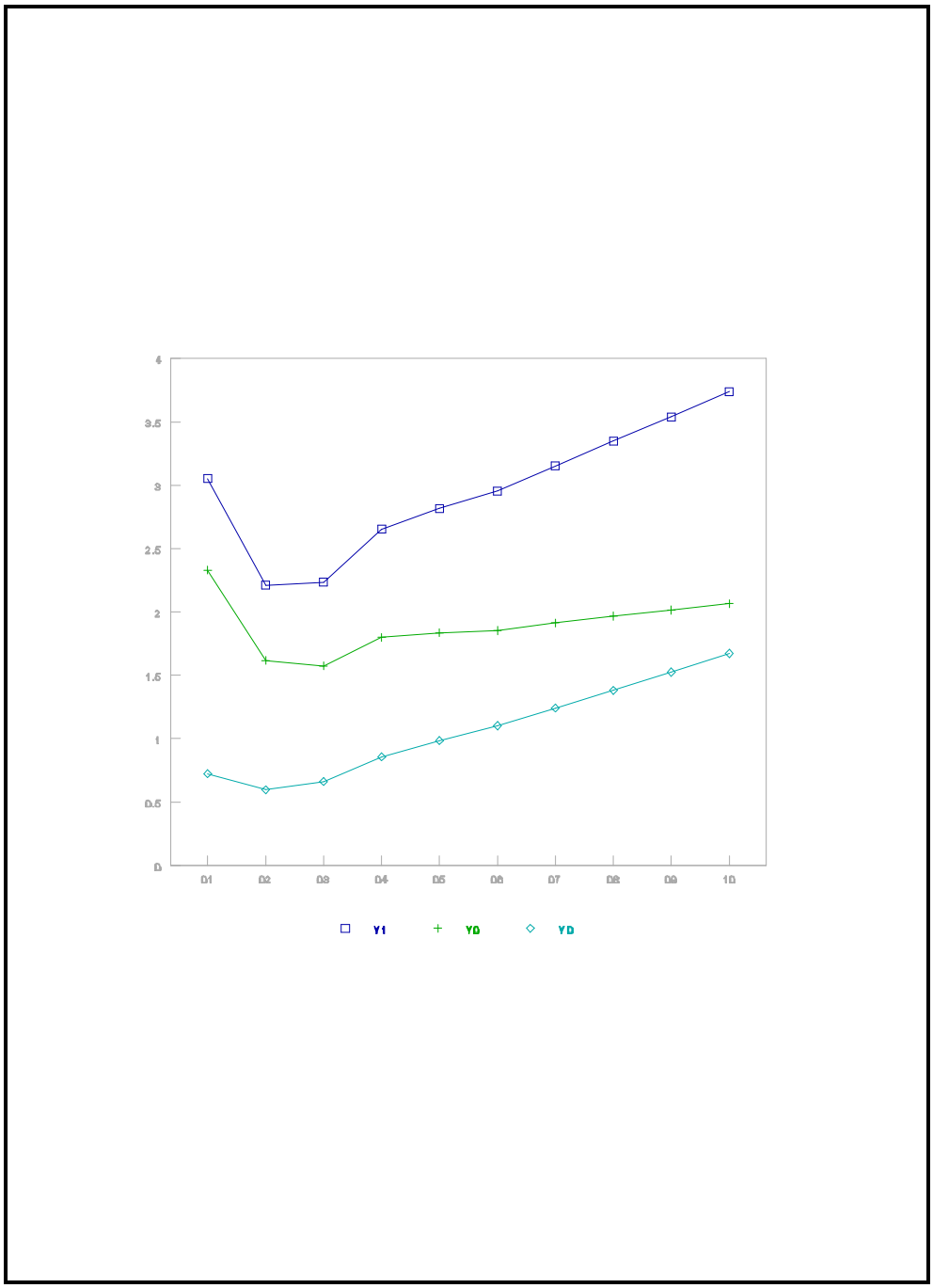

figure 7: demand determined model, effects on GDP

Results for the third simulation are displayed by the figures 8-10. It is interesting to compare this simulation with the first and the second simulation. For our full model, in line with the other two simulations, it appears that foreign aid stimulates government consumption and investment. However, the effects on taxes differ substantially. In the model without feedback effects it was negative for the entire simulation period, for the model with feedback effects, but without supply side, it was positive and for the full model, it was negative for the first simulation periods and then became approximately zero.

