THE BALANCE OF PAYMENTS AS A MONETARY PHENOMENON: AN ECONOMETRIC STUDY OF ZIMBABWE'S EXPERIENCE

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The balance of payments as a monetary phenomenon: An econometric study of Zimbabwe's experience

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Abstract

This paper tests the monetary approach to Zimbabwe's balance of payments during the period 1980 to 1991. It examines whether excess money supply played a role as a disturbance using multivariate cointegration and error-correction modelling. The empirical results suggest that money played a significant role in determining the balance of payments. The one-to-one negative relationship and strong link between domestic credit and the flow of international reserves is established. The policy conclusion is that, given a stable demand for money function, balance of payments disequilibrium can be corrected through appropriate financial programming and monetary targeting.

1. Introduction

During most of the Unilateral Declaration of Independence (UDI) period (1965-1979), Zimbabwe ran trade and current account surpluses. After independence in 1980, however, the country's external position began to deteriorate. From 1980 to 1991 the current account was in deficit all the time except for 1986, 1987 and 1988.

This suggests that the management of the external imbalance has been one of the most serious problems faced by the government since independence. To deal with the problem the authorities have so far relied on ad hoc measures, including import compression through exchange control regulations and, more importantly, reliance on foreign capital inflow.[1] Nevertheless, the persistence of the problem has contributed to undermine the inflow of foreign capital.

It is generally agreed among policy makers that a major cause of the external imbalance was adverse developments in the international economy that were outside the control of the Zimbabwean authorities. Such developments included sharp changes in terms of trade, sharp increases in oil prices, servicing of external debt, increased protectionism and recession in western industrial countries. There is, however, less agreement on the extent to which the external imbalance was caused by the persistent budget deficit, the growth in domestic credit and the consequent over-valuation of the exchange rate.[2] In light of this, the objective of this paper is to apply the monetary approach to Zimbabwe's balance of payments analysis and to test the validity of the hypothesis that under the fixed exchange rate system, changes in the nation's demand for money relative to its supply led to changes in international reserves using the Johansen (1988) and Johansen-Juselius (1990) multivariate cointegration and error-correction modelling. This study differs from existing studies in that it estimates the reserve flow equation through the medium of cointegration and error modelling. The estimation results accept the predictions of the monetary approach to balance of payments.

The rest of the paper is organized as follows: Section II reviews the literature on the alternative approaches to balance of payments theory. Section III is the heart of the paper as it contains the discussion of the monetary approach and macroeconomic models used in the analysis of the impact of domestic monetary disequilibrium on the balance of payments. Section IV presents the balance of payments developments of Zimbabwe since 1980. Section V discusses the salient features of the data and econometric procedure. Results are presented and discussed in Section VI. The final section contains a brief summary and the important conclusions derived from the study.

II. Review of alternative approaches to balance of payments theory

A country faces balance of payments problems for many reasons: among other things, expansionary monetary policies, a deterioration in terms of trade, price distortions, high debt servicing, or a combination of these factors. To solve these problems, many countries seek balance of payments support from outside sources including the International Monetary Fund (IMF) and debt relief from creditors in the framework of a planned adjustment process. Exchange rate adjustment (devaluation) is essentially part of this adjustment process.[3]

Within the international economics literature, there have been three principal approaches to analysing devaluation. These are the elasticity approach, the absorption approach and the monetary approach. Differences among these approaches have occasionally been the focus of sharp controversy, most notably in the case of elasticity and absorption, and recently in the case of the monetary approach as contrasted with the others. It should be noted that each approach has its own sets of arguments, hence the rest of this section and Section III will discuss each of these three approaches.

The elasticity approach

In its simplest form, the elasticity approach focuses on the current account of the balance of payments and is concerned with the condition under which exchange rate changes can compensate for price distortions in international trade, which are assumed to be the major cause of the value of imports exceeding exports. The Marshallian partial equilibrium analysis is applied to markets for exports and imports. Capital movements are assumed away and the domestic price level varies with respect to the world price level.[4] Whether an improvement in the balance of payments occurs as a result of devaluation depends crucially on the foreign elasticity of demand for exports and home elasticity of demand for imports denoted e_x and e_m, respectively. If the elasticity condition, that is, $e_x + e_m > 1$ held, devaluation would improve the balance of payments (assuming of course that the foreign exchange market was stable). This is called the Marshall-Lerner condition.

If the sum is equal to unity, a change in the exchange rate will leave the
balance of trade unchanged. If the sum is smaller than unity, a depreciation
will make the balance unfavourable and an appreciation will make it more
favourable (Harbeler, 1949, p.197).

The logic behind this condition is as follows. Suppose the elasticity of demand for
exports is zero. In this case exports in domestic currency are the same as before
devaluation. If the sum of the elasticities is greater than one, the elasticity of demand for
imports must be greater than one, so that the value of imports falls. With no fall in the
value of exports and a fall in the value of imports, the balance of payments improves.
Now, suppose the demand for imports has zero elasticity. The value of imports will rise
by the full percentage of devaluation. If the elasticity of demand for exports is greater
than unity, the value of exports will expand by more than the percentage of devaluation.[5]
Therefore, the balance of payments will improve. If each element of the elasticity of
demand is less than unity, but the sum is greater than unity, the balance of payments will
improve because expansion of exports in domestic currency will exceed the value of
imports.

