MONETARY AND FISCAL POLICY IN A 'TRIPARTITE ARRANGEMENT': A FRAMEWORK FOR POLICY ANALYSIS IN THE ECCB AREA

By

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1. Introduction and Overview

It seems quite generally presumed that the policy authorities in the Eastern Caribbean, like policy authorities elsewhere, have at their disposal the instruments necessary to pursue stabilization policy. However, mechanisms linking policies to objectives in an Eastern Caribbean context have not been extensively studied and the constraints under which they operate do not seem to be widely appreciated. In this paper we focus on building stylized models linking, the balance of payments and monetary policy, to illustrate the nature of the choices the policy authorities have, under different assumptions about the institutional framework.

We start from the basic accounting relationships in the economy, the balance sheets and the flow of funds accounts to get consistent stock-flow relationships. The system is then closed with some behavioral relationships for the private sector, the government sector, the commercial banking sector and the monetary authority. From these accounting relationships, different scenarios are developed for the analysis of policy. There are two basic models: model-I, the ECCB arrangement with endogenous government expenditure and model-II, the ECCB arrangement with exogenous government expenditure. Model-I has three variants. The first and simplest of these is the currency board case, case (a) in which the monetary authority holds only foreign assets which backs the local currency on a one for one basis, the commercial banks are free from any regulatory obligations and the government's fiscal accounts are balanced. In case (b), the currency issue is still fully backed by foreign assets, the government's budget must still balance but an element of regulation is imposed on the

commercial banks. They are obliged to hold notes and coins in a specified ratio to their liabilities. Finally, in case (c) the government can borrow from both the monetary authority and the commercial banks. However, the extent of borrowing is beyond the government's control, the monetary authority imposes a tight rule on deficit financing, and the banks pursue their own commercial objectives. Model-II examines a freeing up of the constraints on the government sector and it can choose its expenditure, with residual financing for the fiscal deficit provided by the commercial banking system. The models are solved first for their stationary solutions and then for one period solutions from which their dynamic properties are inferred.

The most significant feature of the full stationary state of model-I is that the level of income depends only on trade performance, and is therefore independent of policy. Fiscal policy affects the level of personal disposable income and through this private sector expenditure. Given values for private disposable income, along with the private sector preferences we are able to pin down other variables, such as the money supply, and the cash and bank deposits held by the public. Although monetary policy has no effect on income in any of the model-I cases directly, it may affect the level of foreign assets. The simplest way to characterize such effects is by recognizing that the money supply (the stationary level of which is partly determined by trade performance, fiscal policy and the private sector preferences) is equal by definition to the sum of foreign assets and domestic credit. So foreign assets in the system can be determined as the difference between the money supply and the level of domestic credit. Therefore changes in the money supply or domestic credit will affect the level of foreign assets.

In case (a), the foreign assets of the monetary authority is determined by the level of commercial bank lending to the private sector. In this institutional setting monetary policy has no effect on foreign assets. Indeed monetary policy could be described as a fixed rule, the decision to back the currency 100% by foreign assets.

In case (b), where a cash reserve ratio is imposed on the banks, monetary policy does have some effect. Although it does not alter the overall level of foreign assets, the cash reserve ratio serves to redistribute existing foreign assets between the monetary authority and commercial banks. When the cash reserve ratio is higher, the monetary authority holds more and the commercial banks holds less foreign assets. The mechanism is quite straightforward, since the overall size of the banks' balance sheet is determined by private sector holdings of bank deposits, and bank lending is exogenous, an increase in banks' holdings of cash must be at the expense of their foreign asset holdings. In other words the banks purchase the required cash from the monetary authority using their foreign assets. Of course, since the monetary authority still backs the currency issue 100% by foreign assets, the overall level of foreign assets in the system is left unaffected.

In case (c) things are a little different, since domestic credit now includes not just commercial bank domestic lending but also monetary authority lending to the government. The list of monetary policy instruments is longer too. In addition to the cash reserve ratio, the monetary authority can now choose the extent to which foreign assets are used to back the currency issue, with the balance being backed by holdings of government debt. Under this policy

regime, monetary policy affects the system's foreign assets in three ways. Firstly, monetary policy affects the division of foreign asset holdings between the monetary authority and the commercial banks, as in case (b) through the cash reserve ratio. Secondly, monetary policy affects the level of foreign assets through the monetary authority's rule on foreign assets. Where the rule requirement on the monetary authority's foreign assets are higher, the foreign assets of the system are higher and vice versa. Furthermore, there is a leakage of foreign reserves from the system when the cash reserve ratio is adjusted. When a higher cash reserve ratio is imposed, the foreign assets of the system are reduced, since only a proportion of the foreign assets surrendered by the banks in exchange for currency go into the foreign assets of the monetary authority. Thirdly, and finally, the proportion of the money supply held as notes and coins by the public also affects the level of foreign assets in the system. If the private sector increase the cash component of its money holdings more foreign assets are lost. Evidently, the policy rule on foreign asset backing for the currency has quite profound effects. For given values of these parameters though the overall conclusion remains the same: foreign assets must equal the money supply less domestic credit.

The feature which distinguishes model-II is that the government's budget need not balance, but when it does not it is offset by an imbalance in the current account of the balance of payments. In this setting, the model does not except by chance achieve a full stationary state. In a situation where government expenditure is exogenous and the budget is not balanced, we can obtain a 'quasi-stationary' state where the budget deficit and the external sector are none zero but equal. In this quasi-stationary state the stock of private assets and debt are constant as in

TABLE ONE

THE SECTORAL FINANCIAL BALANCE SHEETS:

Claims/Sectors	Gov't	M.A	C.O.B	Pri-Sec	For-Sec	Total
Domestic:						
Currency		**NC**	**-NCB**	**-NCP**	**---**	**0**
Loans	**MLG**	**-MLG**	**-BLP**	**BLP**		**0**
	BLG		**-BLG**			**0**
Deposits			**BD**	**-BD**		**0**
Foreign:loans			**-FRB**		**FRB**	**0**
	FIG				**-FIG**	**0**
Deposits		**-FRM**			**FRM**	**0**
Total	**TGD**	**0**	**0**	**-NFW**	**-NFR**	**0**

TABLE TWO

THE TRANSACTION MATRIX:

Sector	Income	Expend	Deposit	NC	DP	DG	ML	FL	FI	TL
Private	PDY	PE	-ΔBD	-ΔNCP	ΔBLP	-				0
Gov't	T	G				ΔBLG	ΔMLG		ΔFIG	0
M.A.				ΔNC			-ΔMLG	-ΔFRM		0
C.O.B			ΔBD	- ΔNCB	-ΔBLP	-ΔBLG		-ΔFRB		0
Foreign	M	X						ΔFR	-ΔFIG	0
Total:	PDY+T+ M	PE+G+ X	0	0	0	0	0	0	0	0

Note: ΔFR=ΔFRM+ΔFRB.

the case of the full stationary state solution.[1] The level of income in this quasi-stationary state depends on both the trade performance and fiscal stance. Again in this formulation whilst monetary policy does not affect the level of income, it can affect the ownership of foreign assets and the composition of asset stocks as it did in model-I.

Two important conclusions, follow from the analysis. Firstly there is a structural similarity between the operations of the ECCB and those of the commercial banks. Both can generate a run down of the foreign reserves of the system by increasing domestic credit, the ECCB by lending to governments, the banks can do this by lending to the private sector. Secondly, the role of the particular institutional framework in ensuring fiscal discipline. Since fiscal discipline assists in the maintenance of external balance it is imperative that fiscal policy be consistent with the overall thrust of monetary policy and such consistency can be achieved through the design of appropriate institutional rules. For instance, an institutional framework that puts a limit on monetary authority lending to the government sector protects the foreign reserves of the monetary authority. Similarly, fiscal discipline may assist the commercial banks by obliging them to respect the trade-off between credit creation and the level of foreign assets they hold. The implications for policy are that; existing controls on monetary authority financing to the government should remain, and that controls on the commercial banks ought to be relaxed (especially the obligation to hold government debt). The idea is simple: the independence of

[1]Such a possibility exists for model-I through increased lending to the private sector but it depends on the commercial banks willingness to run down foreign assets or build up foreign debt to finance such lending continuously. Needless to say, it seems unlikely that commercial banks would function in this way.

the monetary authority which underpins the existing monetary rule, plus the independence of the commercial banks are sufficient stabilization tools.

The plan for the remainder of the paper is as follows: Section II presents the general macroeconomic framework, which consist basically of two aspects. The stock-flow relationships, the behavioral relationships and the policy regime under which the various sectors operates. The two models are developed as restrictions on this general framework. In section III the two models are solved, first for their stationary state solutions and then for the one period solutions from which the adjustment dynamics are deduced. In the concluding section some implications are drawn out for the conduct of policy in the ECCB monetary union.

2. The Accounting Framework:

This framework derives from the relationships implied by the balance sheets and the flow of funds accounts for the economic sectors. In this general framework we analyze all the balance sheets and flow of funds accounts with all the variables included. The particular models are developed subsequently as restrictions on this general framework.

2.1 The Balance Sheets

Table 1 yields six independent accounting equations, the first five equations are obtained from the columns and describe the asset positions of the government, monetary authority, commercial banks, external and personal sectors. And from the rows we obtain a further equation which gives the split between the private sector and commercial bank holdings of notes and coins. Of course from the private sector relationship we can obtain a definition for the money stock as[2],

$$MS=NCP+BD \qquad 1.1$$

2.2 The Transaction Matrix:

This matrix (table 2) records each transaction twice once as a purchase and once as a sale. The matrix itself is divided into three categories of transactions; income transactions; expenditure transactions and transactions in financial assets. Generally this matrix describe the budget constraints of the various sectors. However we wish to focus on the private sector, the government and the foreign sectors. That is we assume for convenience that the net financial

[2]A glossary of symbols is contained at the end of the paper.

asset accumulation by the other two sectors, the monetary authority and the commercial banks is zero.

The private Sector:

$$PDY-PE \equiv \Delta NCP+\Delta BD-\Delta BLP \quad 1.2$$

This implies that;

$$\Delta MS \equiv PDY+\Delta BLP-PE \quad 1.3$$

This equation represents the net acquisition of financial assets by the private sector.