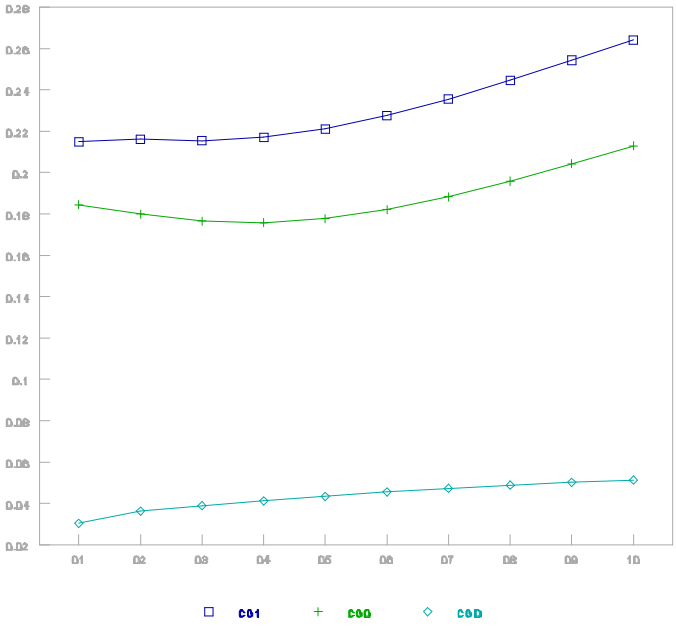

figure 8: full model, effects on government consumption

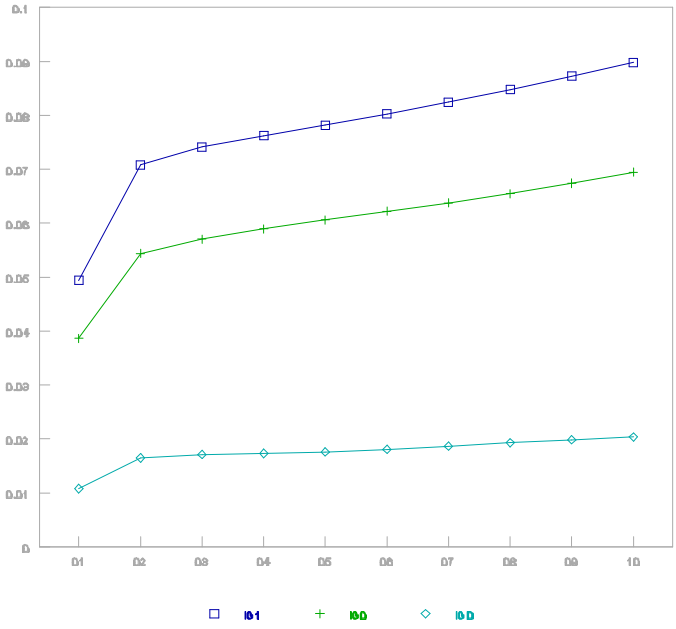

figure 9: full model, effects on government investment

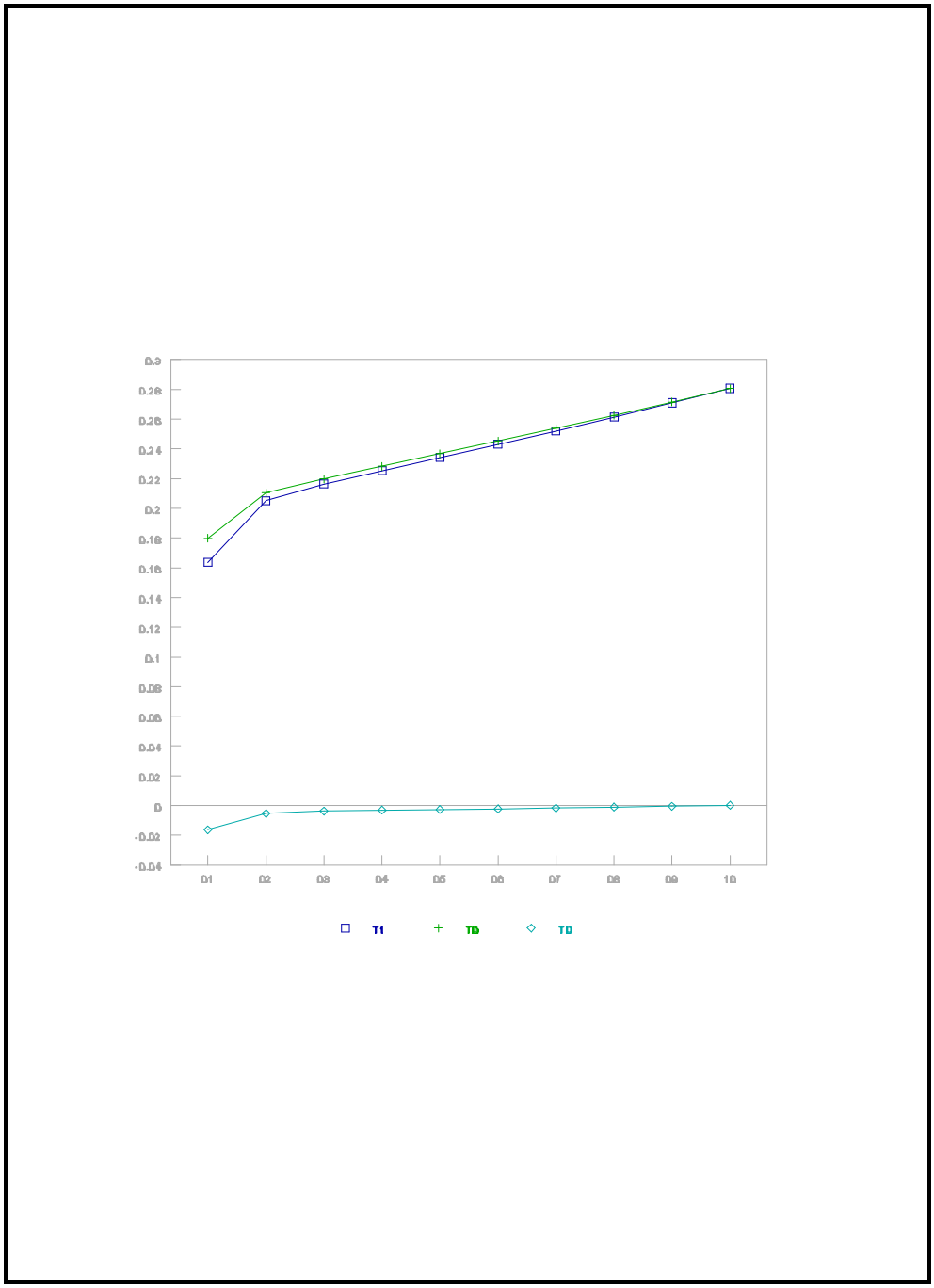

figure 10: full model, effects on taxation

An important reason for the different outcomes for the full model with and without supply side are again the effects of foreign aid on GDP. For the full model, including the supply side, it appears that an increase in foreign aid only has a minor positive effect on GDP, as can be seen in figure 11.

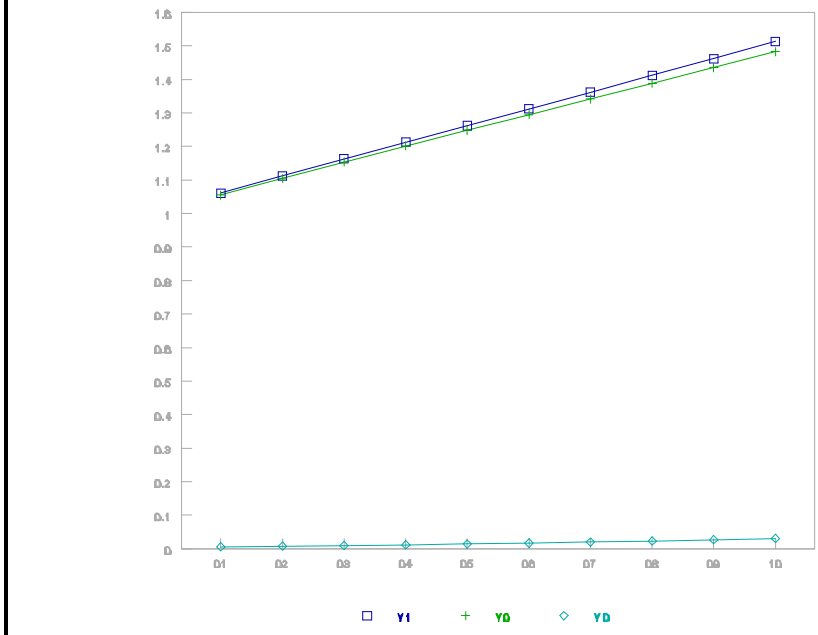

figure 11: full model, effects on GDP

The implications of different degrees of fungibility

We start by showing the effects of an increase in foreign aid assuming that foreign aid is only used for government consumption, i.e. there is full fungibility. The results are given by figures 12-14. In the other simulation we examine the extreme opposite, i.e. all aid is used for government investment, i.e. there is no fungibility. The results of this simulation are given by figures 15-17.

