1980

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WORKING PAPER NO. 8003

MONEY, THE BALANCE OF PAYMENTS, AND GOVERNMENT DEBT IN A SMALL OPEN LDC: HAITI

J. Clark Leith

This paper contains preliminary findings from research still in progress and should not be quoted without prior approval of the author.
MONEY, THE BALANCE OF PAYMENTS, AND GOVERNMENT DEBT IN A SMALL OPEN LDC: HAITI

by

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February 1980

*The author is indebted to the Canada Social Science and Humanities Research Council for financial support, to Ake Blomqvist and David Laidler for extensive comments, to Brian Bentley, Chris Fader and Sue Lawler for research assistance, and to the participants in the U.W.O. International Trade/Money Workshop for a thorough discussion. The author shoulders full responsibility, however.
Introduction

The economies of small less developed countries are notorious for their balance of payments problems. A crop failure, a natural disaster, or a precipitous decline in world commodity prices all too frequently plunges the small LDC into a balance of payments crisis. In the face of such circumstances, many choose not to struggle to maintain an open economy, but to lapse into import licensing and exchange controls. The danger of such a choice is becoming recognized increasingly as counter-productive in achieving the basic goal of economic development. (See Bhagwati (1978) and Krueger (1978).) In other words, there is a significant gain to be had by avoiding chronic external imbalance and maintaining an open economy.

There are two analytically distinct issues to be faced in this regard: (1) What is an adequate level of foreign exchange reserves (and the related issue of who should be responsible for providing those reserves)? (2) Assuming adequate reserves, how can a small LDC maintain long-run balance, and what is the nature of the adjustment path following a disturbance? Obviously there is some interaction between these two issues. The speed and path of adjustment determine both the size of the required reserves and the access of countries to international credit markets. The size of the reserves determines the extent to which a country may be able to let adjustment occur. Nevertheless, there is sufficient analytical distinction between the two issues to permit a separate treatment.

In this paper we focus on the second issue. We develop and apply a very simple macro model of a small open LDC on a fixed exchange rate. The model integrates a number of themes that have been treated in the recent
literature. Our focus is on a small, poor, open economy. The financial system is assumed to be rudimentary with money the only financial asset, following McKinnon (1973). The balance of payments takes a monetary approach in which the flow balance arises from a discrepancy between desired and actual holdings of the money stock in a manner following Dornbusch (1973). Real income and the world price level are exogenously given. The government budget constraint is observed via monetization of the government fiscal deficit or surplus following the lead of Dutton (1971) and Aghevli and Khan (1977). We treat the fiscal deficit or surplus as the outcome of the setting of the tax and expenditure schedules with money income the relevant argument in both schedules. The money stock, then, is endogenously determined from both the balance of payments and the fiscal system. These two sources of change in the money stock do not seem to have been treated simultaneously elsewhere in the literature. The work cited, incorporating the government budget constraint on the money supply process, was carried out in the context of closed economies. The literature on the monetary approach to the balance of payments, as Kreinin and Officer (1978) note, generally ignores the role of fiscal policy as a source of change in the money stock.

In Part I we set out and solve the model, and in Part II we report an empirical application of the model to one of the few LDCs that has maintained an open fixed exchange rate system for an extended period: Haiti.

Our objective is to construct a simple analytical model that has immediate empirical relevance in the tradition of Laidler (1973). Our objective is not to examine the full range of theoretical issues that arises
in the context of the macro behavior of a small LDC. Neither is our objective to get the best possible fit of data to the Haitian history. Rather we want to examine the extent to which there is empirical content to a model that integrates several of the features that are receiving considerable attention in the literature.

I. The Model

Consider a highly simplified model of a small open economy producing one good. Production of the good is exogenously determined. The country consumes some of the good and sells some in the world market in exchange for imports. Prices of both the domestic (export) good and the imported good are determined in the world market. Income is the value of production of the domestic (export) good. Excess demand for goods is zero.

If we were to assume also that there are no assets in the model then the ex ante expenditure must equal income, trade must be balanced, and a balance of payments deficit or surplus cannot arise. Instead, we introduce one asset into the model, money. We assume that the desired stock of money is a fixed proportion of income. If the actual stock of money equals the desired, there is no flow excess demand for money, ex ante expenditure on goods equals income, and trade must be balanced. If, however, the actual stock of money does not equal the desired the flow excess demand or supply of money means that ex ante expenditure on goods does not equal income, trade is unbalanced, and the balance of payments is non-zero. This is because ex ante expenditure equals income minus desired change in asset holdings.