The Government Sector:

$$G-T \equiv \Delta BLG+\Delta MLG+\Delta FIG \quad 1.4$$

The Foreign Sector:

$$X-M \equiv \Delta FRM+\Delta FRB-\Delta FIG \quad 1.5$$

Then by combining these three budget constraints we get the constraint for the nation as a whole. This is given as,

$$\Delta BD+\Delta NCP \equiv (G-T)+(X-M)+\Delta BLP \quad 1.6$$

Then by substitution we obtain;

$$\Delta MS \equiv (G-T)+(X-M)\Delta BLP \quad 1.7$$

2.3 The Behavioral Relationships:

The relationships to be specified describe two sets of phenomena. First behavioral rules used

by the different sectors to guide their decision making. Secondly the policy regime which capture the institutional framework with which economic agents objectives are pursued.

The Private Sector:

Private sector spending is given by the following equation;

$$PE=\alpha*PDY+\Delta BLP+\beta*MS_{-1} \quad 1.8$$

Since income not spent is added to financial asset holdings (which change according to identity (1.3)) it is evident that we could have alternatively specified (1.8) as a demand for money function and derive spending from (1.3). The two formulations are equivalent.

Money holdings are given by:

$$NCP=\gamma*MS \quad 1.9$$

Imports as part of private sector spending satisfied by foreigners:

$$M=\mu*Y \quad 1.10$$

In this setup, α; β; γ and μ are regarded as behavioral norms of the private sector based on tastes and preferences.

The Government Sector:

Government expenditure is endogenously determined by the tax receipts and available finance. However, it is assumed to be able to choose its tax rate; τ and so the level of tax collections, T can be written down as,

$$T=\tau*Y \quad 1.11$$

The Commercial Banking Sector:

The size of the commercial banks balance sheet is determined by the private sector choice of bank deposits. Therefore the banks can only really determine the allocation of the variables on the balance sheet. Such an allocation is determined by considerations of profit maximization by the banks.

The Monetary Authority:

The monetary authority operates under a fixed rule where it can issue domestic currency so as to maintain a one for one relationship between its foreign and local assets.

2.4 The Model

From this general framework we derive two models:

Model-I. The ECCB Arrangement with Endogenous Government Expenditure.

Model-II. The ECCB Arrangement with Exogenous Government Expenditure.

In model-I we have three variants. The basic case (a), the currency board arrangement, plus two others. The variations on case (a) represent successive expansions in the scope for policy. In the first, case (b) the monetary authority attempts to assert more control over the commercial banks by imposing a required reserves ratio on the commercial banks. The second strand of development, case (c) allows the government to borrow.

Case (a), is the currency board type operation. The pertinent balance sheets are listed in table 3.

For **Case (b):** The Currency Board with required reserves ratio:

The only changes are to equation (3), therefore:

(3b) NCB+BLP+FRB ≡ BD	**FRB**
(13) NCB=λ*BD	**NCB**

For **Case (c):** Government borrowing determined:

(1c) FRM+MLG ≡ NC	**MLG**
(3c) NCB+BLP+BLG+FRB ≡ BD	**FRB**
(4c) G-T ≡ ΔMLG+ΔBLG+ΔFIG	**G**
(6c) X-M ≡ ΔFRB+ΔFRM-ΔFIG	**M**
(14) FRM=δ*NC	**FRM**

Table 3

Model I: The ECCB Arrangement with Endogenous Government Spending

(a) THE BASIC CURRENCY BOARD MODEL:

EQUATIONS	ENDOGENOUS VARIABLES
(1) FRM ≡ NC	**FRM**
(2) NCB+NCP ≡ NC	**NC**
(3) NCB+BLP+FRB ≡ BD	**NCB**
(4) G ≡ T	**G**
(5) MS ≡ NCP+BD	**BD**
(6) X-M ≡ ΔFRM+ΔFRB	**M**
(7) PDY ≡ Y-T	**PDY**
(8) ΔMS ≡ PDY+ΔBLP-PE	**MS**
(9) $T=\tau^*Y$	**T**
(10) $M=\mu^*Y$	**Y**
(11) $PE=\alpha^*PDY+\Delta BLP+\beta^*MS_{-1}$	**PE**
(12) $NCP=\gamma^*MS$	**NCP**

The Policy Regime

The commercial banks are given a free hand to determine the composition of their balance sheets. They can choose two of NCB, FRB and BLP with the other being determined residually. We assume they choose BLP and FRB.

Case (b): The only change in this case in relation to case (a) is that the behavior of the commercial banks is assumed to be constrained by an exogenously determined reserve requirement linking their cash holdings to bank deposits.

$$NCB=\lambda BD \qquad 1.12$$

We assume that the commercial banks choose BLP; hence FRB is endogenous. The equations are shown in table 3.

Case (c). The government can now run deficits financed by the monetary authority, foreigners and the commercial banks. The changes are to the policy regime, and the equations of this case are also listed in table 3.

The changes to the policy regime are:

$$FRM=\delta*NC \qquad 1.13$$

Which implies that,

$$MLG=(1-\delta)*NC \qquad 1.14$$

Table 4

Model II: The ECCB Arrangement with Exogenous Government Spending

EQUATIONS	ENDOGENOUS VARIABLES
(1) FRM+MLG ≡ NC	MLG
(2) NCB+NCP ≡ NC	NC
(3) NCB+BLP+BLG+FRB ≡ BD	FRB
(4) G-T ≡ ΔMLG+ΔBLG+ΔFIG	ΔBLG
(5) MS ≡ NCP+BD	BD
(6) X-M ≡ ΔFRB+ΔFRM-ΔFIG	M
(7) PDY ≡ Y-T	PDY
(8) ΔMS ≡ PDY+ΔBLP-PE	MS
(9) $T=\tau*Y$	T
(10) $M=\mu*Y$	Y
(11) $PE=\alpha*PDY+\Delta BLP+\beta*MS_{-1}$	PE
(12) $NCP=\gamma*MS$	NCP
(13) $NCB=\lambda*BD$	NCB
(14) $FRM=\delta*NC$	FRM

Model-II

It must be noted that this model is similar to case (c) save that in this formulation BLG is endogenous and government expenditure is exogenous determined by considerations outside the model. This model is shown in table 4.

The policy regime under which the fiscal authorities operates has changed. They are less constrained and can at least apparently choose G.

3. Solutions.

3.1 The Stationary State Solutions

From the identity, (1.7) on page 9 restated here for convenience as,

$$\Delta MS=(X-M)+(G-T)+\Delta BLP \qquad 1.15$$

we can identify the necessary and sufficient conditions for a stationary state (SS). In the SS the 'injections' in the model necessarily equal the 'withdrawals', that is:

$$PE+G+X \equiv PDY+T+M \qquad 1.16$$

this condition is not however sufficient. In order to guarantee stationarity it is also necessary that 'injections' equals 'withdrawals' sector by sector, that is stationarity of stocks requires equality of sectoral income and expenditure. So the external sector, the private sector and government sector must each separately be in balance. Needless to say any two of these will imply the third. In model-I G is assumed to be endogenous and equal to T, if we assume either X=M or PE=PDY the SS is imposed on the model. Here in fact, we assume X=M.

Case (a);

We start with equation (6), table 3.

$$X-M=\Delta FRM+\Delta FRB \qquad 1.17$$

For a SS we require that the balance of payments deficit must be zero,

X-M=0. That is X=M.

Therefore we assume; ΔFRM=0; ΔFRB=0, which implies ΔFR=0. Now from this relationship we can derive the SS level of income by substituting for M from equation (1.10)

$$X-\mu*Y=0$$

we then obtain the SS level of Y as:

$$Y^s=X^s/\mu, \qquad 1.18$$

Where X is the level of exports exogenously determined and μ is the average propensity to import. So Y^s is determined by the trade performance ratio alone a property which is common to all the cases of model-I, i.e where government expenditure is endogenous. This is a key result which has as we shall see important implications for the conduct of monetary policy in particular and macroeconomic policy in general. Since no fiscal nor monetary variables appear in the solution for the level of income it is evident that policy is unable to affect the SS level of income, unless of course it can affect the trade performance ratio.

Fiscal Policy:

The setting of fiscal policy in the model can be characterized by the choice of the tax rate. The channel through which fiscal policy works is through its influence on private sector income and spending.

PDY^s depends on the trade performance ratio which determines Y and the fiscal policy, the choice of τ. That is,

$$PDY^s=(1-\tau)*Y^s \qquad 1.19$$

Moreover where $\Delta MS=0$ and by implication $\Delta BLP=0$ then from equation (1.3) we obtain

$$PE^s=PDY^s \qquad 1.20$$

Although fiscal policy cannot change the level of GDP it can change its composition. Now given PDY we can obtain the SS of money holdings from (1.8) given $\Delta MS=0$ and $\Delta BLP=0$. Also noting that PE≡PDY, then MS is given as:

$$MS^s=\{(1-\alpha)/\beta\}*PDY^s \qquad 1.21$$

The MS is equal to private disposable income multiplied by the ratio $(1-\alpha)/\beta$. Here α is the proportion of disposable income spent and β the proportion of MS spent.

The private sector parameters determine the split between cash and BD.

$$NCP^s=\gamma*MS^s \qquad 1.22$$

and

$$BD^s=(1-\gamma)*MS^s \qquad 1.23$$

The size of BD is of special importance here because it is BD which determine the size of the commercial banks balance sheets.

Therefore the trade performance ratio, fiscal policy and the private sector parameters between them pin down the important aggregates of GDP, personal disposable income, the MS and BD.

Monetary Policy:

The balance sheet of the monetary authority is given as:

$$FRM^s=NC^s \qquad 1.24$$

Movements in the level of NC are fully reflected in movements in the level of FRM. Moreover since NC is given by the relation NCB+NCP≡NC then FRM by implication depends on the choices of the commercial banks and the private sector. The commercial banking system then faces an allocation problem with respect to NCB; FRB and BLP, i.e the balance sheet is indeterminate. It can choose two, with the third determined residually. Here we assume that the banks chooses BLP and FRB. Therefore an increase in either or both of these leads to a fall in the level of NC and by implication FRM. There is then no role for discretionary monetary policy in this framework. Indeed, monetary policy could be described as the decision to back the currency 100% by immobilized foreign assets, a fixed rule.