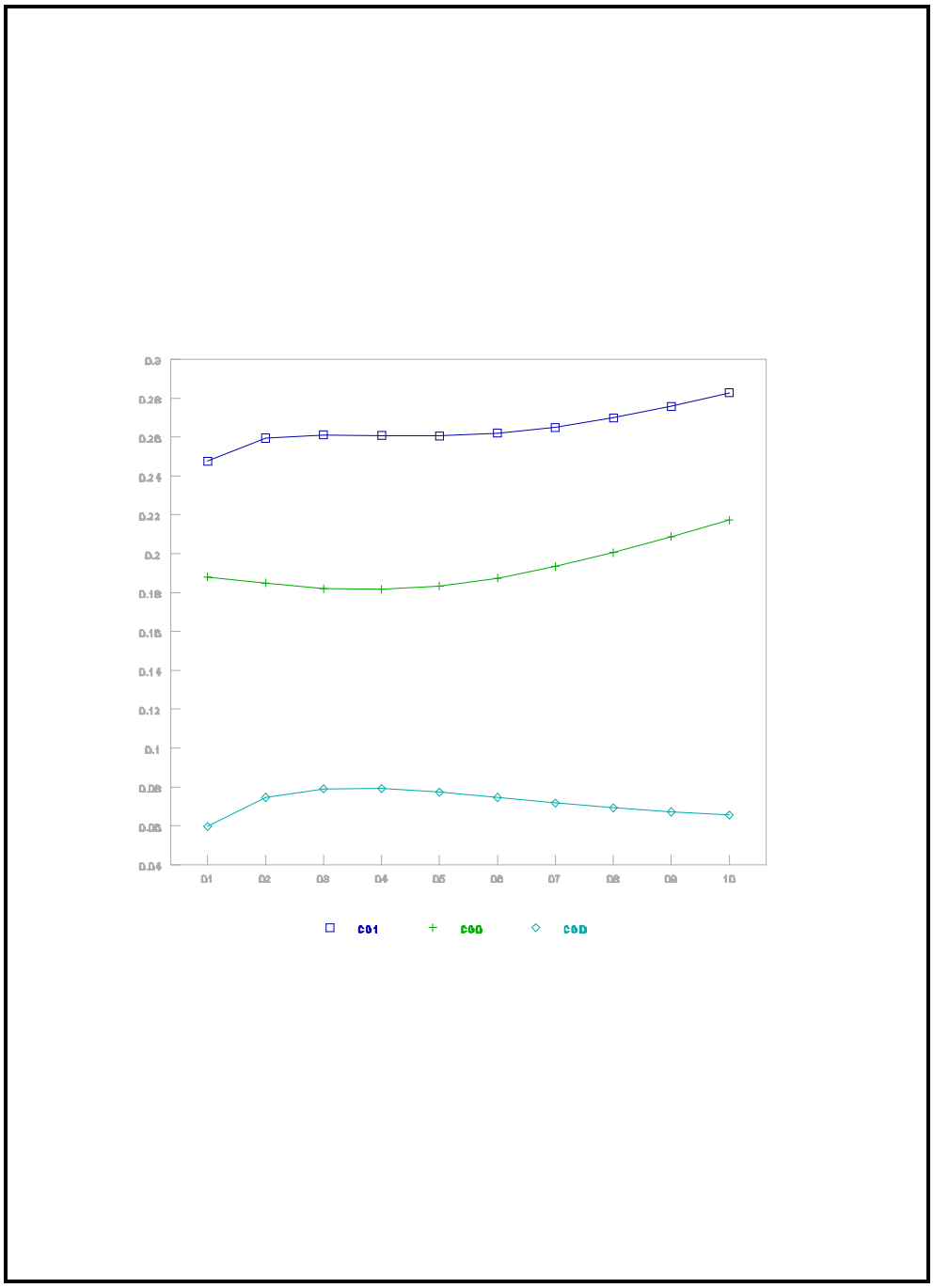

figure 12: full fungibility, effects on government consumption

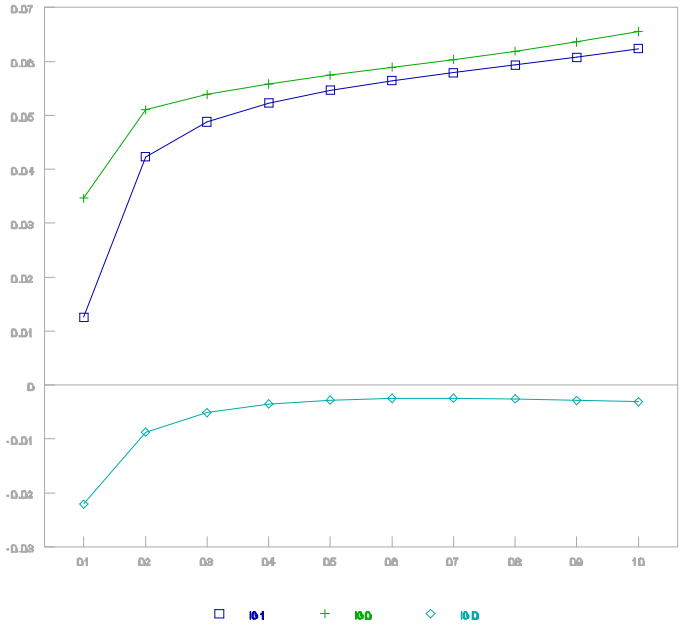

figure 13: full fungibility, effecs on government investment

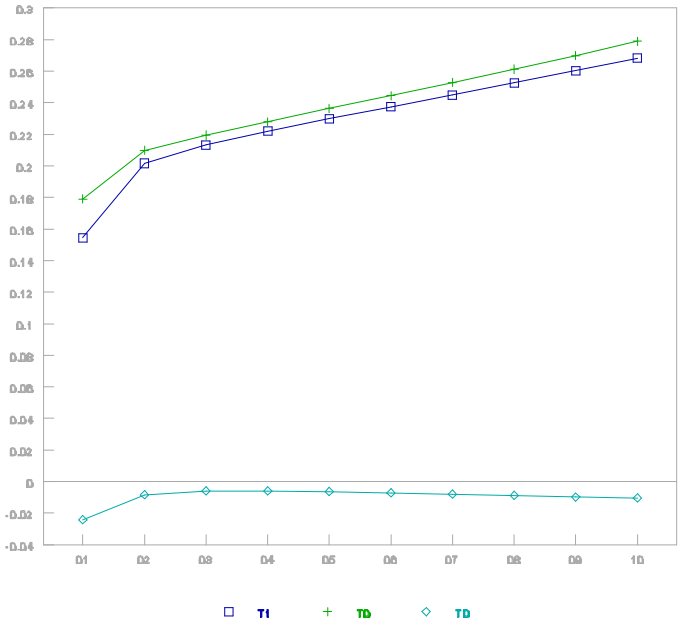

figure 14: full fungibility, effects on taxation

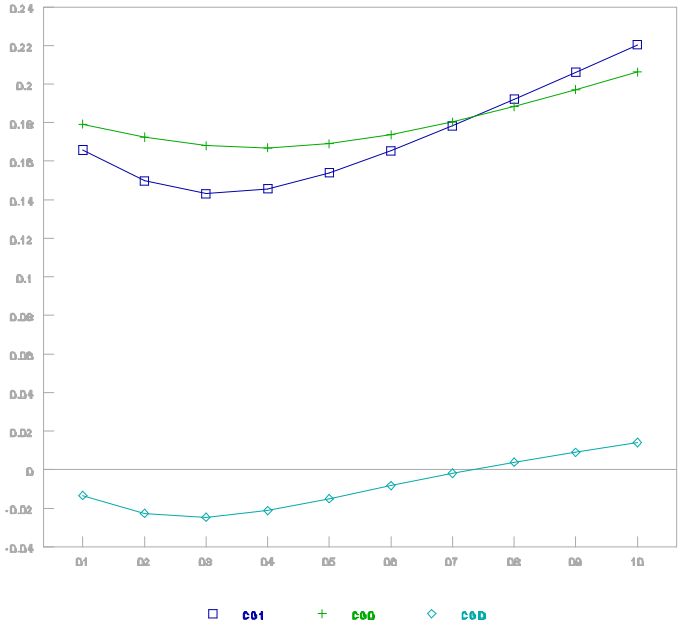

figure 15: no fungibility, effects on government consumption

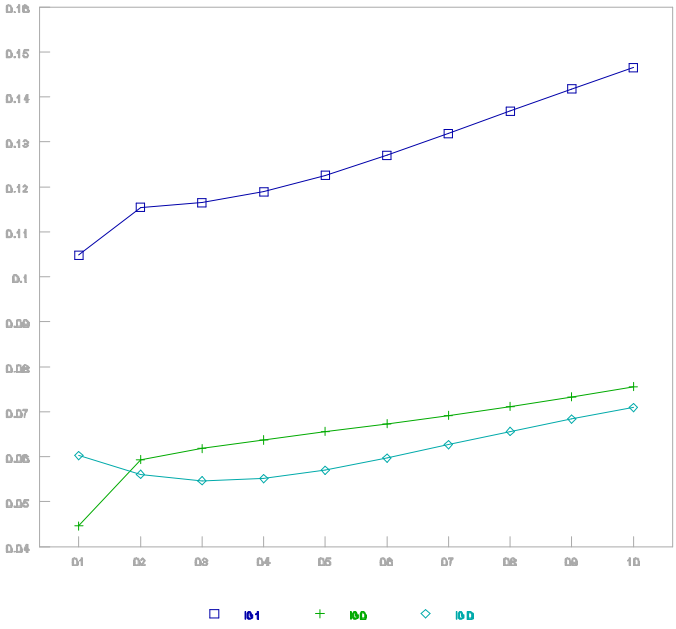

figure 16: no fungibility, effects on government investment

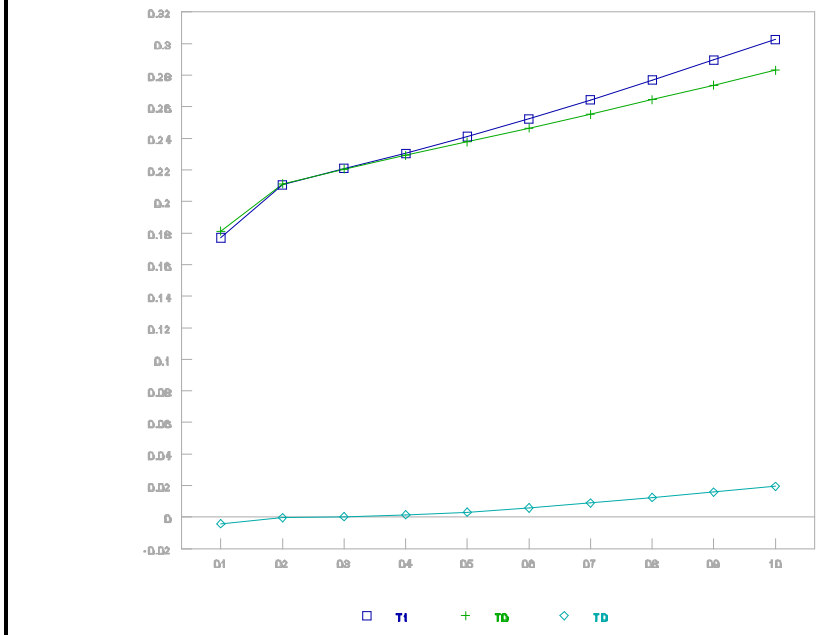

figure 17: no fungibility, effects on taxation

It appears that an increase in foreign aid has a strong positive effect on government consumption when all foreign aid is used for government consumption. If all aid is used for government investment, however, the effect on government consumption is negative during the first part of the simulation period, and positive after 7 years. When all aid is used for government consumption the effect on government investment and taxes is negative, whereas the effect is positive for both variables in the case where aid is only used for government investment.