The essential characteristics of this model may be sketched heuristically in Figure 1. We map the quantities of the domestically produced good (X) and the imported good (I). The quantity of domestic production (OA) is in
part sold on world markets (AB) in exchange for imports of good I (BC) at the relative price of CB/BA. When expenditure equals income, the expenditure line passes through point A permitting consumption at a point such as C.

A change in any one of domestic production, world prices, or the money stock will disturb this equilibrium by creating a discrepancy between ex ante expenditure and real income—between desired and actual asset holdings. For example, a crop failure reduces domestic output from A to A'. Desired asset holdings fall in response to the reduced real income. Residents temporarily maintain expenditure in excess of income at a point such as D by selling off their excess holdings of the asset, money, in exchange for goods. Consequently, a balance of trade deficit equal to the excess expenditure over income is temporarily observed.

The loss of the asset means that the excess of actual over desired asset holdings is reduced; the excess of expenditure over income is reduced. This adjustment process continues until asset stock equilibrium has been restored—flow excess demand for money is zero—and expenditure equals income at a point such as C'.

If the loss of money via this route is being offset from some other source, the expenditure level is being subjected to two opposite pulls: the inward pull of the selling of money for goods, and the outward pull of the injections of new money. In such circumstances the balance of payments deficit would not necessarily extinguish itself. One such source of injections of new money that may be particularly important is money creation to finance the fiscal deficit.
(a) **Specification of Model**

To translate this picture into a simple formal model is the next task. First, then, we define nominal money income ($NY_t$) as the value of output of the single good ($X_t$)

\[ NY_t = \bar{P}_t \cdot \bar{X}_t \]

where $P_t$ is the price of good $X$ and an over bar indicates an exogenous variable.

The money income may be spent either on consumption or to accumulate cash balances. No assets other than money exist. We assume that desired nominal cash balances ($MD_t$) are a fixed proportion of money income

\[ MD_t = b \cdot NY_t \quad b > 0 \]

Notice that in writing the demand for money we do not separate out the price and quantity components of money income, and hence do not consider the demand for real balances. Further, equation (2) is written with a unitary elasticity of money demand with respect to money income.

Turn now to the money supply. We begin by noting the balance sheet identity of the central bank. The monetary base ($MS_t$), consisting of currency plus commercial bank deposits in the central bank at time $t$ is identically equal to the sum of:

1. the net holdings of foreign exchange ($R_t$);
2. the net central bank holdings of government securities, which is the accumulated government debt to the central bank ($GD_t$); and

\[ MS_t = R_t + GD_t \]

1. Note that we are focusing on the monetary base rather than the money stock held by the public. In this we are following the approach originally employed by Christ (1968) in his pioneering article on the government budget constraint.
(c) advances by the central bank to commercial banks, which it is convenient to call bank credit ($BC_t$).

Together, this yields the identity

$$MS_t = R_t + GD_t + BC_t$$

We take $BC_t$ in (3) to be exogenously given. However, in this model we treat $GD_t$ and $R_t$ as endogenously determined.

Consider the determination of the government debt to the central bank. We view the government budget process as a regime in which the tax and expenditure schedules are established by the government. Given the schedules, the government revenue and expenditure respond endogenously to the tax base, which we take to be nominal income, to determine the size of government receipts, government expenditure, and hence the flow of government deficit or surplus. For analytical simplicity, we assume that government revenue is a linear function of money income, and that government expenditure is a different linear function of money income. Together, the revenue and expenditure schedules, and the level of money income, determine the flow deficit or surplus.

We assume further that there is no organized financial market, and consequently the government budget deficit can not be financed from the public. Rather, it is financed entirely by "borrowing" from the central bank. Hence, we write the flow change in government debt to the central bank as a linear function of money income.

$$\Delta GD_t = KG + g NY_t$$

where $KG$ is an exogenously given constant term reflecting the net effect of the setting of the tax and expenditure schedules. An upward shift in the
government revenue schedule would reduce $KG$ and an upward shift in the government expenditure schedule would increase $KG$. The coefficient $g$ is the composite of the marginal government revenue (tax) schedule and the marginal government expenditure schedule. An increase in the marginal tax rate reduces $g$, while an increase in the marginal expenditure propensity increases $g$. We are thus allowing for a potential fiscal policy role in the setting of $KG$ and $g$, but we observe the government budget constraint.

Turn now to the balance of payments. We adopt the monetary approach to the balance of payments. Money is the only asset that residents may hold, and excess demand for goods is zero. The exchange rate is fixed. Any excess of expenditure over income is both a flow reduction of asset (money) holdings and a flow balance of payments deficit.