Case (b); we know that, (i) Y^s depends on the trade performance ratio, (ii) the composition of demand depends on fiscal performance; and (iii) the private sector portfolios depends on α, β, γ. Hence the role for monetary policy is confined to affecting the composition of the balance sheets. The choice of λ turns out to determine not the level of foreign reserves but the proportion held by the banks. Lets us see how.

Since the commercial banks are assumed to choose BLP, the level of foreign reserves they hold is endogenously determined.

$$FRB^s=(1-\lambda)BD'-BLP^s \qquad 1.25$$

The setting of monetary policy in the model can therefore be characterized by the choice of the level of the cash reserve ratio (λ). And the channel through which monetary policy works is its influence on the distribution of foreign assets between the commercial banking system and the monetary authority. There is no effect on the net level of foreign reserves in the

economy as shown by equation (1.26) for the SS level of foreign reserves.

$$FR=\{(1-\alpha)/\beta\}*(1-\tau)*(X/\mu)-BLP. \qquad 1.26$$

Case (c); the variables we are concerned with are BLG; δ; λ, none of these affects Y, T or therefore PDY, PE and BD. They serve only to alter the composition of the banks and the monetary authority balance sheets.

On the balance sheet of the commercial banks BLG affects the level of foreign reserves in the same manner as BLP. As the stock of domestic credit increases of which BLG is a component, the stock of net foreign assets decreases by the same amount.

The parameter δ describes the monetary authority's external monetary policy actions, it can now vary the proportion of immobilized foreign assets held as currency backing. From equation (1.13) the level of foreign assets of the monetary authority is given by,

$$FRM'=\delta*NC' \qquad 1.27$$

While from equation (1.14) the SS level of MLG is given as;

$$MLG'=(1-\delta)*NC' \qquad 1.28$$

The channel through which this particular monetary policy instrument works is therefore through a change in the level of FRM and MLG that the monetary authority holds. That is while NC determines the sum of FRM and MLG, δ determines the split between them. A reduction in δ, results in a reduction in FRM increasing MLG by the same amount. Changes in δ then can result in a change in the composition of asset stocks; with a reduction in δ the

level of net foreign assets is lower, and the level of domestic credit higher by the same amount. From the equation for the SS level of foreign reserves we have.

$$FR=[\delta*\{\lambda*(1-\gamma)+\gamma\}+\{(1-\lambda)*(1-\gamma)\}]*\{(1-\alpha)/\beta\}*(1-\tau)*(X/\mu)-BLP-BLG. \qquad 1.29$$

The significant result in this section though, is that due to the interaction of δ and λ, the system can now lose foreign assets through changes in the policy variable λ which partly increases MLG. This result however depends on the role adopted for δ. The variable δ can be operated in a fixed manner as described here, in which case foreign assets is lost to the system from changes in λ. Of course there need be no loss of foreign assets, from equation (1.29), if δ is adjusted so as to keep MLG constant. In this way the SS level of FRM will increase by the full fall in SS FRB, so changes in λ will simply result in a transfer of resources between two domestic institutions as in case (b).

In summary therefore we can say that neither the SS level of income nor the money supply is affected by monetary policy. In the case of income it follows from the fact that the SS level of income depends on the trade performance ratio alone. For the money supply the result can be seen more clearly, where we define the money supply as the sum of net foreign assets and domestic credit, i.e MS=NFA+DC[3]. It then follows immediately that given the overall size of the money holdings which depend on the private sector parameters and private sector disposable income as the level of domestic credit increases the net level of foreign assets will

[3]By definition originally (1) MS=NCP+BD, with BD=NCB+BLP+BLG+FRB. Then by substitution for BD (1) becomes MS=NCP+NCB+BLP+BLG+FRB. However where NC=NCP+NCB by definition; but also NC=MLG+FRM, which implies by substitution in (1) MS(FRM+FRB)+(BLP+BLG+MLG). Or where FRM+FRB=NFA and BLP+BLG+MLG=DC, then MS=NFA+DC.

fall by exactly the same amount.

Model-II

For model-II given the fact that G-T≠0[4], the model does not except by chance achieve a full SS. In a situation where government expenditure is exogenous and the budget is not balanced; we can obtain a quasi-SS[5] where the government deficit and the external sector deficit are non-zero but equal. Hence,

$$G-T=X-M$$

and by substitution for M and T from equations (1.10) and (1.11) respectively and rearranging we obtain the relationship for the 'quasi-stationary' level of income given in equation (1.30)

$$\mathbf{Y=\{(X+G)/(\mu+\tau)\}.} \qquad \mathbf{1.30}$$

The level of income in the quasi-SS depends on two factors. The first is on the trade performance ratio (X/μ). The second is the fiscal stance (G/τ), that is the level of government expenditure in relation to the tax rate. The denominator of the expression indicates the drain of financial assets from the system as income expands. This result has implications for the conduct of both monetary and fiscal policy. Monetary policy does not affect the level of income, whilst fiscal policy does. In this formulation the use of monetary policy however can affect the ownership of foreign assets and the composition of asset stocks.

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[4]In model-I recall (G-T)=0 was assured by the assumption of an endogenous government expenditure variable. Therefore one of the SS conditions were predetermined as zero.

[5]Such a possibility exists for model-I through ΔBLP but it depends on the commercial banks willingness to run down foreign assets or build up foreign debt to finance BLP continuously. However it seems unlikely that commercial banks would function in this way.

The setting of fiscal policy in this model is characterized by G and τ. Fiscal policy works through three channels in the model: (i) Y; (ii) PDY which depends on the trade performance ratio and the fiscal stance and (iii) BLG, this variable has implications for monetary policy. A higher level of G implies a higher level of BLG and a lower stock of FRB. Of course the level of Y is also higher but the fiscal budget balance and the balance of payments is in deficit and equal. Only a change in FIG outside of BLG on the fiscal deficit affects the foreign reserves of the system. In the other cases there is just a displacement effect with BLG.

3.2 Dynamics of Adjustments:

The behavior of the model outside the stationary state, its adjustment dynamics, are driven by the interaction of private sector spending and financial asset accumulation, the fiscal parameter and the trade performance ratio. This process can be uncovered by examining the single period solution of the model; we first start with case (a) of model-I, given as equation (1.31).

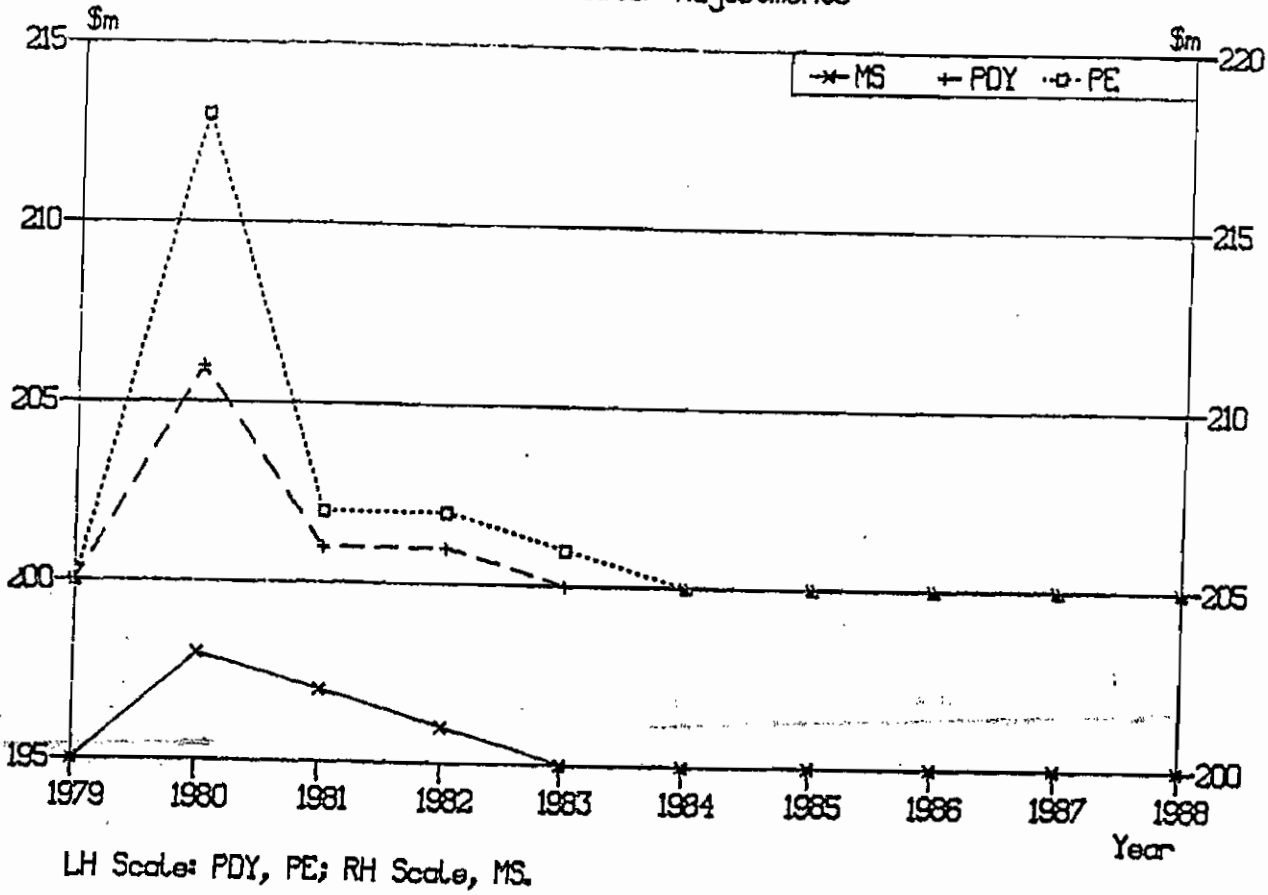
$$Y=\{[X+\Delta BLP+\beta*MS_{-1}]/[(1-\alpha)(1-\tau)+\mu]\} \qquad 1.31$$

The private sector parameters β and α and τ is the fiscal parameter along with μ determine the responses of income to an exogenous shock. That is the path of adjustment is pinned down by the parameters of the model: β is the proportion of spending from lagged money balances; α is the proportion of current disposable income that is spent. The denominator of the expression $1/\{(1-\alpha)(1-\tau)+\mu]\}$ can be regarded as determining the multiplier effect of exogenous changes on income. The important adjustment dynamics are those of the private sector.