The difference between the results again can be explained by considering the movement of GDP. The effects of an increase in aid on GDP, for the full fungibility and no fungibility case, respectively, are given in figures 18 and 19. It appears that GDP is positively affected when all aid is used for government investment, whereas it is negatively affected when it is only used for government consumption.

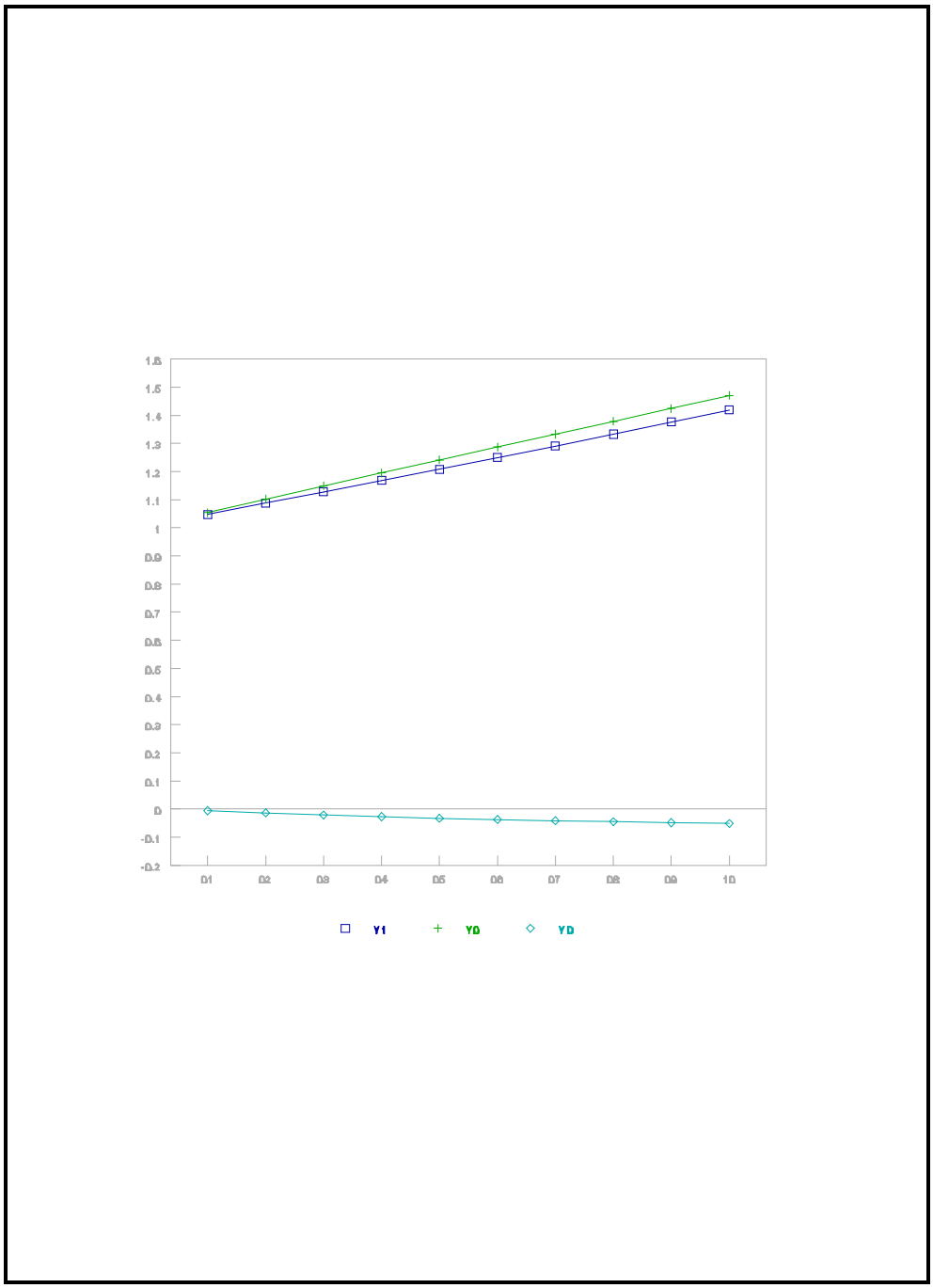

figure 18: full fungibility, effects on GDP

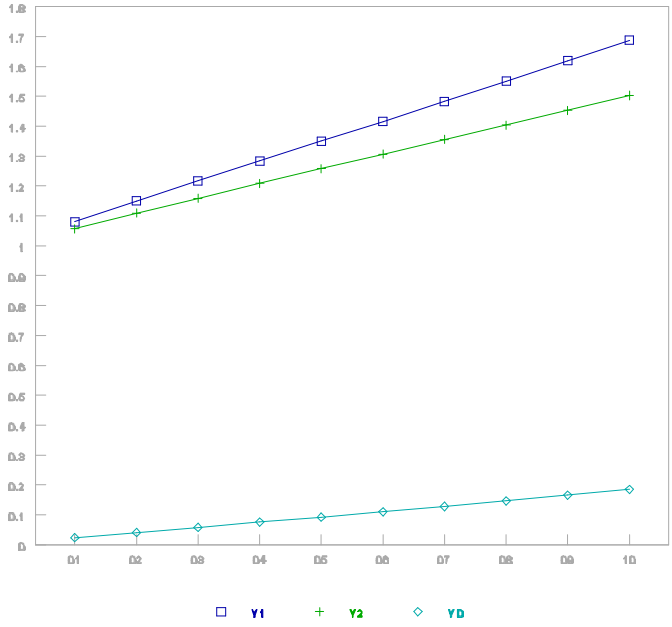

figure 19: no fungibility, effects on GDP

The implications of the way foreign aid is channelled through the economy

The results of the three simulations done to examine this question are given i n figures 20-28.