The component of the money holdings that adjusts is the foreign exchange reserves. This is because it is the only component that is acceptable internationally.

Following a number of recent models (e.g., Dornbusch (1973), Jonson et al (1977), and Laidler and O'Shea (1978)) we assume that the flow change in foreign exchange reserves is proportional to the stock excess demand for money at the end of the last period. Hence we write:

$$
(5) \quad \Delta R_t = d(Mt_{t-1} - Ms_{t-1}) \quad 0 < d < 1
$$

where $d$ is the adjustment coefficient. This specification allows agents to be off their demand for money functions at the end of the period.

We have now completed the specification of the model. It is a simultaneous system of four different equations in four endogenous variables: $MD$, $MS$, $\Delta GD$, and $\Delta R$. Note that since the components of the money stock
identity are specified as first differences, we must also specify the identity itself in first difference form. Consequently we rewrite (3) as

\[(3') \quad MS_t = MS_{t-1} + \Delta R_t + \Delta GD_t + \Delta BC_t \]

(b) Solution of the Model

We may solve the model for the equilibrium values of all the endogenous variables. This implies that the money demand, the money stock, the flow government deficit, and the flow balance of payments are all constant. The equilibrium solutions (indicated by *) are

\[MD^* = b \overline{NY} \]
\[MS^* = b \overline{NY} - \frac{1}{d}[\Delta R^*] \]
\[\Delta GD^* = \overline{KG} + g \overline{NY} \]
\[\Delta R^* = -[\Delta GD^* + \Delta BC] \]

The equilibrium solution permits continuous discrepancy between the actual money stock and the desired money stock, for the balance of payments may be in an equilibrium deficit or surplus. This, in turn, arises when either (or both) the bank credit or the government debt to the banking system perpetually changes. Such an equilibrium is clearly not sustainable indefinitely, and might more appropriately be called a quasi-equilibrium. Note, nevertheless, that such a situation certainly is observed for extended periods of time, particularly when central banks engage in foreign borrowing to augment their foreign exchange reserves and thus maintain the fixed

\[1\text{This is necessary to ensure that the equilibrium solution is unique. Otherwise the equilibrium matrix of coefficients is singular.}\]
exchange rate. In these circumstances, net foreign exchange reserves can take on large negative values.

The nature of the quasi-equilibrium is readily illustrated diagrammatically. An upward sloping money demand function (MD*) is drawn in nominal money and nominal income space. The unitary nominal income elasticity of money demand is reflected in the curve passing through the origin. The quasi-equilibrium money stock equation, combined with the ΔR* equation may be rearranged to a slope intercept form

\[(7') \quad MS^* = (b+g)NY + \frac{1}{d}[KG + \Delta BC]\]

This is drawn as MS* in Figure 2. The curve may be downward or upward sloping—that will not turn out to be important. We have drawn it downward sloping which implies that \((b + g/d) < 0\). This occurs when \(0 < d < 1\), which we have already assumed, and \(g\) is negative (i.e., the marginal tax rate exceeds the marginal propensity of government to spend) sufficiently to yield a negative slope. As drawn, Figure 2 illustrates a quasi-equilibrium in which MS* exceeds MD*. Injections to the money stock (due to ΔGD* and ΔBC) are identical to extractions from the money stock via reserve losses so that level of the quasi-equilibrium money stock is constant at an amount greater than the desired money stock.

Such a quasi-equilibrium can be sustained only so long as reserves last. It is worth exploring the effects of adding an additional restriction to the model that ΔR* = 0. When we do this, setting equation (3) equal to zero, we obtain

\[(10) \quad \Delta GD^* = - \Delta BC\]
which is to say that growth of government debt must be offset by an equal contraction of central bank private credit. When we substitute (10) into (7*) we find that

\[(11) \quad MS^* = bNY\]

Hence, an indefinitely sustainable equilibrium becomes one in which equations (10) and (11) hold, and

\[(12) \quad MS^* = MD^*\]
\[(13) \quad \Delta R^* = 0\]

In terms of Figure 2, the MS* curve must intersect the MD* curve at \(NY\).

Finally, we may wish to go one step further and restrict the crowding out of private bank credit by government debt. Thus, we set \(\Delta BC = 0\) in (10) and the equilibrium becomes one in which \(\Delta GD^* = 0\). To achieve this, we set (8) equal to zero to determine the setting of the fiscal system to achieve a balanced government budget

\[(14) \quad g = \frac{KG}{NY}\]

Equation (14) tells us that the government's marginal tax-less-expenditure propensity must be set equal to the ratio of the constant term in the government deficit equation to money income.