For the private sector the time path of adjustments to change are determined by the process of

financial asset accumulation. Some part of any increase in income is spent and the rest is added to the private sector's money holdings (the split between cash and bank deposits here is just a matter of fixed proportions) and the new stationary state is reached, by definition, when those money holdings are no longer changing. Moreover, as can be seen from the form of the private spending function, an adjustment to a once and for all change will take place smoothly through time with the money stock initially rising (the expenditure function has as one of its determinants a lagged proportion of the money stock) and then falling back towards its stationary level at an ever decreasing rate. The path followed by these private sector aggregates is common to all of the simulation experiments where the exogenous variables appear in the solution for income. Common too, is the path followed by GDP. A graphical illustration of the private sector dynamics is given in chart 1 showing the responses of national income to a step change in BLP. In period 0 all stocks are stationary, and flows are constant, PDY≡PE, ΔMS=0 and so on. We then shock the system in period 1 by increasing BLP from 120 to a new constant level of 130. It is evident from the chart the flows quickly regain their SS levels after the initial jump.

Chart 1
Adjustment to a Change in BLP
Private Sector Adjustments



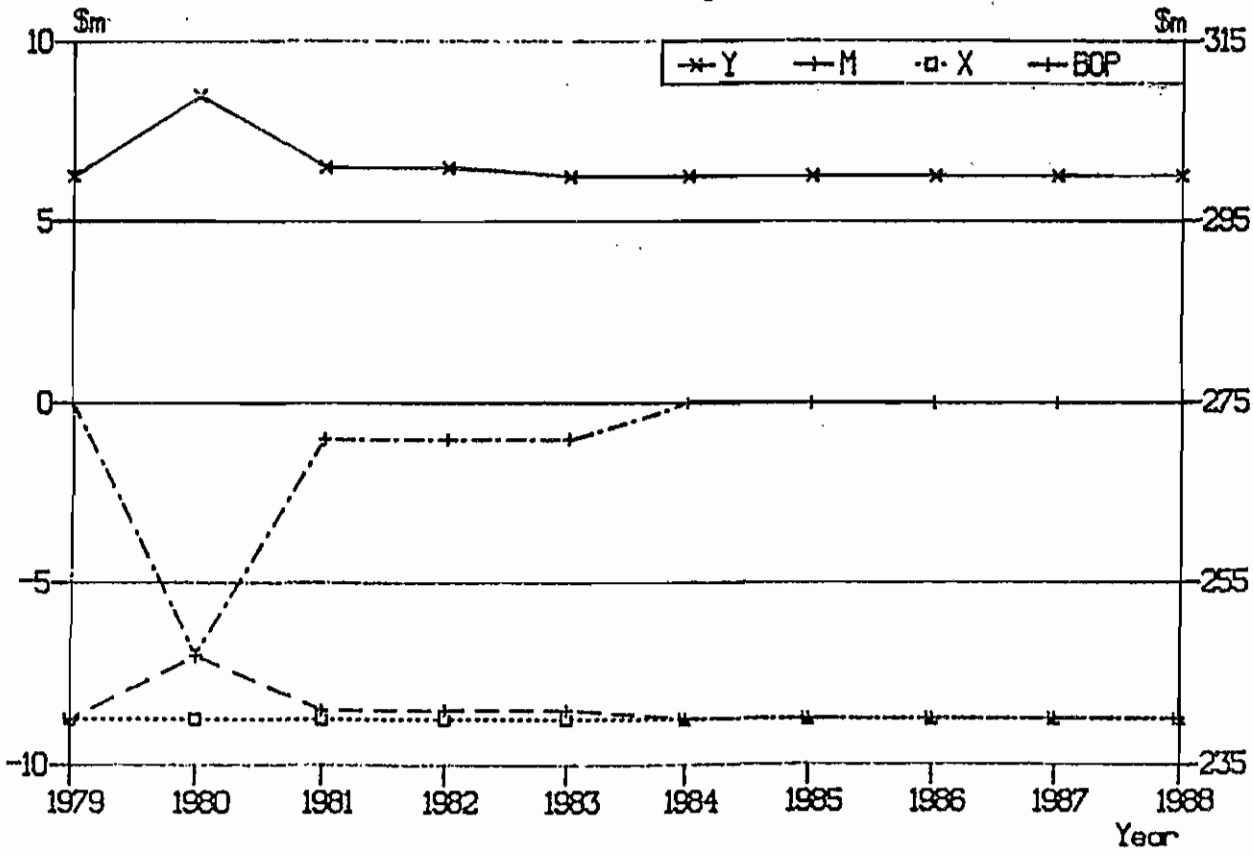
LH Scale: PDY, PE; RH Scale, MS.

Fiscal policy affects the solution via the tax rate, private disposable income and thereby the level of private sector expenditure and also the level of MS. It therefore influences too the level of cash in the hands of the public and the level of BD. Hence fiscal policy determines the extent of expenditure and financial asset accumulation from any increase in GDP occasioned by an increase in an exogenous variable.

The adjustment of GDP to a higher level in the transitional period has direct implications for

the external and government sectors of the economy. We look at the external sector first. The time path of adjustments in the balance of payments deficit is determined by the budget constraint of the external sector, the level of exports is exogenous but as GDP changes the value of imports change since the import propensity is fixed. The new SS is reached, of course, when the balance of payments is no longer changing. The adjustment of the import function to once and for all changes will take place rapidly through time with the balance of payments initially going into deficit and the deficit then closes rapidly. Chart 2 demonstrates the adjustment of the external sector.

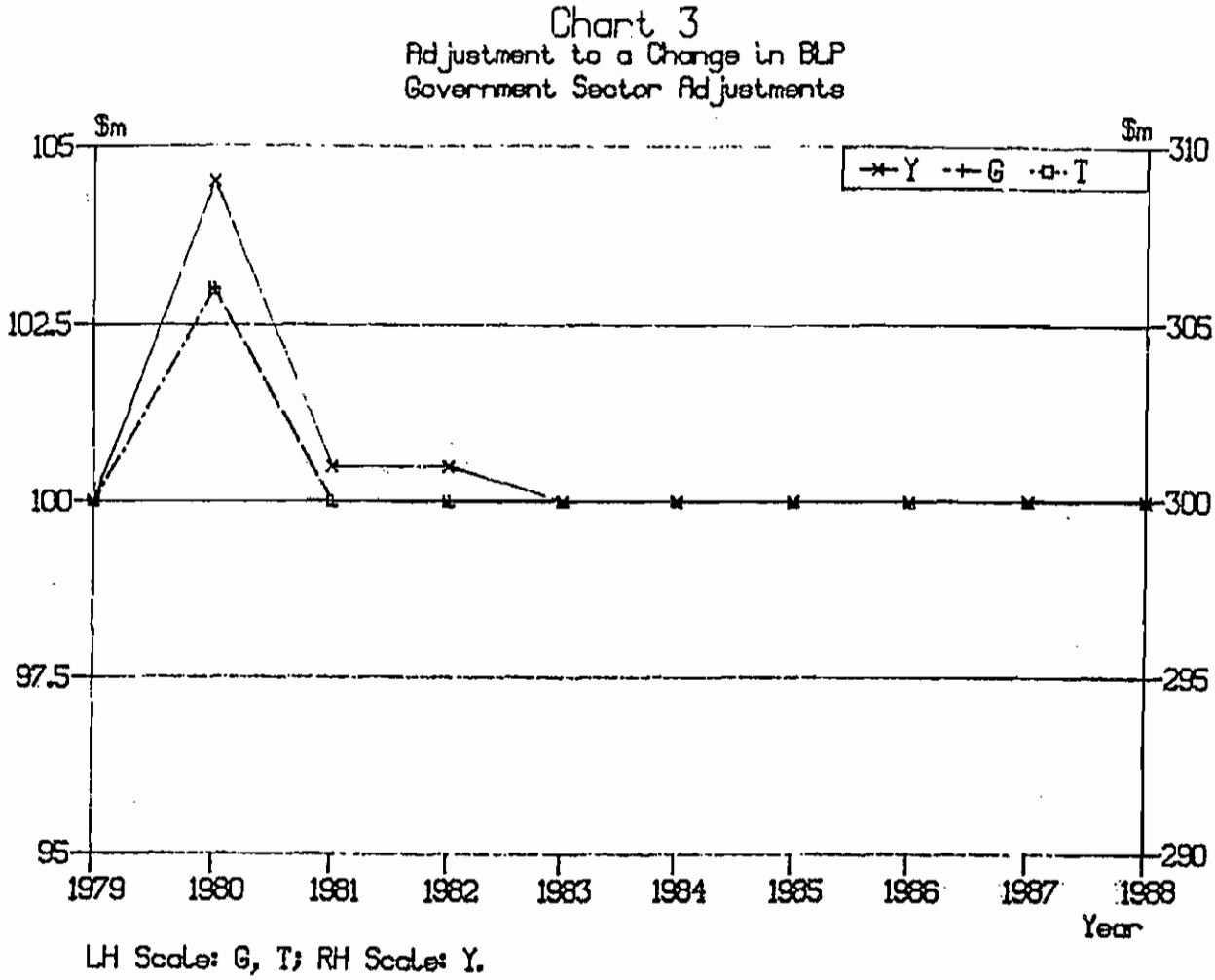
Chart 2
Adjustment to a Change in BLP
External Sector Adjustments



LH Scale: BOP; RH Scale: Y, X, M

Again in period 0 all stocks are stationary, and by implication X=M this implies that the balance of payments is zero and $Y=X/\mu$. However from the shock to BLP the external sector moves into deficit as imports increase given the transitory increase in GDP. Moreover, as before these flows quickly settle down again to their initial SS levels.