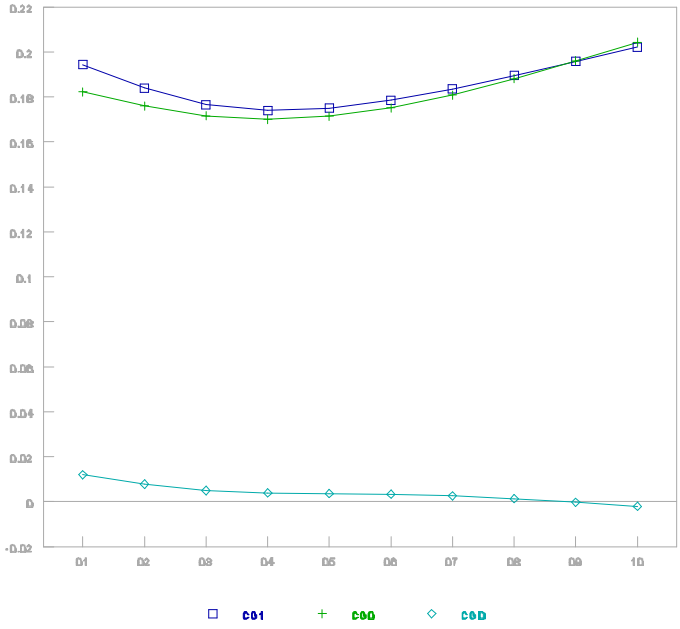

figure 20: partial fungibility, effects on government consumption

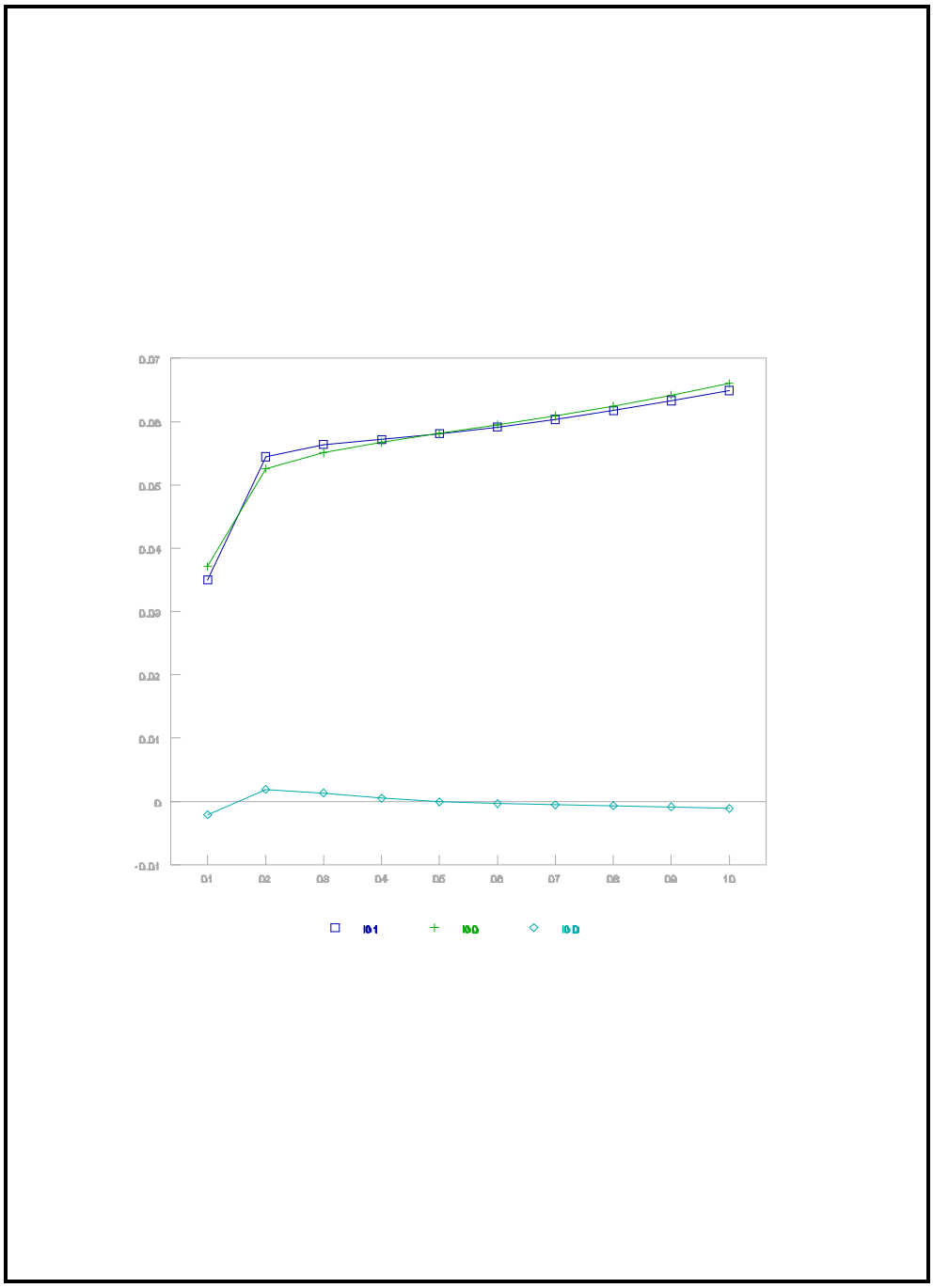

figure 21: partial fungibility, effects on government investment

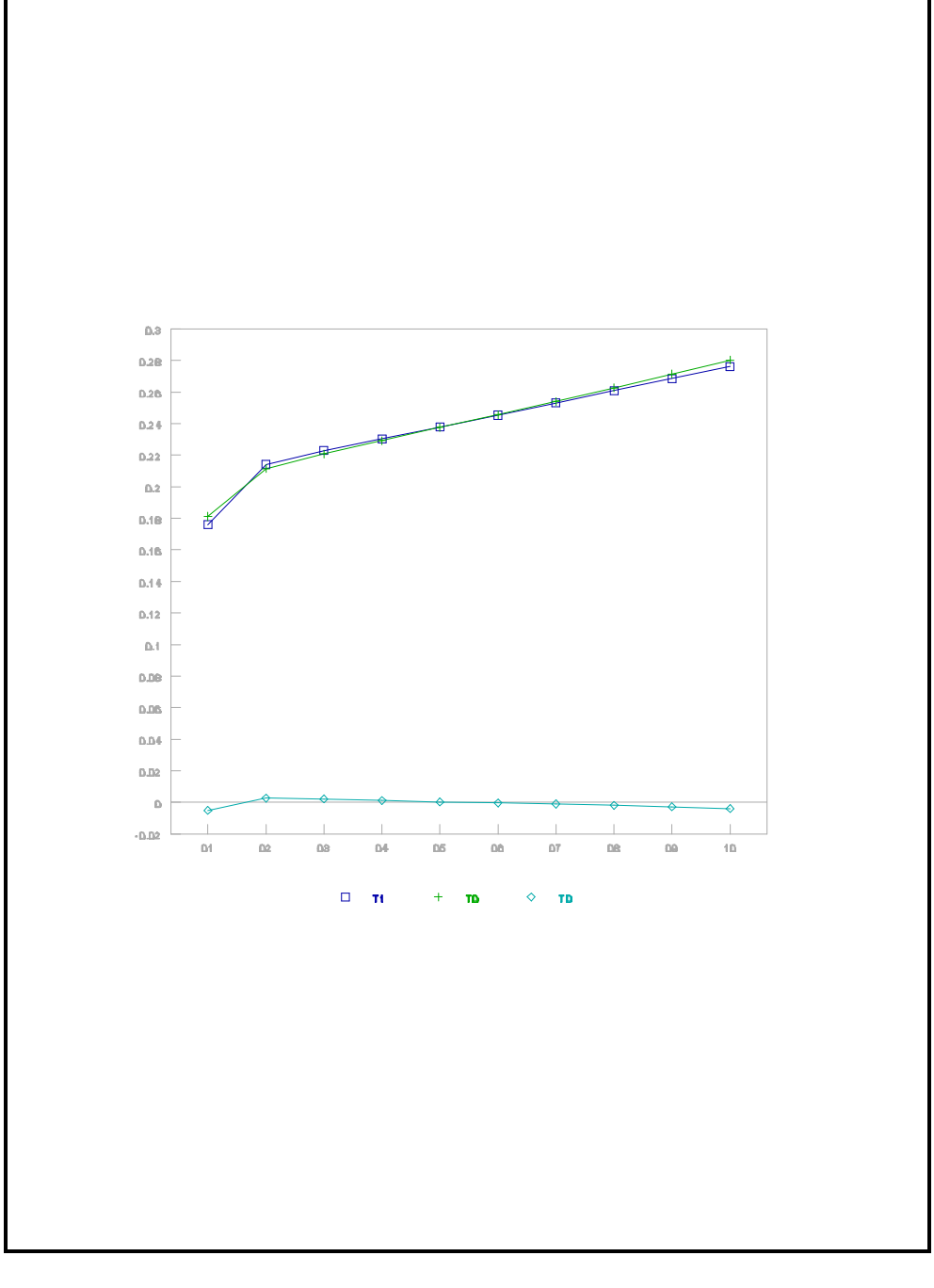

figure 22: partial fungibility, effects on taxation

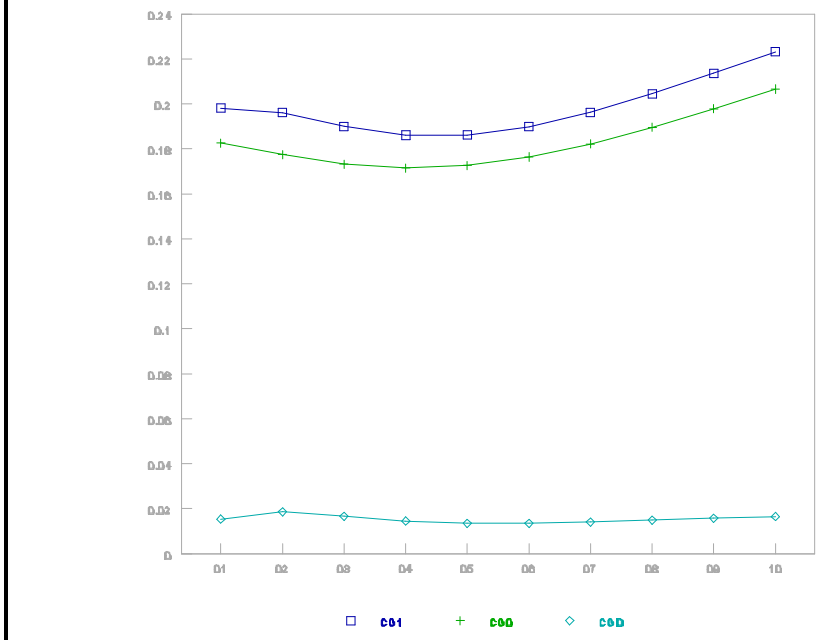

figure 23: no fungibility, effects on government consumption

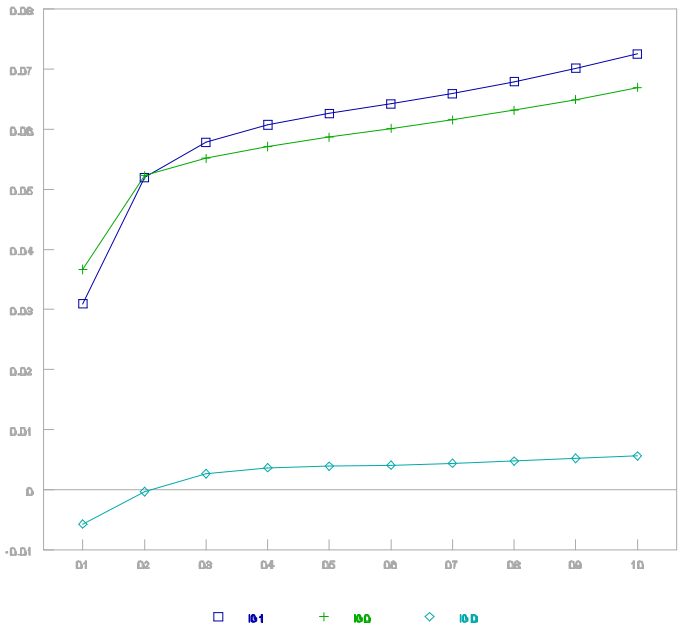

figure 24: no fungibility, effects on government investment

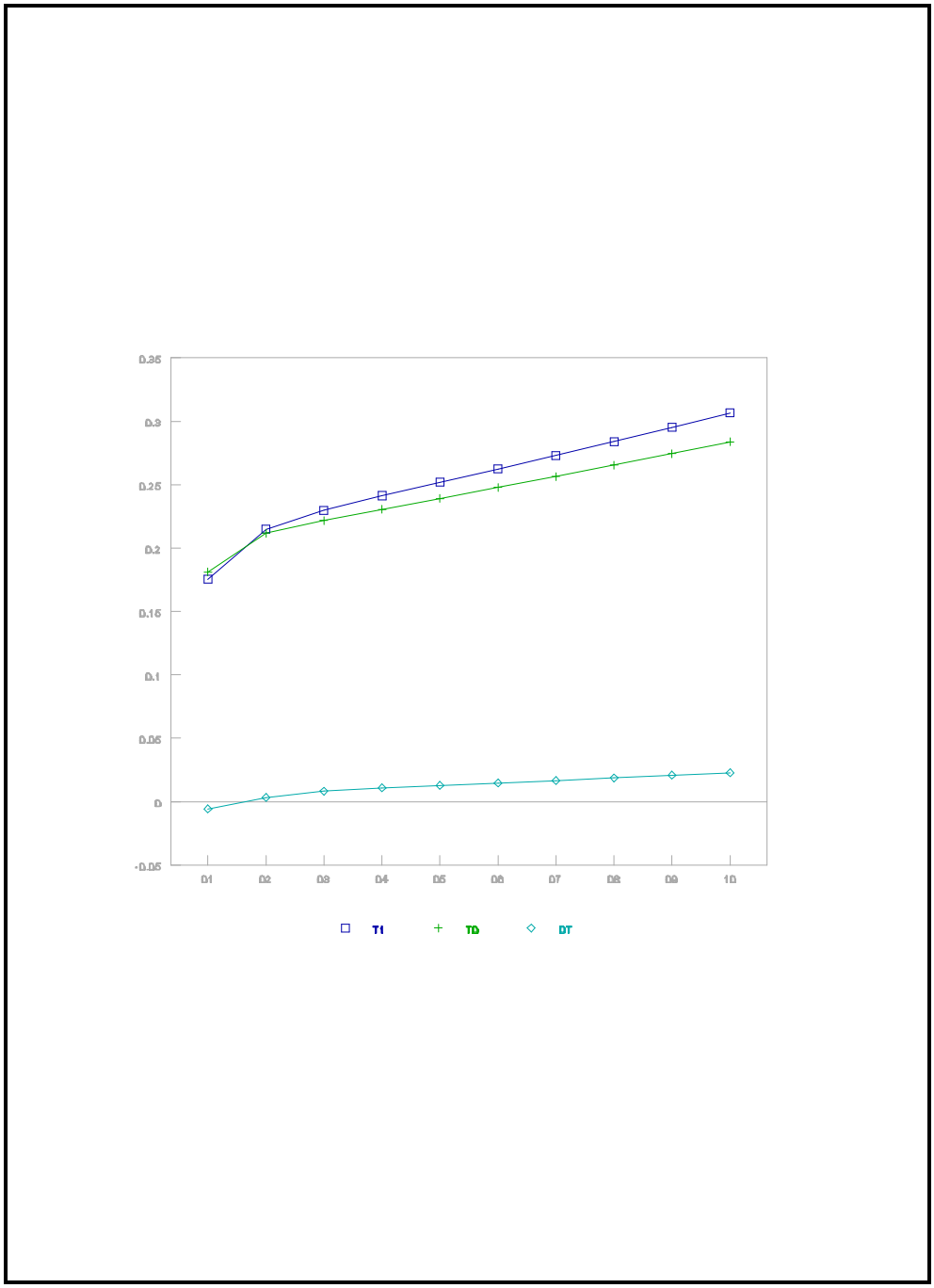

figure 25: no fungibility, effects on taxation

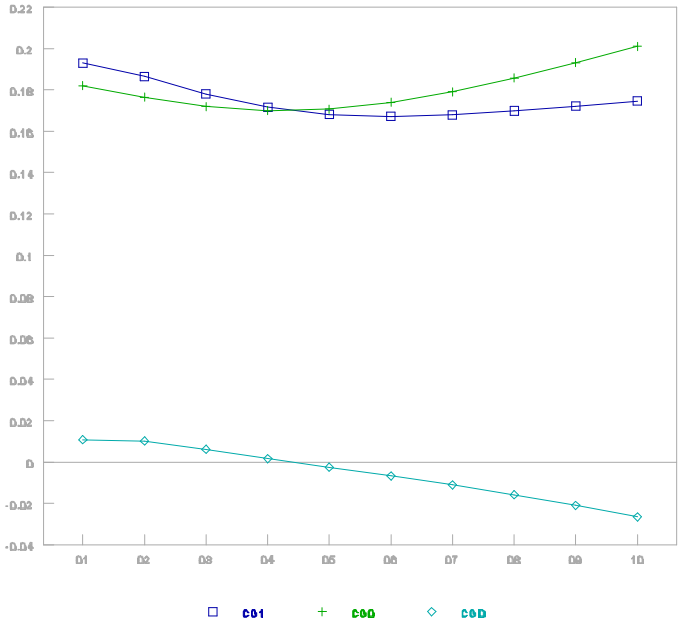

figure 26: full fungibility, effects on government consumption

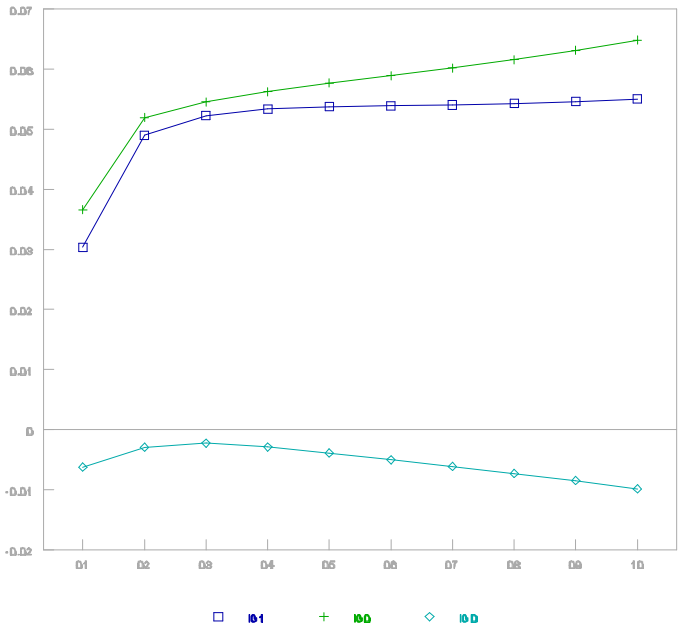