Turn now to the dynamic behavior of the model. The first issue is whether or not the system will converge on its steady state values. The necessary and sufficient conditions for this are that the roots of the characteristic equation are all less than unity. The model yields a quadratic characteristic equation which has three conditions. However, this reduces to the condition that

\[(15) \quad 0 < d < 2\]
In words, the system is stable if and only if foreign exchange reserves respond positively to last period's excess money demand (but do not respond by more than twice the excess, and hence create an explosive situation). The meaning of this conditions is readily seen in terms of Figure 2. Given money income and the desired money stock, excess money stock must shift the MS* curve downwards for the system to be stable. Now it may be seen why the relative slopes of MS* and MD* in Figure 2 do not matter. Since the MD* curve and NY are both fixed, the stability condition simply means that the change in foreign exchange reserves must move the MS* curve towards MD* curve at that level of money income.

Second, we may solve the system for its current values of the endogenous variables. These results are straightforward.

\[
MD_t = b \overline{NY}_t
\]

\[
MS_t = MS_{t-1} - d(MS_{t-1} - b \overline{NY}_{t-1}) + \Delta BC_t + \overline{KG}_t + g \overline{NY}_t
\]

\[
\Delta GD_t = \overline{KG}_t + g \overline{NY}_t
\]

\[
\Delta R_t = (1-d)\Delta R_{t-1} - d[-b\overline{NY}_{t-1} + \Delta BC_{t-1} + \overline{KG}_{t-1} + g\overline{NY}_{t-1}]
\]

The relatively simple structure of the model yields relatively simple current value solutions. The balance of payments is perhaps the most interesting. Assuming \( d \) is positive (which it must be for stability), we see that the current growth of foreign exchange reserves is a positive fraction of last period's balance of payments (if we restrict \( d \) to the range between 0 and 1) and is:

(i) a positive function of last period's growth of money income;

(ii) a negative function of last period's growth of bank credit;
(iii) a negative function of the level of last period's government expenditure schedule and a positive function of the level of last period's tax schedule;

(iv) a function of the level of last period's money income, the function being positively related to the marginal tax rate and negatively related to the government's marginal propensity to spend.

(c) Monetary Equilibrium Case

It is conceivable that equilibrium between money demand and money stock is achieved within each period. While this changes some of the dynamic behavior of the model, it does not alter the long-run characteristics of the model. This may be seen by replace equation (5) with an equilibrium condition

\[ MS_t = MD_t = M_t \]

The quasi-equilibrium properties of this simplified model are identical with those reported in equations (6), (8) and (9) above for Model I. Since monetary disequilibrium is not permitted, in the quasi-equilibrium equation (20) also holds.

Diagrammatically the quasi-equilibrium of the simplified model involves an intersection of \( MD^* \) and \( MS^* \) in Figure 2. However, as in the first model, the composition of the money stock may be changing in the quasi-equilibrium. If, for example, the government budget deficit persists, the falling-off of foreign exchange reserves must persist to maintain the quasi-equilibrium stock of money that is equal to the desired stock.
The simplified model differs from the original model in its current value solutions. Since disequilibrium between money demand and money stock is resolved within each period, there are no lagged values of the endogenous variables entering their current values, and the issue of stability does not arise. The current value solutions are

\begin{align}
M_t &= b \bar{NY}_t \\
\Delta GD_t &= \bar{KG}_t + g \bar{NY}_t \\
\Delta R_t &= b \Delta \bar{NY}_t - [\Delta \bar{BC}_t + \bar{KG}_t + g \bar{NY}_t]
\end{align}

Which version of the model is relevant is fundamentally an empirical question.

II. Application to Haiti

A simple model such as the one presented here is a very useful analytical tool. It captures the essential features of several recent theoretical developments in international monetary theory without resort to complex mathematical manipulations. Further, the simplicity of the model makes the data required relatively undemanding. The application of such a model, however, may prove to be its undoing. Reality always seems to be much more complex and circumscribed by special circumstances than the simple model allows for. Despite this foreboding, we searched for a small open less developed country which has remained essentially open and on a fixed exchange rate (in the sense that foreign exchange reserves were reasonably free to

\footnote{These results may also be obtained by setting \( d = +1 \) and \( MS_t = MD_t \) in the current value solutions of the first model, i.e., equations (16) through (19).}
adjust to external imbalances) for a sufficiently long period to permit estimation. As is well known, few such countries exist. Haiti is one of the few.