However, there are considerable doubts about the efficacy of devaluation in developing
countries. It is argued that the elasticities of exports and imports are sufficiently low,
therefore devaluation cannot be expected to lead to an improvement of the balance of
payments (see, for instance, Miles, 1979; Kincaid, 1984; and Saidi, 1987).[6] A similar
source of pessimism surrounds the lags in the response of the current account to relative
price changes. The argument is that trade volumes respond sluggishly to price changes
because of the inertia of importers switching domestic expenditure away from imports,
and the existence of contracts. Thus, in the short run, it is unlikely that domestic export
earnings following a devaluation will increase by enough to offset the initial increase in
the value of expenditure on imports. This is the "J Curve effect" on the current account,
where, following a devaluation, the balance of trade appears worse before it improves.

Moreover, the elasticity approach ignores any direct effects devaluation may have on
the domestic price level and domestic nominal wages.

The absorption approach

We have seen that in the elasticity approach to the analysis of devaluation, the effect of
exchange rate adjustments on the balance of payments depends principally on the
elasticities of imports for home and foreign goods. This means that the relative price
changes due to devaluation will be a pointer to the substitution effects that will happen.
In this analysis income is assumed fixed. Thus, the income multiplier effects of
devaluation are ignored.[7]

Alexander (1952) criticizes the elasticity approach as a partial equilibrium analysis.
Instead, he proposes the absorption approach as an alternative. The central tenet of the
absorption approach is that a favourable configuration of price elasticities may not be

sufficient to produce a positive balance of payments effect resulting from a devaluation, if a devaluation does not succeed in reducing domestic absorption.

The starting point of the absorption approach is the national income identity:

$$Y = C + I + G + X - M \tag{1}$$

where
Y = national income;
C = private consumption of goods and services purchased at home and from abroad;
I = total investment, by firms as well as by government;
G = government expenditure on goods and services
X = exports of goods and services; and
M = imports of goods and services.[8]

It should be noted that recently this national income identity has been used to explain the current account as the difference between optimal savings and investment decisions (see for instance Jayaraman, 1994; Rosensweig and Tallman, 1993). However, this approach is beyond the scope of this paper.

Combining $C + I + G$ expenditure terms into a single term, A, representing domestic absorption (i.e., total domestic expenditure) and $X - M$ terms into B, net exports/trade balance, we get:

$$Y = A + B \tag{2}$$

Equation 2 states that national income equals absorption plus the trade balance, or alternatively

$$B = Y - A \tag{2'}$$

Equation 2' can be expressed in changes as shown below:

$$dB = dY - dA \tag{2''}$$

But changes in absorption depend on real income and other factors related to devaluation. Taking these into account, changes in absorption dA can be expressed as:

$$dA = cdY - dD \tag{3}$$

where c = the propensity to absorb; and
d = the direct effect of devaluation on absorption.

Substituting Equation 3 into Equation 2" the result is

$$dB = (1 - c) \, dY + dD \qquad (4)$$

From Equation 4 the following questions emerge:

a)   How does devaluation affect income (Y)?

b)   How does devaluation affect domestic absorption (D) at any level of income?

c)   How do (a) and (b) in turn affect the trade balance?

Machlup (1943) postulates that the principal effect of devaluation on income is associated with the increased exports of the devaluing country and the induced stimulation of domestic demand through the multiplier effect, provided the economy is operating below full capacity. Alexander (1952) postulates two effects of the income effect, namely the idle resources effect and the terms of trade effect. The idle resources effect will result in an improvement in the balance of payments as long as the marginal propensity to absorb, c, is less than unity.

> If c is equal to or greater than unity, the foreign balance will not be improved as a result of improved output. Under such circumstances, the devaluation will be effective in stimulating recovery, but not improving the foreign balance except possibly through direct effects...(Alexander, 1952, p.267).

On the other hand, the effect of income on the change in terms of trade is assumed to worsen the balance of payments. Thus, when the devaluing country is at full employment, or c is equal to or greater than unity, devaluation will improve the balance of payments through the direct effect on absorption, that is, the expenditure reducing effect of devaluation. This expenditure reducing effect occurs through three channels, namely, the real cash balance (the most important effect), income redistribution and money illusion effects. The real balance effect occurs when money holders accumulate cash when the general price level increases as a result of devaluation. This will result in a fall in real expenditure. This increase in demand for cash holdings will also results in a rise in interest rates, further reducing absorption through a reduction in investment. Thus, the real balance effect has a direct and indirect effect.