figure 27: full fungibility, effects on government investment

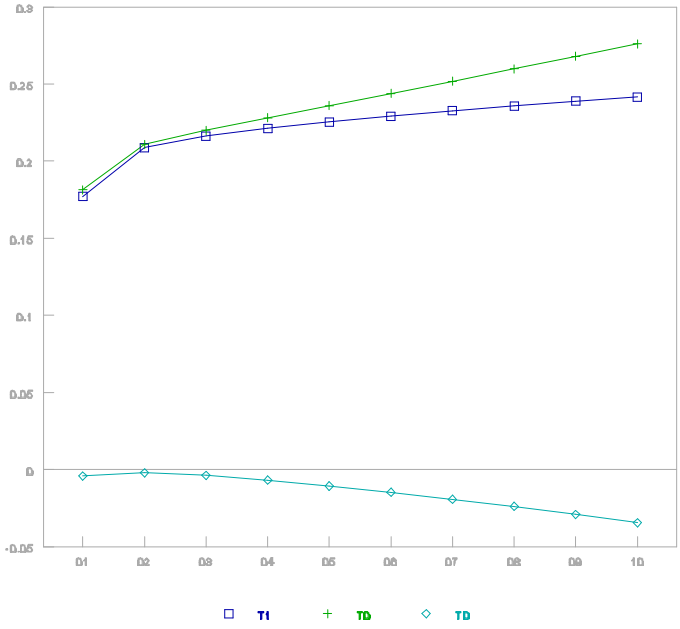

figure 28: full fungibility, effects on taxation

In the first simulation (figures 20-22) it is assumed that all foreign aid is channelled through the private sector and that foreign aid is used exactly in the way formal credit is spend, i.e. the partial fungibility case. It appears that foreign aid has a minor positive effect on government consumption and investment in the first simulation periods and a minor negative effect after 5 and 9 years, respectively. The effect on taxes is minor.

In the second and third simulation it is also assumed that foreign aid is only channelled through the private sector. But now, it is only used for investment, i.e. no fungibility (figures 23-25) or for consumption, i.e. full fungibility (figures 26-28). The results clearly show that the impact of foreign aid on governments fiscal behaviour substantially depends on how the private sector uses foreign aid. If it is only used for private investment, foreign aid has a positive effect on government consumption, government investment and taxes. However, if it is only used for private consumption purposes, foreign aid negatively affects government consumption after 4 years, and negatively affects government investment and taxes during the whole simulation period.

Again the differences may be explained by the effect on GDP. The effects on GDP for the three cases are shown by figures 29-31.