The Haitian economy is one of the least developed of the Western Hemisphere. Over four million people are crammed on the eroded hills and mountains that constitute the western third of the Caribbean island of Hispaniola. Per capita G.N.P. in 1975 amounted to $200, and had scarcely changed in the previous two decades. Export earnings are dominated by coffee, bauxite, and sugar sales. There is considerable instability in the volume and the unit values of all three.

Haiti is one of the few LDCs that has no exchange control law, and the restrictions on import payments and export receipts are remarkably minor when compared with most LDCs. (See I.M.F., 1977.) Effectively, then, Haiti allows exchange reserves to adjust in response to an ex-ante external imbalance. It appears to correspond rather closely to our simple model.

To apply the model to Haiti we used data from the I.M.F's International Financial Statistics, 1979. The period covered in the estimation was 1956 through 1977.

The estimation procedure was full information maximum likelihood (FIML) estimation of the simultaneous equations, employing the program written by Clifford Wymer. There are two major advantages of using the FIML estimation procedure. First, it is asymptotically unbiased, and hence the well-known simultaneous equations biases that arise in single-equation estimation are avoided, to the extent that our model adequately captures the systematic behavior of the demand and supply of money. Second, the FIML estimation

\[^{1}\text{For an extensive discussion of the shortcomings of single-equation estimation in this context, see Kreinin and Officer (1978), Chapters 8 and 9.}\]
is a system method, and hence the influence of each equation carries through the entire system. A specification error in one equation is unlikely to go undetected. Consequently, we have a test of the model as a whole rather than of one part of it.

Estimation of the first model revealed that the disequilibrium version of the model did not yield a significant adjustment coefficient. Consequently, we proceeded to estimate the simplified model in which the assumption is made that monetary equilibrium is achieved in each period. Note that in our estimation of the simplified model we do not want to estimate \( \Delta R \) as a residual from the money supply identity, for this would yield a biased estimate of \( \Delta R \). To get around this difficulty and yet to retain the existing simultaneous structure, we included the money supply identity constraint implicitly by estimating equations (21), (22), and (23) simultaneously, imposing all the cross-equation restrictions on the parameters contained in these equations. The results are presented in Table 1.

The estimated model is a reasonably strong fit. The t-ratios, computed from the asymptotic standard errors, are all large. The Carter-Nagar \( R^2 \) statistic of 0.95 is large and significant. Also, the system tracks

---

1 Results may be obtained from the author on request.

2 If \( \Delta R \) is entered as a residual in the money stock identity, then the residual of the identity is zero, but the mean square error of \( \Delta R \) is positive (and large), yielding an asymptotically biased estimate.

3 This is a measure of correlation of the whole simultaneous system that specifically accounts for the identifying restrictions and has the same interpretation as the familiar \( R^2 \) used with classical least squares. (See Carter and Nagar (1977).) The \( \chi^2 \) statistic associated with the Carter-Nagar \( R^2 \) is 1286.85 which has as asymptotic \( \chi^2 \) distribution with 3 degrees of freedom. This substantially exceeds the critical value, and hence the hypothesis that this model is not consistent with the data must be rejected.
### Table 1: FIML Estimate of Simplified Model, Haiti, 1956-1977

<table>
<thead>
<tr>
<th>Equations</th>
<th>Residuals</th>
<th>Dependent Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Variance</td>
</tr>
<tr>
<td>21) ( M_t = \frac{0.092 \overline{NY}}{(39.2)}_t )</td>
<td>-8.17</td>
<td>1024</td>
</tr>
<tr>
<td>22) ( \Delta GD_t = -67.76 + 0.041 \overline{NY} )</td>
<td>3.54</td>
<td>343</td>
</tr>
<tr>
<td>( (10.2) ) ( (16.2) )</td>
<td>t</td>
<td>t</td>
</tr>
<tr>
<td>23) ( \Delta R_t = \frac{0.092 \Delta NY}{(39.2)}_t + 67.76 - 0.041 \overline{NY} - \Delta BC )</td>
<td>0.21</td>
<td>911</td>
</tr>
<tr>
<td>( (10.2) ) ( (16.2) )</td>
<td>t</td>
<td>t</td>
</tr>
</tbody>
</table>

**Notes:**

a. Carter-Nagar \( R^2 \) statistic = .9512

b. \( t \)-ratios in parentheses are calculated from asymptotic standard errors.

c. Units of all variables are millions of gourdes.

d. Exogenous Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>NY</td>
<td>2376</td>
<td>1400</td>
</tr>
<tr>
<td>( \Delta NY )</td>
<td>233</td>
<td>347</td>
</tr>
<tr>
<td>( \Delta BC )</td>
<td>3</td>
<td>13</td>
</tr>
</tbody>
</table>

e. Log-likelihood value of unrestricted reduced form = -182.54
Log-likelihood value of overidentified model = -204.016
Chi-square value of log-likelihood ratio = 42.96 with 9 d.f.
\[ P[\chi^2 > 21.7] = .01 \] for 9 d.f.
the endogenous variables reasonably well: the actual, estimated, and residual values of $M$, $\Delta GD$, and $\Delta R$ are reported in Table 2.