The redistribution of income effect occurs when wages lag behind prices, such that prices increase at the expense of profit. If income is shifted from individuals with high propensity to absorb to those with low propensity, absorption will decline, and the balance of payments will improve. However, high profits may stimulate investment demand, so absorption may not decline (Alexander, 1952). The money illusion effect occurs when individuals pay more attention to money prices rather than money income. This scenario will result in a reduction in expenditure as prices increase with devaluation. If the decline in consumption is more than the real cash balance effect of devaluation, then money illusion may improve the balance of payments.

The foregoing suggests that the overall effects of devaluation can be summarized as:

$$dB/dE = (1 - c)dY_m/dE + (1 - c)dY/dE + dD/dE \qquad (5)$$

where db =   change in the trade balance;

         dE =   change in the exchange rate (the rate of the devaluation);

         c =   marginal propensity to absorb;

         dY_m =   the effect of devaluation on income through the multiplier effect;

         dY_t =   the effect of devaluation on income through the terms of trade effect; and

         dD =   direct effect on absorption.

Equation 5 shows that the effect of devaluation on the balance of payments depends on three factors, namely, the income multiplier effect, the terms of trade effect and the direct effect on absorption.

Alexander (1952, p.274) also postulates that policies that affect absorption directly such as tight monetary and fiscal policy are more effective than devaluation:

> ...in many cases, in which the question of devaluation is likely to become a live issue under conditions of full employment, the favourable direct absorption effects are likely to be weak. It would seem to be much more effective to operate an absorption directly through monetary and credit policy — limitation of government expenditures, of private investment and, possibly, of private consumption — provided these can be brought to bear on the foreign balance without adversely affecting income and employment. They must, of course, "adversely" affect absorption, since, at full employment, it is possible to improve the foreign balance only through reducing absorption.

The implication of this is that at full employment devaluation alone will not solve the balance of payments. Instead, devaluation should be combined with deflationary policies.

It is interesting to note that in Equation 5 above, when there are no income multiplier nor terms of trade effects, $dY_m/dE = dY/dE = 0$, the only effect of devaluation on the trade balance is the direct or real balance effect. Thus, devaluation will affect the trade balance only when the money supply is fixed. This is the view of the monetary approach discussed below.

III. The monetary approach

Alexander's (1952) presentation of the absorption approach contains seeds of the monetary approach to balance of payments, which sprang out in the 1960s as part of the monetarist anti-Keynesian revival. The theoretical analysis of the monetary approach comes from the writings of Mundell (1968), Johnson (1975, 1976, 1977), Mussa (1974), Krueger (1969) and Dornbush (1973), even though the arguments for the relationship between the foreign sector and the domestic sector of an economy through the working of the monetary sector can be traced to Hume's (1752) price specie flow mechanism. The monetary approach views imbalances in the balance of payments in terms of imbalances between the demand for and supply of money stock. The approach focuses its analysis on the monetary account of the balance of payments in the context of a general equilibrium analysis.[8] Thus, "the balance of payments is a 'monetary' and not a real phenomenon and ... balance of payments disequilibria are 'stock' and not flow disequilibria" (Johnson 1975, p.220).

The monetary approach to balance of payments postulates that the overall balance of payments measured by international reserves is influenced by imbalances prevailing in the money market. Under a system of fixed exchange rates excess money supply induces increased expenditure, which shows itself in increased purchases of foreign goods and services by domestic residents. These purchases have to be financed by running down foreign exchange reserves, thereby worsening the balance of payments. The outflow of foreign exchange reserves reduces money supply until it is equal to money demand, thereby restoring monetary equilibrium and halting an outflow of foreign exchange reserves. An excess demand for money leads to an opposite adjustment, which in turn induces foreign exchange reserves inflow, domestic monetary expansion and eventually a restored balance of payments equilibrium position.[9]

The formal monetary approach to balance of payments model based on Johnson (1976) specifies a money supply identity, a money demand function and an equilibrium condition. The model consists of the following set of equations:

$$M^s = (R + D) \tag{6}$$

$$M^d = L(Y, P, I) \tag{7}$$

$$M^s = M = M^d \tag{8}$$

where M^s = money supply;
  R = international reserves;
  D = domestic credit;
  M^d = money demand;
  Y = level of real domestic income;
  P = price level;
  I = rate of interest; and
  M = equilibrium stock of money.

Equation 6 postulates that money supply is determined by the availability of international reserves and the level of domestic credit created by the country's monetary reserves, while Equation 7 sets out the real demand for money as a function of real income, the inflation rate and the interest rate. The monetary theory states that there is a positive relationship between money held and income $(\partial M^d/\partial Y > O)$ and money held and the price level $(\partial M^d/\partial P > O)$, and a negative relationship between money held and the interest rate $(\partial M^d/\partial I < O)$. Equation 8 is the equilibrium condition in the money market.