For the government sector the time path of adjustment in the fiscal deficit is determined by its budget constraint. Some proportion τ of GDP is taken from the private sector and forms the income of the government sector all of which by virtue of our assumption that the budget is balanced, is spent. The new SS is reached when the government fiscal deficit (GFD), is no longer changing. Adjustments to a once and for all change in G will take the form of a jump, with the GFD first rising rapidly and then falling equally rapidly to its SS level. In case (a) where GFD=0, an increase in GDP will be followed by an equal increase in both tax revenue and government expenditure. Chart 3 depicts the typical adjustment dynamics in the government sector to an increase in income in the currency board case.

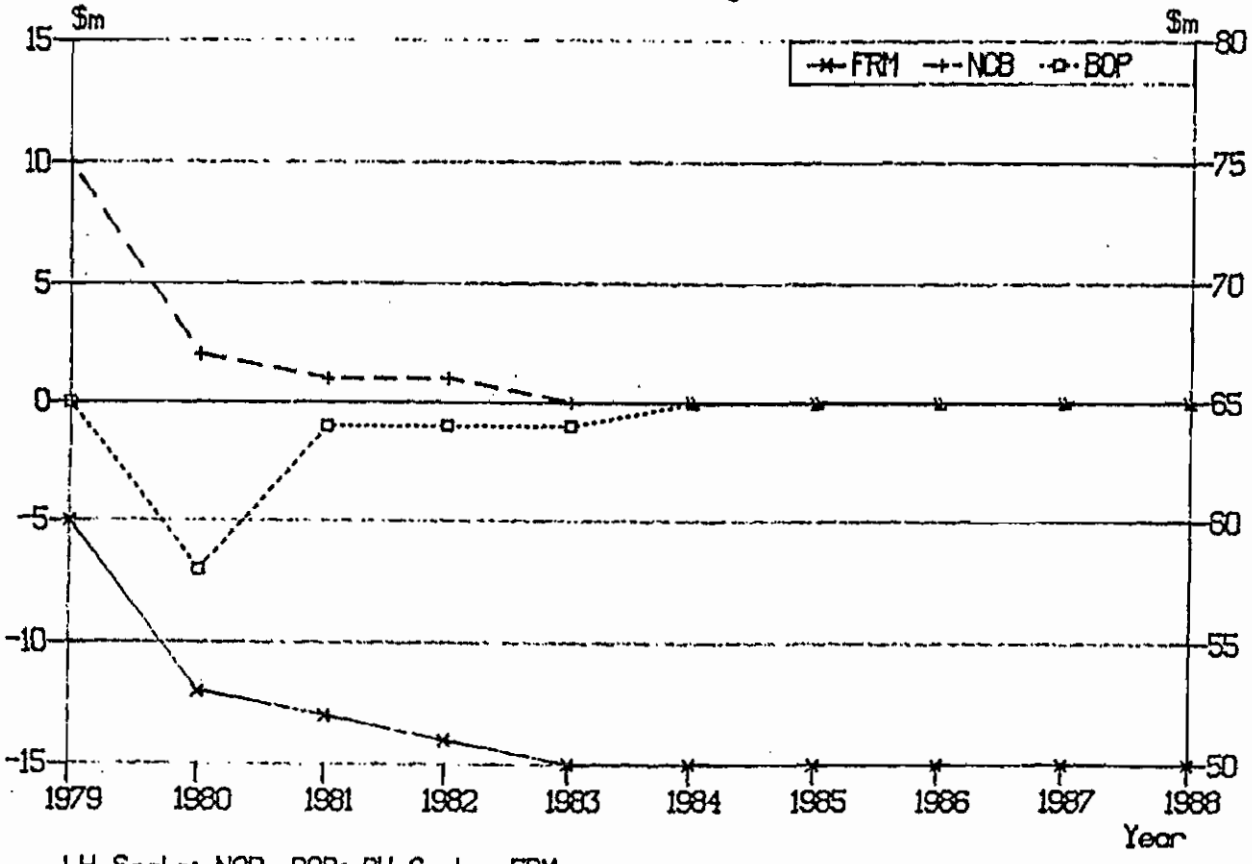


The positive shock to GDP causes an equal and simultaneous jump in tax revenue and expenditure for the government sector. However as is shown by the diagram these flows soon regain their SS levels.

Changes in GDP necessarily causes adjustments in MS which have further implications for the other variables of the system. According to our characterization of case (a) where the increase

in income was occasioned by ΔBLP, then this results in a fall in NCB since NCB is assumed to be residually determined. These effects are of course transmitted to the foreign assets of the monetary authority through NC, since NC=NCB+NCP the foreign reserves of the system decreases. This particular adjustment is shown in chart 4. In period 1 BD and NCP jump and then fall rapidly back to their SS, whilst NCB and FRM fall to new lower levels.

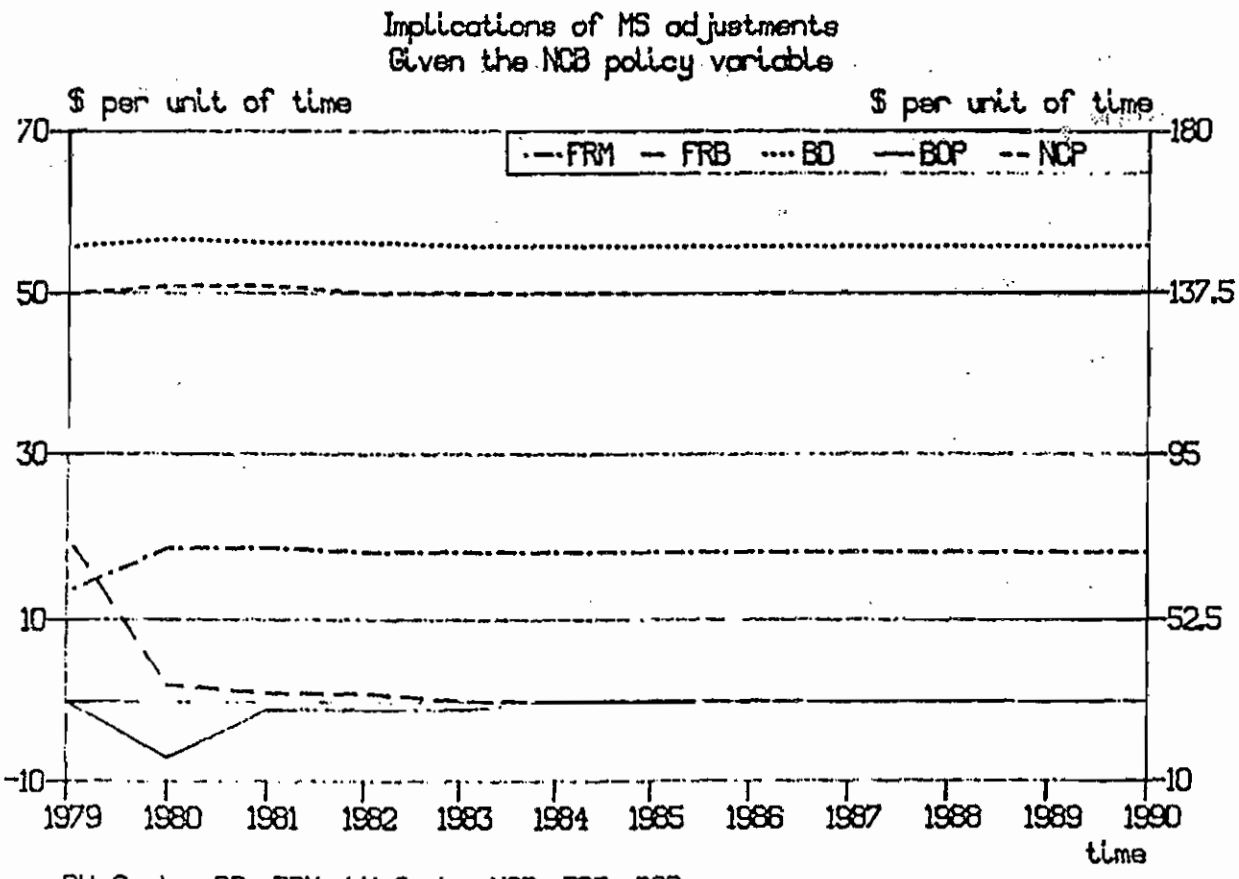
Chart 4
Adjustment to a Change in BLP
Implications of MS Adjustments



LH Scale: NCB, BOP; RH Scale, FRM

For case (b) the single period solution for income, along with the adjustment processes are generally the same as in case (a). The role of fiscal policy too remains the same. The variable λ however changes the implications of MS adjustments for the system. Given NCB=λBD, an increase in BLP increases GDP which in turn increases MS and through this BD; NCP; NCB and by implication FRM. However the economy loses foreign reserves through the commercial banks. Chart 5, below depicts this new adjustment path.

Chart 5
Adjustments to a change in BLP



RH Scale: BD, FRM; LH Scale: NCP, FRB, BOP.