Table 2: Actual, Estimated and Residual Values of Endogenous Variables, 1956-77

<table>
<thead>
<tr>
<th>Year</th>
<th>$M$</th>
<th></th>
<th></th>
<th>$\Delta GD$</th>
<th></th>
<th></th>
<th>$\Delta R$</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Actual</td>
<td>Estimated</td>
<td>Residual</td>
<td>Actual</td>
<td>Estimated</td>
<td>Residual</td>
<td>Actual</td>
<td>Estimated</td>
</tr>
<tr>
<td>1956</td>
<td>112.9</td>
<td>134.3</td>
<td>-21.4</td>
<td>13.9</td>
<td>-8.3</td>
<td>22.2</td>
<td>-8.5</td>
<td>16.1</td>
</tr>
<tr>
<td>57</td>
<td>114.9</td>
<td>133.2</td>
<td>-18.3</td>
<td>-4.1</td>
<td>-8.8</td>
<td>4.7</td>
<td>-8.3</td>
<td>13.4</td>
</tr>
<tr>
<td>58</td>
<td>96.1</td>
<td>140.5</td>
<td>-44.4</td>
<td>20.7</td>
<td>-5.6</td>
<td>26.3</td>
<td>-24.7</td>
<td>8.5</td>
</tr>
<tr>
<td>59</td>
<td>100.4</td>
<td>124.8</td>
<td>-24.4</td>
<td>-8.5</td>
<td>-12.6</td>
<td>4.1</td>
<td>10.0</td>
<td>-6.0</td>
</tr>
<tr>
<td>1960</td>
<td>100.1</td>
<td>125.5</td>
<td>-25.4</td>
<td>-4.7</td>
<td>-12.2</td>
<td>7.5</td>
<td>13.3</td>
<td>21.1</td>
</tr>
<tr>
<td>61</td>
<td>115.4</td>
<td>124.5</td>
<td>-9.1</td>
<td>3.5</td>
<td>-12.7</td>
<td>16.2</td>
<td>0</td>
<td>0.4</td>
</tr>
<tr>
<td>62</td>
<td>119.3</td>
<td>129.6</td>
<td>-10.3</td>
<td>17.2</td>
<td>-10.4</td>
<td>27.6</td>
<td>-22.2</td>
<td>6.4</td>
</tr>
<tr>
<td>63</td>
<td>126.5</td>
<td>135.4</td>
<td>-8.9</td>
<td>10.1</td>
<td>-7.8</td>
<td>17.9</td>
<td>-10.7</td>
<td>5.4</td>
</tr>
<tr>
<td>64</td>
<td>125.7</td>
<td>149.4</td>
<td>-23.7</td>
<td>8.7</td>
<td>-1.7</td>
<td>10.4</td>
<td>-11.4</td>
<td>14.6</td>
</tr>
<tr>
<td>1965</td>
<td>123.6</td>
<td>162.3</td>
<td>-38.7</td>
<td>8.2</td>
<td>4.0</td>
<td>4.2</td>
<td>-2.1</td>
<td>16.2</td>
</tr>
<tr>
<td>66</td>
<td>116.0</td>
<td>169.7</td>
<td>-53.7</td>
<td>.4</td>
<td>7.3</td>
<td>-6.9</td>
<td>-3.9</td>
<td>4.2</td>
</tr>
<tr>
<td>67</td>
<td>129.9</td>
<td>169.6</td>
<td>-39.7</td>
<td>17.8</td>
<td>7.3</td>
<td>10.5</td>
<td>-6.0</td>
<td>-9.5</td>
</tr>
<tr>
<td>68</td>
<td>151.3</td>
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Sources: Actual from IMF (1979). Estimates from equations in Table 1, above.
The one statistical test that the model fails is the log-likelihood ratio test of the over-identified model. The $\chi^2$ value of this ratio exceeds the critical value, and hence the hypothesis that the over-identifying restrictions are consistent with the sample must be rejected. This suggests that there are some relationships in the data which an unrestricted model would pick up, but which our highly simplified model does not capture correctly.