By combining Equations 6, 7 and 8, placing the variables in percentage changes, and isolating reserves as the dependent variable, we may write the reserve flow equation as follows

$$\Delta R = \Delta[L(Y, P, I)] - \Delta D \tag{9}$$

Equation 9 is the fundamental monetary approach to balance of payments equation. It postulates that the balance of payments is the outcome of the divergence between the growth of the demand for money and the growth of domestic credit, with the monetary consequences of the balance of payments bringing the money market into equilibrium. An increase in domestic credit will cause an opposite and equal change in international reserves, given a stable demand function for money. The coefficient of ΔD is thus known as an offset coefficient. It shows the extent to which changes in domestic credit are offset by changes in international reserves. The monetary approach predicts a value of minus unity for this coefficient in the reserve flow equation. Most of the empirical studies on the monetary approach confirm this result. (See, for instance, Kannan, 1989; Kamas, 1986; Dalamagas, 1990; Dhliwayo and Moyo, 1990; Sundararajan, 1984; and Sohrab, 1985.)

IV. Balance of payments developments during 1980-1991

During most of the UDI period, Zimbabwe ran substantial trade and current account surpluses. However, after independence in 1980, the country's external position began to deteriorate. Over the period 1980-1991, the current account was in deficit all the time except in 1986, 1987 and 1988 (Table 1). This adverse development on current account reflects the land-locked nature of the Zimbabwean economy. Because of this, the country experiences large net service payments in respect of freight payments for its imports. Other, less visible, outflows include net income payments in terms of interest payments on external obligations, dividend and profit remittances. Thus, overall, the balance on the invisible account has always been strongly negative with virtually all the invisible items resulting in an outflow of foreign currency.

Given the structure of the balance of payments, which has been characterized by large export dependence on agricultural and private sectors, relatively large outflows on the invisible account (mostly in respect of interest, pensions and dividend remittances), large external debt obligations, and net capital outflows, the balance of payments has experienced severe imbalances since 1980. The economy's dependence on agricultural and mineral exports, though less than that of most developing economies, has led to a decline in real export growth by trying the balance of payments developments to the general fluctuations in international commodity markets. Thus, the timely honouring of the economy's external obligations, through a prudent debt management policy that has seen the debt service ratio fall from a peak of 35% in 1987 to an estimated 20% in 1991, has continued in the face of adverse effects. This achievement, although maintaining the country's credit-worthiness in the international capital markets, has been at a considerable cost to the economy. These costs included curtailing import growth so that a large visible trade surplus could finance both the negative invisible payments and negative capital flows. The regime of import compression, by negatively affecting domestic investment and production, has left the economy facing a situation of low investment and low growth in the directly productive sectors of the economy and resulted in high unemployment.

In terms of monetary developments over the period 1980-1991, a cautious monetary policy contributed to keep the economy fairly stable, keeping inflation low and real interest rates negative (see Table 2 for trends in broad money supply, net foreign assets and domestic credit). However, the huge fiscal deficit over the period contributed to high growth rates in money supply, domestic credit and the current account deficits.

Table 1. Balance of payments: A summary

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Merchandise exports (fob)	1,446	1,451	1,321	1,154	1,174	1,120	1,323	1,452	1,665	1,694	1,742	1,694
Merchandise imports (fob)	-1,339	-1,534	-1,472	-1,070	-989	-919	-1,012	-1,071	-1,164	-1,318	-1,505	-1,646
Balance of trade	107	-83	-151	84	185	201	311	381	501	376	237	48
Service receipts	167	131	180	144	139	295	168	164	190	240	274	286
Service payments	-382	-522	-420	-417	-350	-496	-310	-344	-404	-480	-523	-631
Income receipts	107	96	82	71	56	38	37	34	18	43	24	28
Income payments	-179	-226	-308	-269	-178	-172	-232	-235	-240	-241	-294	-318
Goods and services balance	-180	-604	-617	-387	-148	-134	-26	0	65	-62	-282	-587
Unrequited transfers (net)	-63	-33	-83	-73	50	20	31	48	53	60	105	98
Private (net)	-121	-124	-128	-114	-38	-45	-27	-32	-13	-19	-3	3
Official (net)	58	91	45	41	88	65	58	80	66	79	108	95
Current account balance	-243	-637	-700	-460	-98	-114	5	48	118	-2	-177	-489
Capital account	-30	616	249	-37	109	121	99	75	32	116	130	408
Direct investment	2	4	-1	-2	-3	3	8	-31	4	-11	-12	3
Portfolio investment	-28	-30	-47	-43	3	9	1	1	-61	-37	-22	7
Other capital	-4	642	297	8	109	109	90	105	89	164	164	398
Net errors and omissions	188	128	92	35	45	37	-69	17	-63	-92	19	-24
Overall balance	-86	-8	-22	-174	-46	82	56	125	102	-53	-22	-105
Current account/GDP %	5.60	11.50	11.10	8.40	3.70	3.50	2.00	1.00	2.10	1.20	4.40	8.40

Source: International Monetary Fund, *Financial Statistics* (various issues).