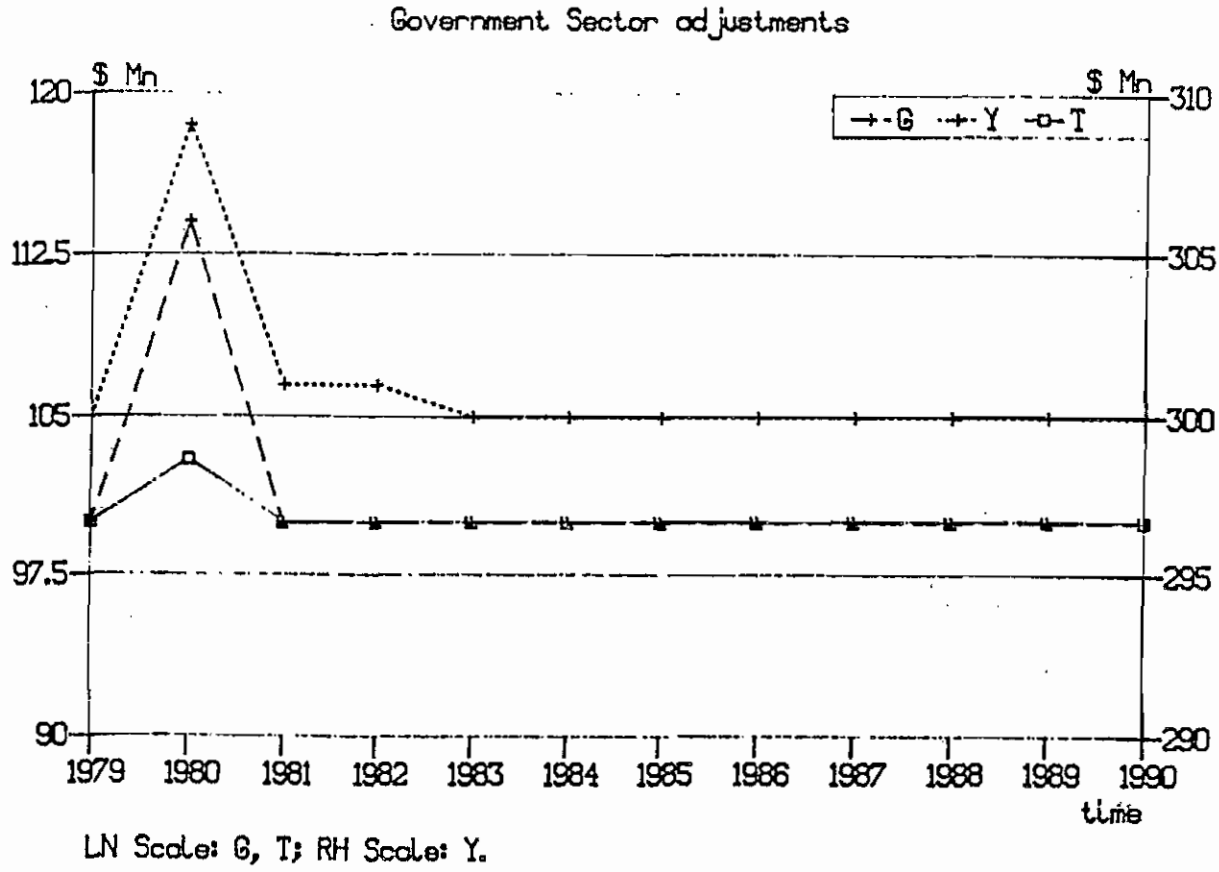
Naturally in period 0 the stocks of BD; NCP; NCB; FRM and FRB as with the others are stationary. However the shock to income in the period 1 cause changes in all these stock variables. In that BD; NCP and NCB jump with the shock to GDP and fall again equally rapidly to regain their SS levels. While FRM and FRB moves to higher and lower constant levels respectively.

The one period solution for income in <u>case (c)</u> is given as:

$$Y=\{[X+\Delta FIG+\Delta BLG+\Delta BLP+\beta^{*}MS_{-1}]/[(1-\alpha)(1-\tau)+\mu]\} \qquad 1.32$$

Therefore the one period solution for income in case (c) as shown in equation (1.31) would in addition to the variables listed for case (a), depend on once and for all changes in the following exogenous variables, ΔBLG, ΔFIG. However they all increase income and the balance of payments deficit transitionally but each variable tends to affect a different institution in the system. Of course as can be seen the transitional level of income is driven by the parameters of expenditure function, the fiscal parameter and the trade performance ratio as in case (a). The various adjustments in respect of the private sector, MS and the external sector remain the same as for case (b). However in the case of the government sector there is the possibility of debt accumulation. Chart 6 demonstrates the adjustment of the government sector to GDP adjustments in this particular variant.

Chart 6
Implications of a change in BLG



Moving from a position of stationarity, a shock to GDP originating from ΔBLG leads GDP to jump, after which regains its SS level gradually. Naturally this jump in GDP causes an increase in both government expenditure and the tax take. However the overall increase in government expenditure is greater than tax revenues on account of debt financing. Hence the government runs a fiscal deficit which closes rapidly soon afterwards, so that G and T also regain their SS

levels. Note that the level of GFD would have been larger if GDP did not increase and so set up a flow back of tax revenue to the government sector.

The monetary policy instruments in this case (c) are δ and λ. These two monetary policy variables have no effect on income nor MS, and therefore do not affect directly private sector adjustments. However they do have implications for the external sector adjustment and debt accumulation along with the level of expenditure by the government sector. A result which differs fundamentally, particularly changes in λ, from case (b). Lets see why this is so.

The variable which changes the model structurally so as to produce these particular results is δ. Now where MLG+FRM=NC, δ represents the proportion of immobilized foreign assets, (i.e FRM) backing the currency issue, then $(1-\delta)$ represents the level of domestic assets, MLG, also backing the currency issue. Therefore any adjustments in the model which affect the level of NC also have implications for FRM and MLG because of δ. For instance an increase in BLP or BLG which increases Y, increase MS and by implication BD, NCP and NCB, will increase both FRM and MLG by δ and $(1-\delta)$ respectively. Therefore, foreign assets will be loss from the system to the extent of the increase in domestic credit to the government sector; $(1-\delta)$.

Model II

The equation for the single period solution is given as,

$$Y=\{[X+\Delta BLP+\beta^{*}MS_{-1}]/[(1-\alpha)(1-\tau)+\mu+\tau]\} \qquad 1.33$$

The dynamics of adjustments are again driven by the parameters of the model, that is the fiscal

parameter τ; the private sector parameters, the trade performance ratio and in this case the fiscal stance. Therefore private sector adjustments, that is expenditure and asset accumulation resulting from an increase in GDP are the same as in model-I. This is also true of the implications for MS adjustments. For instance in the private sector, although the model does not regain a full-SS from an exogenous shock to income, the flow of expenditure, PDY and asset accumulation do settle down to constant levels.

Whilst fiscal policy still determines the level of private sector expenditure and financial asset accumulation, it is given the added role of directly influencing the level of income. The level of G and τ chosen, i.e (G/τ) partly determines income, and more particularly, the setting of fiscal policy has implications for the adjustment processes. Specifically the speed at which the model will eventually settle down. Now given that the level of G does not equal T; $G \neq T$, then $(G/\tau) \neq (X/\mu)$ which as we have demonstrated has implications for the external sector: while imports and taxation are working together adjusting the stock of assets available to the private sector, they are not working in the same direction. Therefore the ability of the model to settle down to a full-SS after an exogenous shock to income is hampered. In fact the balance of payments is equal in size to the budget balance.

4. Implications of the Models for the Conduct of Policy:

We look at two aspects: first the structural similarity between the operations of the central bank and those of the commercial banks. The second is the role of the particular institutional framework in ensuring fiscal discipline.

4.1 Commercial banks as quasi-central banks:

Notwithstanding the existence of the ECCB, the commercial banks operating in the area on account of their large holdings of foreign assets, can and do, provide "accommodating finance" and imposes limits on credit creation in the individual islands, for both the public and private sectors.

Given stability in the behavior of the private sector, increases in domestic credit will result in a one for one loss of foreign assets. Normally with the existence of a central bank one would typically expect this loss in foreign assets to take the form of a flow from the central bank. However this is not necessarily the case in the ECCB area. Here reserve losses can occur in two ways. In the first case, it can take the form of currency issue by the monetary authority and /or through changes in foreign balances of the commercial banks. In both of these cases the mechanism becomes ultimately self correcting when reserves run out.

Let us look at the question of currency issue first. The ECCB controls the currency issue under the constraint of a foreign asset cover for the currency issue, of .6:1 ratio of liquid assets and liabilities. That is, in the limit at least 60% of the currency issue must be backed by foreign assets. The other 40% can facilitate an extra increase in currency where it is backed by local assets, for example, by credit to the government. Of course the commercial banks which hold accounts with the ECCB can get accommodation from the ECCB and so cause an increase in currency. However any advances in this way are at present tightly controlled by the ECCB's foreign assets. In actual practice, the backing of the currency in terms of foreign assets usually

ranges between 80 to 90%. Therefore the currency issue of the ECCB is limited and operates a currency issue regime almost as tight as the former currency boards from which it evolved. Hence, currency issues, cannot continue indefinitely under the present regime since the reserve loss provides a self-limiting mechanism.

Turning now to reserve losses by the commercial banks. The foreign reserve losses which are stemming from this source are limited by the extent of the commercial banks holdings of foreign reserves or their ability to borrow abroad, i.e to acquire foreign debt. Quite naturally these decisions depend on the commercial banks preferences. When the commercial banks bring in foreign balances these are surrendered to the ECCB for EC dollars, i.e currency issue. The foreign currency which is surrendered for the domestic currency is immediately immobilized (or at least 60% of it is) in overseas investments and kept as reserve for supporting the value of the EC currency. This process can continue for as long as the head office accommodates the local branches, or in the case of the NCBs where they have reasonably large foreign asset balances. However, the commercial banks will generally only expand credit and bring in foreign balances where the perceived and calculated risk of such action is routine. Beyond this point credit will only be extended on a guarantee of a "bail-out" from some one who has the foreign assets to make such a guarantee, credible. When the commercial banks halts their credit expansion the loss of foreign assets would stop.

Moreover, in the case of the individual islands, whilst access to its 'share' of the ECCB portion of reserves is restricted, the islands without foreign reserves have to undergo adjustment by

way of income contraction unless of course they are able to encourage an inflow of foreign assets. Such a situation would lead initially to a liquidity squeeze on the commercial banking sector which is transferred to the economy as a credit squeeze. Such conditions would prevail until the commercial banks are able to rebuild their foreign asset balances. Hence the commercial banks by their operations decentralize the reserves and the consequent adjustment pressures; and thereby provide the region with an element of flexibility diverting some of the payments pressure from the central bank.

It seems likely that in the future with the development of a regional market for capital and government debt and the active development of mortgage finance, the commercial banks will come under increasing pressure to run down their foreign asset balances. Needless to say this would have disastrous consequences. Therefore the question naturally arises: what should the ECCB do to modify the commercial banking behavior? At this point we argue for a 'no bail-out' pledge by the central bank to the commercial banks. A view that is developed further in the notion of fiscal discipline discussed below.