Before interpreting the numerical results of our estimates, a few comments are warranted on the issue of whether or not the variables $NY$ and $ABC$ which we treat as exogenous, are in fact exogenous. First, regarding $NY$, it is important to recognize that since this is a highly open economy, the usual channel of endogeneity from the money stock to the price level is not present. The channel of export prices to domestic prices that we set out above seems to be a much more reasonable way of approaching price determination. To check this, we constructed an export price index ($PX$), using unit values of the three principal exports (coffee, bauxite, and sugar), which account for about half of the total exports. We then compared the export price index with the GDP deflator (both 1975 = 100). The two indexes are charted below. The inevitable index number problem arises the further back the indexes go, and this is compounded by the fact that one export item (bauxite, with about one-third weight in the index $PX$) was not exported until 1963. Allowing for these problems, and the smoother nature of the more comprehensive index, the result is strongly suggestive of our hypothesis. The aggregate domestic price level is closely related to the prices of exports, which clearly are exogenous. Hence, our working hypothesis that the aggregate domestic price level is exogenously determined does not seem out of line with reality.
One might argue that while the price level is exogenous, real output may be subject to endogenous influences in the manner of an expectations augmented Phillips curve. Extensive experimentation with various specifications of such a relationship found no significant effect to be present.

Turning to the matter of bank credit growth (ΔBC), one might suggest that for some (unspecified) reason ΔR is fundamentally exogenous and ΔBC is endogenously determined. Certainly such a switch in equation (23) of our simultaneous system would not alter the estimates of the coefficients because we are using a system method of estimation. However, such a switch does not leave ΔBC very well explained. In fact, the variance of the
residual of the estimate of equation (23) is substantially larger than the variance of ΔBC at its mean (see Table 1) which tells us that a switch of ΔR and ΔBC in equation (23) would yield a negative $R^2$ implied for equation (23). In other words, this system explains none of the variation in ΔBC, suggesting that is not an endogenous variable.

The estimated values of the coefficients merit some comment. The low value of the coefficient b is consistent with the ratio of money stock to money income found in very low-income countries with poorly developed or repressed financial systems. The positive value of the coefficient g means that the marginal propensity of the government to spend exceeds the marginal tax rate. Hence, as income rises, the flow government deficit increases. Again this is consistent with the general pattern found in LDCs: revenue inelasticity and expenditure elasticity with respect to money income growth.¹

Finally, it is of some interest to employ the empirical parameters to evaluate the equilibrium conditions discussed in our treatment of the model structure. Recall that for an equilibrium of ΔR* = 0, we must set ΔGD* = -ΔBC (see equation (10)). Hence substituting our estimate of equation (22), we require that

$$-67.76 + .041\bar{NY} = -\Delta BC$$

For the level of NY prevailing in 1977 of 6,511 million gourdes, the required ΔBC per period to achieve ΔR* = 0 is ΔBC = -199.19. Given that the level of BC in 1977 was 135.1 million gourdes, and its mean value over the full period was one-third of that, suggests that the government tax and expenditure schedules are not compatible with long-run external balance.

¹ On both these points, see McKinnon (1973). The low ratio of money stock to money income in financially repressed countries is discussed in Chapter 8, and the revenue inelasticity problem is developed in Chapter 10.
Furthermore, if we want to obtain $\Delta GD^* = 0$, we saw from equation (14) that we must set $g = \frac{-KG}{NY}$. Thus, for $NY = 6511$, and given the slopes of the schedules that yield $g$, we need to have $KG = -[(.041)(6511)] = -267$, whereas, in fact our estimated $KG = -67.76$.

Hence, to achieve steady state $\Delta GD^* = 0$ at the 1977 income level, Haiti would need to introduce a combination of tax increases and expenditure reduction that is net equivalent to a 3.9 fold increase in the taxes collected at the current income level. Alternatively, should we wish to change the coefficient $g$ to achieve $\Delta GD^* = 0$ at the current income level (keeping $KG$ constant), we would need to have

$$g = \frac{-67.76}{6511} = -.0104$$

Thus the tax and expenditure system would have to change from its current positive value of .041 to a mildly negative value of -.0104. In other words, the tax-cum-expenditure system must be transformed into a "progressive" (negative $g$) system from its current "regressive" setting.