Table 2. Trends in money supply, net foreign assets, net claims on government and claims on the private sector (annual changes) 1980 - 1991

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Broad money supply	243	83	202	32	283	66	220	226	498	578	663	897
Net foreign assets	-82	-119	-35	-161	233	149	-83	108	54	-115	-263	-36
Net claims on government	197	-69	261	-49	-47	-96	-9	328	-13	203	359	1010
Claims on the private sector	95	351	170	350	-2	331	321	112	442	786	995	1924
Rate of inflation (%)	5.5	13.1	10.7	23.1	20.2	8.5	14.3	12.5	7.4	12.9	17.4	24.3

Source: Reserve Bank of Zimbabwe, *Quarterly Economic and Statistical Review* (various issues).

V. Data and econometric procedure

Data

Quarterly data covering the period 1980-1991 are utilized to test the monetary approach to Zimbabwe's balance of payments. The data were obtained from the IMF's *International Financial Statistics* (various issues), Reserve Bank of Zimbabwe's *Quarterly Economic and Statistical Review* (various issues), and the Central Statistical Office's *Quarterly Digest of Statistics* (various issues).

Net foreign assets *(R)* are the sum of international reserves and gold. Domestic credit *(D)* is the sum of net claims on government and claims on the private sector by the monetary sector. Quarterly real income *(Y)* was interpolated from annual series using a technique introduced by Friedman (1962). The consumer price index (1985 = 100) represents the price level *(P)*. The weighted average of interest rates was used for interest rate *(I)*.[10] All variables are transformed into natural logarithms. In the sequel, we use the following conventions: lower case denote the natural logarithm of the corresponding variables and Δ denotes the kth difference, i.e., $\Delta_k x_t = x_t - x_{t-k}$.

Econometric procedure

Most empirical studies on the monetary approach estimate Equation 9 using differenced data to test the validity of the predictions of the monetary approach to balance of payments (see, for instance, Dalamagas, 1990; Kamas, 1986; Kannan, 1989; and Sohrab, 1985). However, by examining differenced data, information about the fundamental long-run relationship is inadvertently lost. The information about the long-run equilibrium of the model is contained in the error-correction term, however, so cointegration analysis is the appropriate technique for examining potential long-run relationships (Engle and Granger, 1987). This section describes the tests for stationarity and the estimation procedure appropriate for analysing the monetary approach to balance of payments.

Many test procedures are available for testing for a unit root in a time series. The question is not simple, as the usual asymptotic theory does not apply in the unit root case. Moreover, the usual tests are not very powerful in our case where the number of observations is only 48. Because of this we use the augmented Dickey-Fuller (ADF)

(Dickey and Fuller, 1981; Said and Dickey, 1984), and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) (Kwiatkowski *et al.*, 1992) tests. The former tests the null of a unit root, or I(1) against the null of stationarity, while the latter tests the null of stationarity against the alternative of a unit root. The choice of the KPSS to supplement the ADF test stems from the evidence that tests based on the null of non-stationarity have low power in rejecting the null. Testing the null of stationarity reduces the inherent bias towards concluding in favour of non-stationarity.

The ADF is the t statistic for the estimated $\hat{\gamma}$ in the regression

$$\Delta x_t = \alpha_0 + \gamma x_{t-1} + \alpha_1 t + \sum_{t=2}^{p} \beta_i \Delta x_{t-1+1} + \varepsilon_t \tag{10}$$

where t is the time trend, p is the number of lags, ε_t is the stochastic error term, and augmentation with the lagged difference ensures that the errors are white noise.

The KPSS is based on the regression of the form

$$x_t = \delta t + r_t + \varepsilon_t \tag{11}$$

where

$$r_t = r_{t-1} + \xi_t \tag{12}$$

where ε_t and ξ_t are uncorrelated white noise. The null of the hypothesis is simply that the variance of the noise in the random walk, $\sigma_\xi^2 = 0$, is zero. Under the null, x_t is stationary around a constant $(\delta = 0)$ or trend stationary $(\delta \neq 0)$. The KPSS can be viewed as a special case of a random coefficient model with r_t as the coefficient, such that testing $\sigma_\xi^2 = 0$ is equivalent to testing the null hypothesis of a constant coefficient against a random coefficient.

The appropriate La Grange test works out to be

$$LM = T^{-1} \sum_{t=1}^{T} S_t^2 \Big/ S^2(l) \tag{13}$$

where

$$S_t^2 = \sum_{t=1}^{T} \varepsilon_t^2, t = 1, 2, \ldots, T \tag{14}$$

and ε_t are the residuals from Equation 11. $S^2(l)$ is the serial correlation and heteroscedasticity consistent variance given by

$$S^2(l) = T^{-1} \sum_{t=1}^{T} \varepsilon_t^2 + 2T^{-1} w(s,l) \sum \varepsilon_t \varepsilon_{t-s} \tag{15}$$

$w\,(S,l)$ are weights corresponding to the choice of the spectral window.[11]

The results of the stationarity tests, which are reported in Table 3, all point to the same conclusion. Both unit root tests are unable to reject the single unit root null while the test for stationarity rejects the null of stationarity in favour of the single unit root alternative. Taken together, the results of the ADF and KPSS tests suggest that all series are integrated of order 1 or I(1) (i.e., all series are stationary after first differencing, but are not stationary in levels).