4.2 The Policy Regimes:

There exist two broad policy regimes in the two models constructed and we will deal with them in turn.

Model-I: In case (a), monetary policy is conducted on the basis of a fixed rule administered by the monetary authority. This is essentially an external policy. There are no monetary policy instruments for internal policy and so no internal monetary policy. Hence lending and

borrowing revolves around the portfolio preferences of the commercial banking system with regard to FRB and BLP. The commercial banks regulate themselves according to their own prudential considerations so in this variant of the model the commercial banks themselves determine the properties of the system. The level of bank lending to the private sector and the level of foreign reserves. An expansion of credit to the private sector (BLP) or foreigners (FRB) results in the monetary authority losing foreign reserves. However the mechanisms are different; while the increase in BLP increases income and pushes the balance of payments into deficit during the transitional period to a new SS. An increase in lending to foreigners results only in a lowering of the currency held by the monetary authority would fall and so also would FRM, as FRM≡NC.

There is of course no problem of fiscal indiscipline in this case since the government operates under the constraint of a balanced budget. However the tax rate determines the share of the private sector in national income. As a consequence fiscal policy can affect both BD, which in turn determines the size of the banking system, and NCP, which in turn affects the size of the monetary authority's balance sheet. Therefore fiscal policy when taken together with the monetary authority's rule can affect the level of foreign assets that the monetary authority holds.

In case (b) monetary policy, is also conducted on the basis of a fixed rule but is extended by the inclusion of a policy variable, the required cash ratio; (λ). This ratio does not affect the balance of payments, income or bank deposits, rather it acts like a tax on the commercial

banking system requiring it to increase its holdings of cash which in turn requires it to purchase this cash from the monetary authority using its foreign assets. Moreover a large λ may restrict the growth of domestic credit (BLP) if the commercial banks keep their lending to foreigners (FRB) constant. Alternatively if the banks choose BLP then their foreign asset holdings would be residually determined.

From a policy point of view then as long as the commercial banks care to some extent about their level of foreign assets, the monetary authority can regulate credit expansion by changing λ. In this way λ would operate as a credit policy variable affecting domestic conditions, while the monetary policy rule remains the external policy. Needless to say the government can still influence the economy by its choice of tax rates as in case (a).

In case (c), in addition to the cash reserve requirement, monetary policy involves the monetary authority lending to the government, through an exchange of foreign assets for domestic assets, i.e government debt. Now changes in the level of MLG, i.e $[1-\delta]$ do not affect the level of income, this is reflected in the portfolio preferences of the monetary authority. In that changes in MLG affects the level of government expenditure, the government fiscal deficit and by implication the stock of total government debt. The level of foreign reserves in the system falls.

The policy implications of the interaction between the policy variables λ and δ are non-trivial; the government where it is faced with an exogenous BLG, can still access the resources of the commercial banks for debt financing through the manipulation of the monetary authority and

by so doing having access to λ and δ as policy variables, i.e by increasing λ and simultaneously adjusting δ to finance a larger fiscal deficit.

Conversely these two variables can be manipulated so as to stave off a loss of foreign reserves from the system. By increasing λ, the monetary authority can control credit expansion by reducing the level of FRB commercial banks hold and transfer these to itself. While simultaneously the monetary authority can also raise the δ ratio so as to prevent a loss of foreign reserves through the automatic increase in credit to the government sector.

One source of fiscal discipline derives from the freedom the commercial banking system to choose the composition of its portfolios. There are no controls on the banking system which automatically channels resources to the government sector and thereby government expenditure. Therefore in the present circumstances, generally the commercial banks have the option to refuse accommodation to the governments financing needs. This situation could be regarded as one where fiscal discipline is imposed on the government sector by the market mechanism operated by the commercial banking sector. The other source of fiscal discipline is the limit on the level of monetary authority lending to the government as dictated by δ requirements. The monetary authority has monetary policy making independence from the manipulation of the government sector. In effect the monetary authority ties the hands of the government.

We turn now to the instances where foreign loans contracted by the government (FIG) used to finance the public sector borrowing requirement. FIG can either serve to expand or contract

the government activities. However, given the 'large' stock of foreign assets the monetary authority holds lenders may anticipate a 'bail-out' if members run into financing difficulties and so proceed to lend large sums. As will be argued below this possibility makes it important that the ECCB issue a 'no-bail out' pledge to reinforce the operation of the market mechanism.

Model-II: represents, a break down of the fiscal discipline imposed by the "market" mechanism discussed in case (c) model-I. However, the fiscal discipline imposed by the monetary authority remains intact. When it is BLG alone which is used to finance the deficit (i.e $\Delta MLG=0$, $\Delta FIG=0$) then an increase in BLG will cause the level of FRB to fall. So changes in FRB link the balance of payments to government operations. In the first instance the foreign reserves of the commercial banks would be exhausted, after the commercial banks can only continue lending to the government if it borrows abroad. Notice that fiscal indiscipline is possible even though the monetary authority does not accommodate the government sector. Of course the effects of this fiscal indiscipline is the same as if the monetary authority financed it: both would lead to a continuous loss of foreign assets from the system through a persistent balance of payments deficit. There is nothing in the income-expenditure relationships which brings the system back to a full SS. The adjustment need only occur when the level of foreign assets of the commercial banks is exhausted or when no more domestic debt can be sold overseas. One implication of the analysis above then, is that domestically imposed fiscal discipline can only be secured by constraining the level of financing from both the monetary authority and the commercial banks to the government sector.

4.3 Sufficiency Conditions for Fiscal Discipline[6]:

Let us turn now to the question of attaining and maintaining fiscal discipline. When fiscal policy is undisciplined, monetary policy efforts to promote balance of payments stability will be severely handicapped. The economic policy stance is inconsistent and unsustainable. It is natural then to ask: how can fiscal discipline be imposed on the government sector? This concern becomes even more urgent in the context of a monetary union where the policies of one member may jeopardize the more disciplined policy stance of the union as a whole. One sure way to maintain policy discipline is simply to impose some manner of fiscal/budget discipline along with the existing monetary rule.

To achieve and maintain fiscal discipline on government, there are three conditions which must be satisfied *simultaneously. These can be regarded as the sufficiency conditions for fiscal* discipline.

(a) A low ceiling on the monetary authority financing of the public sector borrowing requirement. The effect of increased deficit financing by the monetary authority as shown above is a rapid loss of foreign assets from the monetary authority. Such a result assumes greater significance in the case of a monetary union, where if there are no controls on the government borrowing from the monetary authority, all countries would suffer the consequences of each others fiscal indiscipline through the monetization of fiscal deficits.

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[6]For our purposes the concept of fiscal discipline is defined as the situation where FRM>0, FRB>0, and also $\{\Delta FIG/G\}<\{\Delta Y/G\}$; given $G \leq T$. From this we can derive a simple definition for fiscal indiscipline as occurring when FRM<0 or FRB<0, also where $\{\Delta FIG/G\}>\{\Delta Y/G\}$, given that G>T.

(b) There must be no blanket control mechanisms on the commercial banks which channels funds to the government. Moreover the monetary authority ought to issue an explicit 'no-bail out' pledge, so as to improve the efficiency of the market mechanism.

(c) There should be limits on the extent of the foreign indebtedness of the governments; (FIG).

It is not entirely obvious that limits on borrowing as a strategy to ensure fiscal discipline (apart from the conceptual difficulties of defining a meaningful formula) can be effective in reducing the level and growth of government borrowing overseas and borrowing in general. Rules on borrowing may only result in the substitution of non-restricted debt instrument for restricted debt instrument.[7] The creation in the various islands of government owned commercial banks, (national commercial banks) can be rationalized in this way. In recent times both from experience and theoretical analysis it would appear that the 'best' strategy to keep institutions including governments from borrowing excessively is to allow them to face the full consequences of their actions, notwithstanding this may involve a 'crisis' situation. In this context, I propose an information gathering and dissemination role for the ECCB. Such a role if properly performed, can provide the relevant information to prospective creditors of the individual countries in the monetary union so that they can make the appropriate trade-offs. The performance of this function by the ECCB may also act as a signalling devise with respect to its 'no-bail out' policy.

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[7]See Jürgen von Hagen (1991).

5. Summary and Conclusions.

This paper examined the scope of monetary and fiscal policy under alternative policy regimes, in the ECCB region. To do this an analytical framework was developed linking the institutional framework to the balance of payments. The results indicate that in the full-stationary state solution the level of income depends on the trade performance ratio alone, whilst in a quasi-stationary state solution it depends on the trade performance ratio and the fiscal stance. The role of fiscal policy, given stationary state level of income, is to change the composition of demand through its influence on stationary state level of personal disposable income, which in combination with the private sector behavioral parameters determines the money stock, the level of bank deposits and by implication the size of the banking system.

Monetary policy on the other hand has no role to perform in the model outside of the redistribution of resources between the commercial banks and the monetary authority. In some variants it also changes the composition of asset stocks, when domestic credit is substituted for foreign assets of an equal magnitude. The channel through which monetary policy works then is the foreign asset holdings of the banking system. The adjustment dynamics for the economy turn on private sector behavior, the adjustment of expenditure and financial asset accumulation, adjustments which are ultimately constrained by fiscal policy.

The models have shown generally, that policy by rules for both the monetary and government sector, along with a hands off approach to the commercial banks, may result in a better policy outcome, than in a policy regime that allows discretion and involves extensive restrictions on

the commercial banks. The interrelatedness of monetary and fiscal policy; implies a need for coordination between the monetary and fiscal authorities. With a rule-governed framework for monetary policy this in turn implies a need for fiscal discipline.