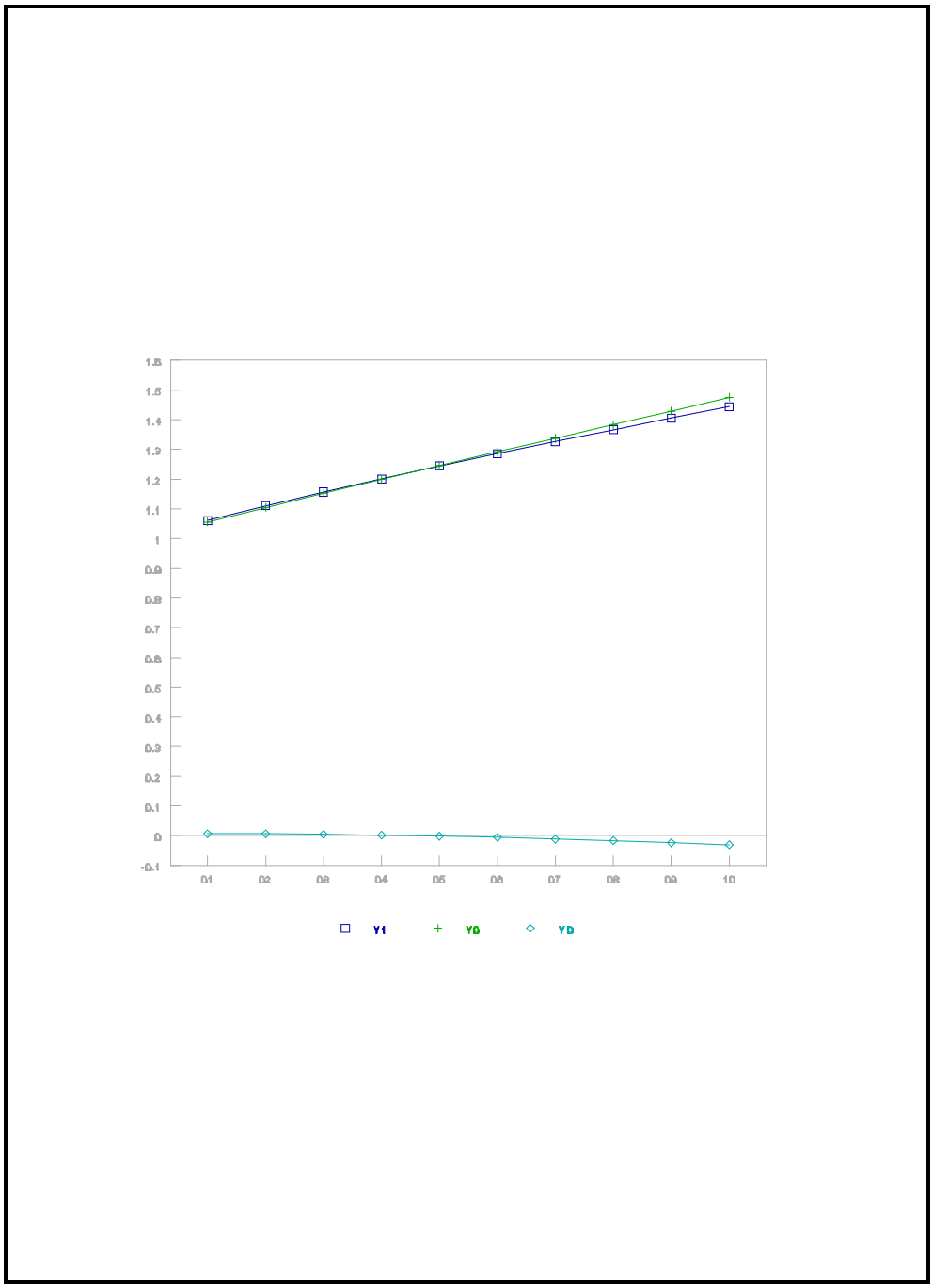

figure 29: partial fungibility, effects on GDP

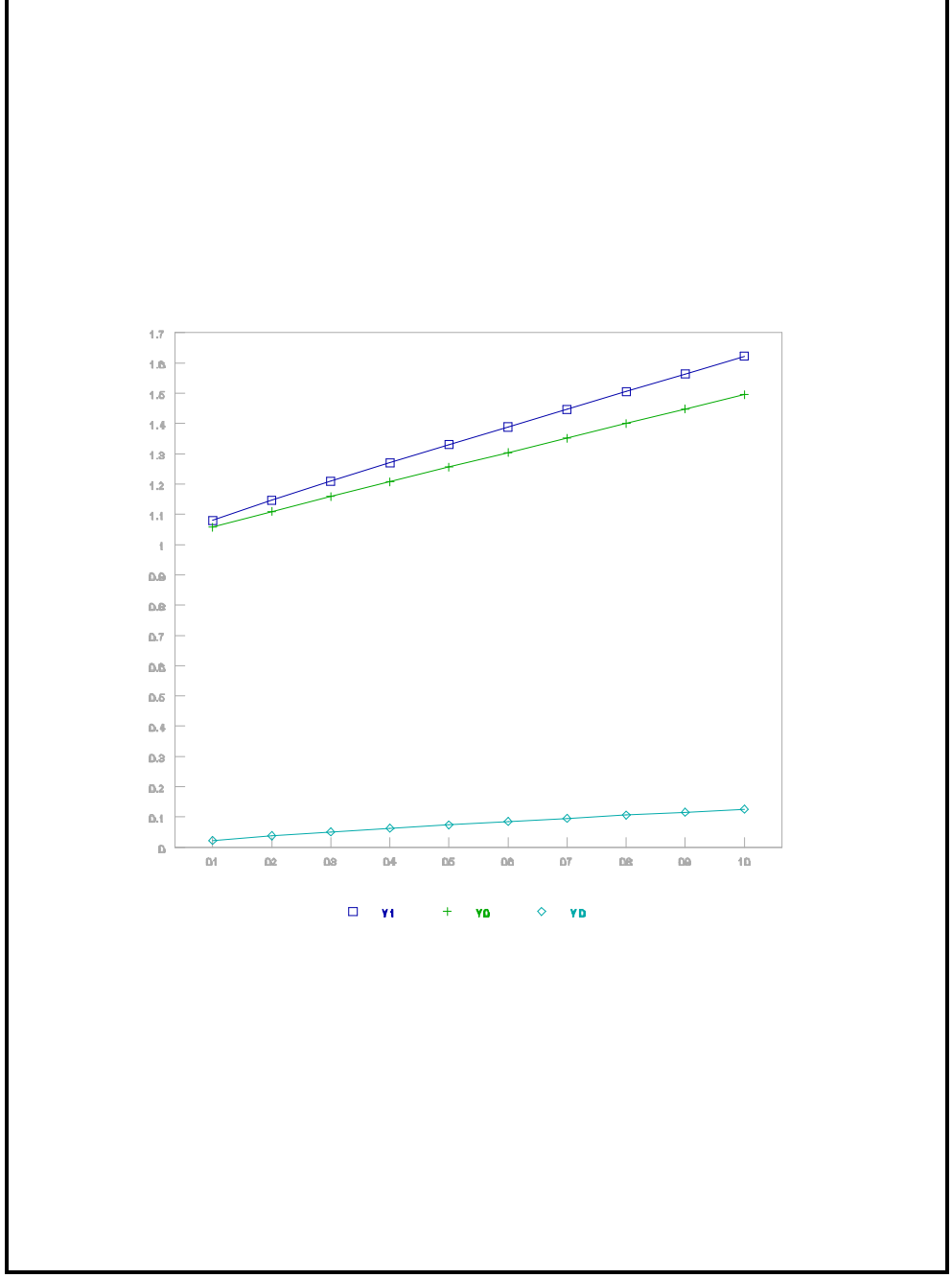

figure 30: no fungibility, effects on GDP

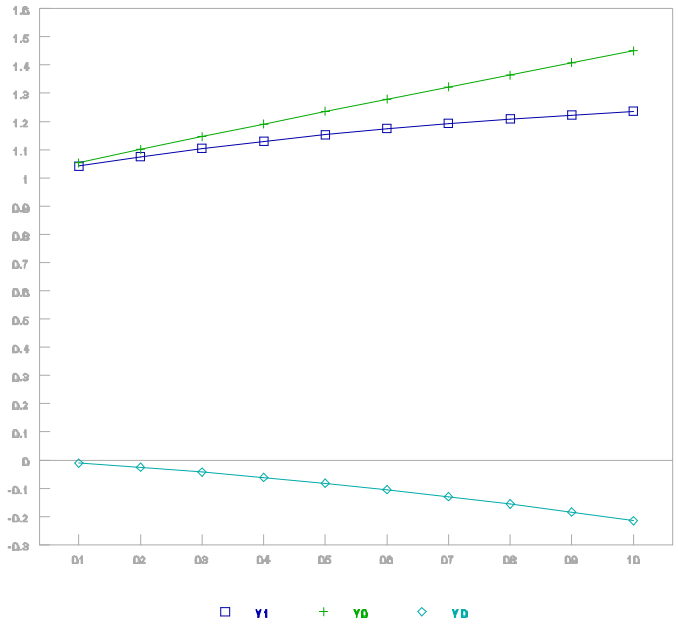

figure 31: full fungibility, efects on GDP

It appears that foreign aid has a small negative effect on GDP when aid is spend in the way formal credit is used (figure 29). Alternatively, GDP is positively affected when foreign aid is used for private investment (figure 30). Finally, it is negatively affected when foreign aid is only used for private consumption purposes (figure 31).

Conclusions

The aim of this paper is to examine the effects of foreign aid on government's fiscal behaviour. We have tried to do this by using and simulating a model which explicitly allows for interactions between the non-bank private sector, the government sector, the banking sector and the external sector and which also allows for supply side effects. This is in marked contrast to the existing literature which only examines this issue by confining itself to the government sector.

The simulations have tried to shed light on the effects of aid on government's behaviour under alternate assumptions about the nature of feedback effects, about the degree of fungibility and about the allocation of aid between the public and the private sectors. The summary of the various outcomes is given in Table 5.

Table 5: total effects of foreign aid

	CG	IG	T	Y
Foreign aid channelled through the government				
No feedbacks	+	+	-	
Demand determined model	+	+	+	+
Full model (partial fungibility)	+	+	s	s
Aid for consumption only (full fungibility)	+	-	-	-
Aid for investment only (no fungibility)	-/+	+	-/+	+
Foreign aid channelled through the private sector				
aid used as formal credit (partial fungibility)	+/-	s	s	s
aid for investment only (no fungibility)	+	-/+	-/+	+
aid for consumption only (full fungibility)	+/-	-	-	-

Notes: s denotes very small; + denotes a positive effect; - denotes a negativ e effect; +/- (-/+) denotes positive (negative) in the first simulation periods an d negative (positive) in the later simulation periods.

The simulations should be seen as illustrative examples and not as representin g the actual magnitudes of the various outcomes. Yet they shed light on a numbe r of important issues. They clearly demonstrate the importance of allowing for th e implications of interactions between different sectors in the economy fo r examining the effects of aid on government's fiscal behaviour as well as th e importance of allowing for supply side effects. This is shown by comparing th e results for the "no feedbacks," the "demand determined model" and the "ful l model," as given in Table 5. Especially, the effect of foreign aid on taxes appea r to differ considerably. Hence, the simulations point out that an assessment of th e effect of foreign aid on government's fiscal behaviour by only considering a government sector, and abstracting from supply side effects, which is done i n nearly all existing literature in this field, may give the wrong answers. Moreover , the simulations show the importance of the degree of fungibility for the tota l

effects of aid on government's expenditures and taxes. The total effects of foreign aid on government investment and taxes are positive, at least after some simulation periods, in the case where foreign aid is only used for investment, or in other words when there is no fungibility. This holds irrespective of the way how foreign aid is allocated, i.e. whether it is channelled through the government or the non-bank private sector. If foreign aid is only used for investment it appears that government consumption is also affected positively after some simulation periods. Again, this holds irrespective of the way how foreign aid is allocated. Thus, the simulations suggest that the way foreign aid is allocated between the public and the private sectors is not so crucial. What matters, though, is how foreign aid is used. The simulations point out to the need of using aid for investment purposes and show the negative implications of using aid for consumption purposes.

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Notes

1. The model is based on Gupta and Lensink (1996).

2. For reasons of convenience Heller's distinction between "civil" and "socioeconomic " consumption in the public sector is not taken into account.

3. This type of utility function is also used in studies of Mosley *et all* (1987) and Mosley (1987).

4. This variable could also represent gold or the stock of land. It may be seen as a composite o f highly substitutable assets, which serves as an inflation hedge.

5. Note that normally consumption fixed capital is introduced in the definition of disposable income of the private sector. For pragmatic reasons we, however, decided not to take consumption fixe d capital into account in disposable income, but to subtract it from savings in order to calculate th e increase in net wealth. Since depreciation is exogenous our assumption does not substantially affec t the results.

6. Note, that for this last case actually foreign aid is not only used for private consumption, it i s also, implicitly, used for foreign assets, as can be seen by figuring out the adding-up restriction fo r the private sector.