Table 3: Stationarity tests of the principal series

Variable	ADF	KPSS-LM
r	-1.73*	0.56*
y	-1.25*	0.60*
p	-0.95*	0.74*
i	-1.37*	0.94*
d	-2.11*	0.86*
Δr	-5.92	0.10
Δy	-5.03	0.06
Δp	-4.28	0.08
Δi	-3.79	0.12
Δd	-4.54	0.09

Notes:

1. The auto-regressions are estimated with a time trend.
2. The ADF tests for H_0 x_t is $I(l)$ against H_1 x_t is $I(O)$, while the KPSS tests the reverse.
3. The optimal lag for conducting the ADF was selected based on the Schwartz, Akaike Information Criterion and the auto-correlation function of the series. The optimal lag length in most cases was 4. For the KPSS we use the $I(8)$, which sets $l = int(8(T/100)^{1/4})$.
4. The 5% critical values of the ADF and KPSS are -3.50 and 0.146, respectively. The * indicates significance at the 5% level of significance.

Given the evidence of a single unit root in the variables, we use cointegration analysis to investigate the long-run relationship among international reserves, real income, prices,

interest rates and domestic credit using the Johansen (1988)/Johansen and Juselius (1990) procedure. The procedure is based on a maximum likelihood estimation of the error-correction model (ECM):

$$\Delta x_t = \mu + \Gamma_1 \Delta x_{t-1} + \Gamma_2 \Delta x_{t-2} \ldots \ldots + \Gamma_{k-1} \Delta x_{t-k+1} + \pi x_{t-1} + \varepsilon_t \tag{16}$$

where x_t is an (n x 1) vector of I(1) variables, μ an n-dimensional vector of parameters, $\Gamma_1, \ldots, \Gamma_{k+1}$, π are (n x n) matrixes of parameters and ε_t is an (n x 1) vector of white noise errors. The matrix π contains long-run information in the system and is analogous to the Engle-Granger error-correction term (Engle and Granger, 1987). The number of cointegrating vectors (r) is determined by the rank of this matrix and is decomposed into $\pi = \alpha\beta^1$, where the columns of α are known as loading factors since they load the cointegrating vectors into various equations of the system and the rows of β^1 are the cointegrating vectors. The Johansen-Juselius procedure employs two test statistics, the trace and maximum eigenvalue, which are applied sequentially to determine the exact number of cointegrating vectors in the system.[12]

Our choice of the Johansen-Juselius procedure among the available number of estimators to estimate the cointegrating vectors deserves an explanation. The most commonly used procedure is Engle and Granger's (1987) static regression involving the levels of the variables. The problem with this procedure is that the OLS estimators are inefficient and can lead to contradictory results if there are more than two $I(1)$ variables under consideration. Moreover, the Johansen-Jeselius procedure provides a way of testing the number of cointegrating vectors.

VI. Empirical results

Estimates of the cointegrating vector

To test the number of cointegrating vectors r, the Johansen (1988) maximum eigenvalue and trace tests are applied. The results, reported in Table 4, show that the null hypothesis of one cointegrating vector r = 1, is accepted at the 5% level.[13] Normalizing with respect to international reserves, the estimated cointegrating vector is:

$$r_t = 2.3473y_t + 0.97158p_t - 1.3458i_t - 1.2052d_t \tag{17}$$

Since there is only one cointegrating vector, the coefficient of a variable in the cointegrating vector has the natural interpretation as the long-run effect of the variable in question on the normalizing variable in Equation 17. The estimated coefficients in Equation 17 have the expected signs and sensible magnitudes on the basis of the monetary approach to balance of payments theory. This approach predicts that an increase in domestic credit will cause an opposite and equal change in international reserves; under the assumption of price homogeneity in the money demand relationship, there is a one-to-one relationship between international reserves and prices. These propositions and the significance of the other variables are formally tested using long-run restrictions on these variables and long-run exclusion restrictions on real income and interest rates in the cointegrating vector; the results of which are presented in Table 5. It is evident from Table 5 that the estimated χ^2 test statistics accept the predictions of the monetary approach to balance of payments, especially about the effects of domestic credit on the balance of payments. The interpretation is that increases in real income and the price level increase reserves, while increases in interest rates and domestic credit decrease reserves.