Mention should be made of one option that would not work given the estimated value of the coefficients. Since $g$ is positive (and $KG$ negative), a rise in nominal income due to a devaluation raising $FX$, and hence money income will not resolve the equilibrium balance of payments problem. On the contrary, from equations (8) and (9) above we can see that for a positive $g$, an increase in money income will exacerbate the negative reserve flow. In other words, it would be necessary to reduce money income substantially from the current level to achieve equilibrium $\Delta R^* = 0$, assuming of course that the tax expenditure system were unchanged. Obviously such an
option is not to be taken seriously. Rather, what is clear from this analysis is that a focus on the government budget regime is essential if a fixed exchange rate regime is to be maintained in the long run.

III. Conclusion

In this paper we have developed a simple model of a small open LDC on a fixed exchange rate in which the money stock, the balance of payments, and the flow of government debt to the monetary authorities are all explained endogenously. Consideration of the latter two together as sources of change in the money stock is the principal theoretical contribution of the paper. Empirically we have estimated the model using FIML estimation, a simultaneous-equation technique that takes into account the simultaneity of demand and supply of money, and estimates the demand function and the two supply functions as a system. The country chosen for the empirical application, Haïti, particularly matches the assumptions of no organized financial system and an exogenously given nominal income. The estimate is a reasonably strong confirmation that there is substantial empirical content to the simple model presented.
REFERENCES


MATHEMATICAL APPENDIX

1. The Model

The model consists of equations:

\( (2) \quad MD_t = b \overline{NY}_t \)

\( (3') \quad MS_t = MS_{t-1} + AR_t + AGD_t + ABC_t \)

\( (4) \quad AGD_t = KG + g \overline{NY}_t \)

\( (5) \quad AR_t = d(MS_{t-1} - MD_{t-1}) \quad -1 < d < 0 \)

These are readily expressed in matrix form as follows:

\( (A.1) \quad Ac + Bl = j \)

where

\[
A = \begin{bmatrix}
1 & 0 & 0 & 0 \\
0 & 1 & -1 & -1 \\
0 & 0 & 1 & 0 \\
0 & 0 & 0 & 1 \\
\end{bmatrix}
\]

\[
B = \begin{bmatrix}
0 & 0 & 0 & 0 \\
0 & -1 & 0 & 0 \\
0 & 0 & 0 & 0 \\
d & -d & 0 & 0 \\
\end{bmatrix}
\]

\[
c = \begin{bmatrix}
MD_t \\
MS_t \\
AGD_t \\
AR_t \\
\end{bmatrix}, \quad l = \begin{bmatrix}
MD_{t-1} \\
MS_{t-1} \\
AGD_{t-1} \\
AR_{t-1} \\
\end{bmatrix}, \quad j = \begin{bmatrix}
b \overline{NY}_t \\
\overline{ABC}_t \\
KG + \overline{NY} \\
0 \\
\end{bmatrix}
\]

2. The Quasi-Equilibrium

To solve for this equilibrium, we set
\[ c = \lambda = \begin{bmatrix} MD^* \\ MS^* \\ \Delta GD^* \\ \Delta R^* \end{bmatrix} \]

where the * indicates the steady state equilibrium value. Here, in equilibrium, (A.1) becomes

\[ (A + B) \begin{bmatrix} MD^* \\ MS^* \\ \Delta GD^* \\ \Delta R^* \end{bmatrix} = j \]

Then if \((A + B)^{-1}\) exists,

\[ (A.3) \begin{bmatrix} MD^* \\ MS^* \\ \Delta GD^* \\ \Delta R^* \end{bmatrix} = (A + B)^{-1} j \]

3. **The Characteristic Equation**

To obtain the characteristic equation we set \( \lambda = c \beta^{-1} \) which we substitute into (A.1) to obtain

\[ (A.4) \quad Ac + Bc\beta^{-1} = j \]

or

\[ (A.4') \quad (A + B\beta^{-1})c = j \]

Then, the characteristic equation is

\[ (A.5) \quad |A + B\beta^{-1}| = 0 \]

Solving (A.5) yields
(A.6) \[ 1 - (1 - d)\beta^{-1} = 0 \]
or

(A.6') \[ \beta - (1 - d) = 0 \]

The root of the characteristic equation is less than unity in absolute value iff

\[ |1 - d| < 1 \]

This condition is met if

\[ 0 < d < 2 \]

4. Current Value Solution

When we solve for the specific case of \( t \), we see from (A.4') that if \( (A + B\beta^{-1})^{-1} \) exists, we can solve for

\[
\begin{bmatrix}
M_{t}^D \\
M_{t}^S \\
\Delta G_{t}^D \\
\Delta R_{t}
\end{bmatrix}
= (A + B\beta^{-1})^{-1} j
\]

This yields equations (16), (17), (18) and (19) in the text.
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