Glossary

FRM - Foreign reserves of the monetary authority (MA)

MLG - (MA) lending to the government

NC - (NC) notes and coins: domestic currency

NCP - (NC) held by the public

NCB - Notes and coins held by commercial banks

BLP - Commercial bank lending to the private sector

FRB - Foreign lending by the commercial banks

BLG - Commercial bank lending to the government

MS - Money stock

BD - Bank deposits

G - Government expenditure

T - taxation

FIG - Foreign indebtedness of the government

Y - National Income: (GDP)

M - Imports

X - Exports

PE - Private spending

PDY - Private disposable income

DC - Domestic credit

NFA - Net foreign assets

C.o.B - commercial banks

NFR - The stock of foreign debt

NFW - The stock of private sector financial wealth

Pri sec - private sector

For sec - foreign sector

Gov't - government

Expend - expenditure

Depst - deposits

DP - domestic private sector credit

DG - domestic government sector credit

ML - monetary authority domestic lending

FL - foreign lending by the domestic economy

FI - foreign indebtedness of the domestic economy

TL - total

B.O.P - balance of payments

TGD - Total government debt

GFD - Government's fiscal deficit

Δ - represent a change in a variable

τ - The average tax rate.

μ - The average propensity to import

α, β, γ, λ, δ: are parameters

Appendix (i)

Model-I Stationary Solutions; Case (a)

(1) **FRM=$\{(1-\alpha)/\beta\}*(1-\tau)*(X/\mu)$-FRB-BLP**

(2) **NC=$\{(1-\alpha)/\beta\}*(1-\tau)*(X/\mu)$-FRB-BLP**

(3) **NCB=$(1-\gamma)*\{(1-\alpha)/\beta\}*(1-\tau)*(X/\mu)$-FRB-BLP**

(4) **G=$\tau*(X/\mu)$**

(5) **BD=$(1-\gamma)*\{(1-\alpha)/\beta\}*(1-\tau)*(X/\mu)$**

(6) **M=$\mu*(X/\mu)$**

(7) **Y=(X/μ)**

(8) **T=$\tau*(X/\mu)$**

(9) **PDY=$(1-\tau)*(X/\mu)$**

(10) **PE=$(1-\tau)*(X/\mu)$**

(11) $MS=\{(1-\alpha)/\beta\}*(1-\tau)*(X/\mu)$

(12) $NCP=\gamma*\{(1-\alpha)/\beta\}*(1-\tau)*(X/\mu)$

For case (b) the changes to the stationary solutions are to equation (3) where NCB is now tied down by the λ requirements of the monetary authority. NCB is now included as a separate equation, (13). The (SS) for FRM and NC also change by virtue of the fact that NCB is now determined by the monetary authority. These changes can be represented as:

(1b) $FRM=\{\lambda*(1-\gamma)+\gamma\}*\{(1-\alpha)/\beta\}*(1-\tau)*(X/\mu)$

(2b) $NC=\{\lambda*(1-\gamma)+\gamma\}*\{(1-\alpha)/\beta\}*(1-\tau)*(X/\mu)$

(3b) $FRB=(1-\lambda)*(1-\gamma)*\{(1-\alpha)/\beta\}*(1-\tau)*(X/\mu)-BLP$

(13) $NCB=\lambda*(1-\gamma)*\{(1-\alpha)/\beta\}*(1-\tau)*(X/\mu)$

The equation for the level of foreign reserves in the system is given as:

$FR=\{(1-\alpha)/\beta\}*(1-\tau)*(X/\mu)-BLP.$

For CASE (c): the changes to the stationary state solutions obtained in case (b) are the following.

(14) $FRM=\delta*\{\lambda*(1-\gamma)+\gamma\}*\{(1-\alpha)/\beta\}*(1-\tau)*(X/\mu)$

and (1c) $MLG=(1-\delta)*\{\lambda*(1-\gamma)+\gamma\}*\{(1-\alpha)/\beta\}*(1-\tau)*(X/\mu)$

(3c) $FRB=(1-\lambda)*(1-\gamma)*\{(1-\alpha)/\beta\}*(1-\tau)*(X/\mu)-BLP-BLG$

Finally the equation for the level of foreign reserves in this model is given as:

$FR=[\delta*\{\lambda*(1-\gamma)+\gamma\}+\{(1-\lambda)*(1-\gamma)\}]*\{(1-\alpha)/\beta\}*(1-\tau)*(X/\mu)-BLP-BLG.$

Appendix (ii)

Model-I single period solutions

Case (a). The Basic Currency Board

One period solution for income:

$M=\mu Y$

$X-[\Delta FRM+\Delta FRB]=\mu Y$

$X-\Delta NC-\Delta FRB=\mu Y$

$X-[\Delta BD-\Delta BLP-\Delta FRB+\Delta NCP]-\Delta FRB=\mu Y$

$X-[\Delta MS-\Delta NCP-\Delta BLP-\Delta NCP]=\mu Y$

$X-[(Y-T)+\Delta BLP-PE-\Delta BLP]=\mu Y$

$X-\{(Y-T)-[\alpha(Y-T)+\Delta BLP+\beta*MS_{-1}]\}=\mu Y$

$X+\Delta BLP+\beta*MS_{-1}=[(1-\alpha)(1-\tau)+\mu]Y$

$Y=\{[X+\Delta BLP+\beta*MS_{-1}]/[(1-\alpha)(1-\tau)+\mu]\}$

Case (b)

The Basic Currency Board Case; with a required reserves ratio:

One period solution for income:

$M=\mu Y$

$X-\Delta FRM-\Delta FRB=\Delta Y$

$X-\Delta NC-[\Delta BD-\Delta NCB-\Delta BLP]=\mu Y$

$X-[\Delta NCB+\Delta NCP]-[\Delta MS-\Delta NCP-\lambda\Delta BD-\Delta BLP]=\mu Y$

$X-[\lambda\Delta BD+\gamma\Delta MS]-[(1-\gamma)-\lambda(1-\gamma]\Delta MS+\Delta BLP=\mu Y$

$X-\{[\lambda(1-\gamma)+\gamma]-(1-\gamma)-\lambda(1-\gamma)\}\Delta MS+\Delta BLP=\mu Y$

$X-\{[\lambda(1-\gamma)+\gamma]-(1-\gamma)-\lambda(1-\gamma)\}\{(Y-T)+\Delta BLP-[\alpha(Y-T)+\Delta BLP+\beta MS_{-1}]\}+\Delta BLP=\mu Y$

$Y=\{[X+\Delta BLP+\beta^{*}MS_{-1}]/[(1-\alpha)(1-\tau)+\mu]\}$

The exogenous variables in this case are:

(a) Policy instruments: λ; τ.

(b) Portfolio allocation: BLP

Case (c)

A one period solution

$$X-[\Delta FRM+\Delta FRB-\Delta FIG]=\mu Y$$

$$X-\Delta FRM-\Delta FRB+\Delta FIG=\mu Y$$

$$X-[\delta\Delta NC]-[\Delta BD-\Delta NCB-\Delta BLP-\Delta BLG]+\Delta FIG=\mu Y$$

$$X-[\delta\Delta(NCB+NCP)]-[(\Delta MS-\Delta NCP)-\lambda\Delta(MS-NCP)]+\Delta BLG+\Delta FIG=\mu Y$$

$$X-[\delta\{\lambda(1-\gamma)+\gamma)-(1-\gamma)-\lambda(1-\gamma)]\{(Y-T)+\Delta BLP-[\alpha(Y-T)+\Delta BLP+\beta*MS_{-1}]\}+\Delta BLG+\Delta BLP+\Delta FIG=\mu Y$$

$$Y=\{[X+\Delta FIG+\Delta BLG+\Delta BLP+\beta*MS_{-1}]/[(1-\alpha)(1-\tau)+\mu]\}$$

The exogenous variables are:

(1) Policy instruments: FIG; λ; τ; δ.

(2) Portfolio allocation: BLP; BLG.

Appendix (iii)

Quasi- Stationary State Solutions: Model-II

(1) $MLG=(1-\delta)*\{\lambda*(1-\gamma)+\gamma\}*\{(1-\alpha)/\beta\}*(1-\tau)*([X+G]/[\mu+\tau])$

(2) $NC=\{\lambda*(1-\gamma)+\gamma\}*\{(1-\alpha)/\beta\}*(1-\tau)*([X+G]/[\mu+\tau])$

(3) $FRB=[1+\lambda 2(1+\gamma)+\gamma+\gamma(1-\delta)]*\{(1-\alpha)/\beta\}*(1-\tau)*([X+G]/[\mu+\tau])$-BLP+FIG-G.

(4) $BD=(1-\gamma)*\{(1-\alpha)/\beta\}*(1-\tau)*([X+G]/[\mu+\tau])$

(5) $M=\mu*([X+G]/[\mu+\tau])$

(6) $Y=([X+G]/[\mu+\tau])$

(7) $T=\tau*([X+G]/[\mu+\tau])$

(8) $PDY=(1-\tau)*([X+G]/[\mu+\tau])$

(9) $PE=(1-\tau)*([X+G]/[\mu+\tau])$

(10) $MS=\{(1-\alpha)/\beta\}*(1-\tau)*([X+G]/[\mu+\tau])$

(11) $NCP=\gamma*\{(1-\alpha)/\beta\}*(1-\tau)*([X+G/[\mu+\tau])$

(12) $NCB=\lambda*(1-\gamma)*\{(1-\alpha)/\beta\}*(1-\tau)*([X+G/[\mu+\tau])$

(13) $\Delta BLG=G-(1-\delta)*\{\lambda(1-\gamma)+\gamma\}*\{(1-\alpha)/\beta\}*([X+G]/[\mu+\tau])-FIG.$

(14) $FRM=\delta*\{\lambda*(1-\gamma)+\gamma\}*\{(1-\alpha)/\beta\}*(1-\tau)*([X+G]/[\mu+\tau])$

Appendix (iv)

Model-II

Single Period Solution for Income:

$M=\mu^{*}Y$

$X-\Delta FRM-\Delta FRB+\Delta FIG=\mu^{*}Y$

$X-\delta\Delta NC-\{\Delta[BD-NCB]-(G-T)-\Delta MLG-\Delta FIG\}+\Delta FIG=\mu Y$

$Y=\{[X+G+\Delta BLP+\beta^{*}MS_{-1}]/[(1-\alpha)(1-\tau)+\tau+\mu]\}$

The exogenous variables:

(1) Policy instruments: λ; δ; FIG.

(2) Portfolio allocation: BLP

(3) Fiscal performance: G; τ.

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