Short-run dynamics: The error-correction model (ECM)

The cointegration of the previous section pertains to long-run relationships among non-stationary variables. However, a particular long-run relationship may be compatible

Table 4: Johansen test for the number of cointegrating vectors: r[a]

	The cointegrating vector is (r, y, p, i, d)			
H_0	λ_{tr} -statistic	λ_{tr} (0.95)	λ_{max} -statistic	λ_{max} (0.95)
$r = 0$	94.5418*	68.5240	60.3639*	33.4640
$r \leq 1$	42.8179	47.2100	22.1430	27.0605
$r \leq 2$	19.0348	29.6800	11.7564	20.9600
$r \leq 3$	7.2784	15.4100	6.4093	14.6895
$r \leq 4$	0.8691	3.7620	0.8612	3.7620

[a] These results are based on the lag structure of four.
* denotes significant at the 5% level.

with many short-run adjustment processes. Given the strong evidence that reserves, real income, the price level, interest rates and domestic credit are cointegrated, we present the short-run dynamics of the system where the movements in all the variables are considered explicitly. We use the conventional ECM, which takes into account the cointegrating relation among the I(1) variables explicitly. The system is estimated with data-consistent restrictions on the cointegrating vector.[14]

Table 5: Test of long-run restrictions in the cointegrating vector[b]

Null (H_0)	Test statistic (χ_c^2)	Distribution of $\chi_c^2 \mid H_0$	95% Value
$\beta_1 = 1$ & $\beta_5 = -1$	1.50	$\chi^2(2)$	5.99
$\beta_1 = \beta_3 = 1$	2.23	$\chi^2(2)$	5.99
$\beta_2 = 0$	8.29*	$\chi^2(1)$	3.84
$\beta_4 = 0$	6.79*	$\chi^2(1)$	3.84

[b] The cointegrating vector is $\beta_1 r_t + \beta_2 p_t + \beta_3 r_t + \beta_4 i_t + \beta_5 d_t$.
* denotes significant at the 5% level

The results of the most parsimonious short-run dynamic reserve flow equation are reported in Table 6. The results show that an error-correction approach is an adequate representation of reserve flow in Zimbabwe. None of the reported diagnostic tests reported are significant at the 95% critical value (except the F-test that all slopes coefficients are zero), and therefore there is nothing to suggest that the short-run dynamic reserve equation is mis-specified. The adjusted R^2 is 0.78. This is normal for regressions based on first differences. The coefficient of the error-correction term is negative and statistically significant at the 5% level of significance, providing a more powerful support for cointegration.[15] The error-correction term is statistically significant and has the expected negative sign. The coefficient gives a measure of the average at which reserve flows adjust to changes in

equilibrium conditions. The absolute value of the error-correction term indicates that about 57% adjustment of reserves occurs in one quarter. The coefficients of real income, the price level, interest rates and domestic credit in the ECM show how the speed of adjustment may differ depending on the source of the shock. In the ECM, the domestic credit effect is larger than all coefficients, indicating a faster response of reserve flows to domestic credit changes than to other changes.

Finally, the short-run dynamic reserve equation is further evaluated for its structural stability using the one-step Chow test for all coefficients and one-step-ahead residuals. The recursive one-step-ahead Chow test of all coefficients and one-step residuals appear remarkably constant over the sample period, thus implying that the short-run dynamic reserve equation does not show parameter instability.[16]

Table 6: Regression results for the error-correction models of the reserve flow equation

$$\Delta r_t = 6.0274 + 0.2567\Delta r_{t-1} - 0.6240\Delta y_t + 0.5612\Delta p_t - 0.4671\Delta i_t - 0.8089\Delta d_t - 0.54684\,\hat{\varepsilon}_{t-1}$$
$$(2.7251)\quad(3.0653)\qquad(4.1867)\qquad(5.4865)\qquad(3.9679)\qquad(6.3144)\qquad(5.6080)$$

$R^2 = 0.78$ F[7,39] = 16.9735 DW = 2.03 LM F[4,44] = 1.22 LM ARCH F[4,41] = 0.34
RESET F[1,47] = 0.42 NORMALITY ^{2}[2] = 1.70 Schwarz Criteria SC = -6.6407

Notes:

1. Figures in parentheses are absolute t-statistics.
2. The F statistic is against the null that all coefficients = O. The DW is the Durbin-Watson for first order serial correlation (which is strictly not valid in these models with a lagged dependent variable). The lagged error-correction term is statistically significant at the 5% level of significance and has the expected negative signs.
3. LM is the Lagrange multiplier in general test of residual serial correlation, LM ARCH is the Lagrange Multiplier test for Autoregressive Heteroscedasticity, RESET is the Ramsey's RESET test for functional mis-specification, NORMALITY is the Jarque-Bera test for skewness and excess kurtosis of the residuals, and SC is the Schwarz Criteria. A fall in the latter in the general-to-specific modelling is an indication of model parsimony.
4. The heteroscedastic consistent standard errors (HCSE) not reported here were not statistically different from the conventional standard errors.
5. The unit root t- statistic for the null of no cointegration with 4 regressors at the 5% significance level is -4.05 (Banerjee, Dolado and Mestre, 1992).

VII. Conclusions

IMF structural adjustment programmes include a requirement for restrictive monetary and fiscal policies, namely control of domestic credit creation and reduction of budget deficits. Typically, the reason for urging this requirement is to redress balance of payments deficits. A method used in the literature to assess this recommendation is to test the monetary approach to balance of payments. This entails estimating a reserve flow equation and testing if the estimated partial coefficient of changes in domestic credit with respect to reserve changes is not significantly different from minus one. If the condition is satisfied, the inference is that the money plays a role in the determination of balance of payments deficits.

Using this approach, we estimate a reserve flow equation through the medium of cointegration and error-correction modelling using quarterly Zimbabwean data over the period 1980 to 1991. The main empirical results can be summarized as:

1. The unit root tests (ADF and KPSS) are unable to reject the null hypothesis of a single unit root in all the five variables: reserves, real income, the price level, interest rates and domestic credit.
2. Cointegration analysis indicates that reserves, real income, price level, interest rates and domestic credit are cointegrated.
3. The long-run restriction test indicates that there is a one-to-one negative relationship between domestic credit and flow of international reserves.
4. The estimated short-run dynamic reserve equation does not show parameter instability.

Taken together, the empirical results suggest that the monetary approach to Zimbabwe's balance of payments is indeed applicable. The empirical results confirm that money has played a significant role in the determination of deficits in the balance of payments.

The policy conclusions are clear. Given the stability of the demand for money in Zimbabwe, balance of payments disequilibriums can be corrected by appropriate financial programming and monetary targeting (see Kwashirai, 1993). The conventional policy measures, such as devaluation, import compression and export subsidization, can only succeed when domestic credit creation is consistent with the difference between the project demand for money and the targeted international reserve level.

Notes

1. The Government of Zimbabwe embarked on a phased trade liberalization and structural adjustment programme with effect from 1 October 1990.

2. The public sector deficit in the period 1980-1991 was, on average, equivalent to about 10% of GDP and this led to public debt reaching 79% of GDP by 1989; 36% of which was external debt. Government investment accounted for more than one-half of total investment and central government expenditures accounted for nearly one-half of GDP. However, most of the investment has been channelled into social infrastructure and some highly capital-intensive activities, such as public utilities.

3. Although currency devaluation is frequently recommended by the IMF as a standard stabilization policy, it is fraught with controversy (see for instance, Cooper, 1971; Nashashibi, 1983; Krugman and Taylor, 1978; and Barbone and Rivera-Batiz, 1987).

4. The law of one price (one of the central propositions of the monetary approach) does not hold in this case.

5. This must be true for the sum of elasticities of demand to be greater than unity.

6. This argument of low elasticities is termed the "elasticity pessimism".

7. By expanding domestic income, a devaluation will lead to increased imports.

8. This is in sharp contrast to the elasticity and absorption approaches, which either concentrate on the current account or rely on partial equilibrium analysis.

9. Another fundamental proposition of the monetary approach is that the balance of payments deficit is caused by, and is equivalent to, the excess supply of money in the economy.

10. All series are seasonally adjusted.

11. KPSS recommend the use of a Bartlett window, $w(s,l)=1 - s/(l+1)$. The power of

the test obviously depends on the choice of the lag truncation. KPSS suggest $l(8)$ = $int(8(T/100)^{1/4})$.

12. The null hypothesis of the trace statistic is that there are r or fewer cointegrating vectors, where $r = 0, 1, 2, 3, 4$. Here the null hypothesis of $r \le 0$ is tested against the general hypothesis $r \le 1$, $r \le 2$ and so on. The maximum eigenvalue tests the null $r = 0$ against the specific hypothesis of $r = 1$, $r = 2$ and so on. Johansen and Juselius (1990) recommend the use of both tests because the power of the trace test is lower than the maximum eigenvalue test.

13. However, the empirical results are sensitive to deviations from the Gaussian error assumption. The normality and iid properties of the residuals are tested with Jarque-Bera test (J-B test) and Ljung-Box Q-test, respectively. Using the two tests, the residuals with the most desirable properties are those generated by two lags on each of the variables, that is in (1.15) $k = 2$.

14. The general over-parameterized short-run dynamic reserve flow equation can be written as:

$$\Delta r_t = \beta_0 + \sum_{i=1}^{p} \beta_{1i} \Delta r_{t-i} + \sum_{i=0}^{p} \beta_{2i} \Delta y_{t=i} + \sum_{i=0}^{p} \beta_{3i} \Delta p_{t-i} +$$
$$\sum_{i=0}^{p} \beta_{4i} \Delta i_{t-i} \sum_{i=0}^{p} \beta_{5i} \Delta d_{t-1} + \beta_5 \hat{\varepsilon}_{t-1} + \mu_t$$

where p is the number of lags included and $\hat{\varepsilon}$ are the residuals of the restricted cointegrating vector (the error-correction term). Starting with three lagged differences of each variable this over-parameterized ECM is tested via the general specific modelling to arrive at the most "parsimonious" dynamic reserve flow equation using the standard t and F test statistics against information from each lagged period.

15. Kremers, Ericsson, and Dolado (1992) and Banerjee, Dolado and Mestre (1992) show that this is a more powerful test for cointegration because no common factor restrictions are imposed as in the ADF test. The distribution of the t-statistic for the ECM is not standard. The 5% critical values with 4 regressors of -4,05 with four regressors and a constant given by Banerjee, Dolado and Mestre (1992) rejects the null of no cointegration.

16. Ericsson (1991) points out that a more powerful test for exogeneity is parameter constancy.

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