An Investigation of Policy Implications of a Polak Model on Botswana's monetary and Balance of payment system

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Introduction

When Botswana first got its independence in 1966, it found itself entangled in a number of complications. Not only was it a member of the South African dominated Southern African Customs Union Agreement (SACUA) but it was also a member of the Rand Monetary Area (RMA). Membership into these two organisations had great implications for the extent to which the new administrators, from whom so much was expected, could use economic tools to direct and control the development of the economy.

Membership into the RMA denied Botswana the use of monetary tools as it meant that Botswana could not have a completely independent monetary authority of its own. For almost ten years after independence, Botswana had to depend on monetary policies that were independently taken by South African authorities.

In 1976 Botswana broke away from the RMA and formed its own monetary authority which came to be known as the Bank of Botswana (BOB). The extent to which Botswana suffered from its membership in the RMA is clearly reflected in the following reasons that were given for breaking away from the RMA:

(1) The ability to choose our own domestic interest rate pattern instead of having rates largely determined by the Johannesburg Money Market.

(2) The ability to manage Botswana's foreign exchange reserves instead of having South African Reserve Bank to do it for us.

(3) The ability to retain Botswana's savings for investment in Botswana, instead of routinely lending them to South Africa as a contribution to financing South Africa's development.

(4) The ability to set our own exchange control regulations, instead of having the South African Reserve Bank to do it for us.

(5) The ability of the Government of Botswana to place its funds with its own bank, instead of continuing to bank at one of the two Commercial Banks.[1]

The establishment of the BOB in 1976 was therefore viewed as a means by which monetary tools could be used to steer the economy into the direction which favourable BOP position and economic growth could be achieved.

Membership into SACUA meant free movements of goods from the relatively much more industrialised South Africa into Botswana. That, coupled with the neglect of the Agricultural Sector, resulted in an economy which was not only to remain with a weak industrial base but an economy so highly dependent on imported food. It is clear from Table 1 that the ratios of imports to GDP are very high and they are in fact among the highest in Africa. This Table further indicates that a significant proportion of the imports are food stuffs.

Although the Botswana economy has managed to maintain a healthy BOP position since 1976, the trade account reveals that imports have always been more than exports. This implies that the capital account has played a major role in maintaining this healthy BOP position. If imports are going to continue exceeding exports, a downturn in the capital movements might lead to disastrous consequences for the BOP position.

Notwithstanding the fact that Botswana is highly dependent on imports, Table 1 also shows that the ratio of exports to GDP is very high too. This is a major result of the rapid expansion of the Mining Sector. Table 1, therefore unambiguously shows that Botswana is a highly open economy and it is therefore bound to be vulnerable to international economic instabilities. This therefore, calls for a carefully managed monetary and credit system.

TABLE 1

Botswana Trade Flows and Import/GDP and Export GDP Ratios 1973-1981 in Thousand Pulas

Year	Imports	Exports	Trade Balance	Food % of Imports	Import as % of GDP	Export as % of GDP
1973	114 963	59,200	-55,763	15.8	65.9	41.32
1974	125,418	81,990	-43,428	16.9	70.79	44.99
1975	159,288	105,040	-54,248	18.2	69.50	50.11
1976	181,385	153,172	-28,213	19.6	67.25	50.00
1977	239,605	156,653	-82,952	18.2	73.20	45.48
1978	307,090	192,676	-114,414	18.3	70.59	54.69
1979	438,289	367,253	-71,036	16.9	64.72	51.90
1980	537,592	391,235	-146,357	15.7	71.92	51.01
1981	690,308	356,302	-334,006	14.0	N/A	N/A

Source: Derived from Republic of Botswana.
Statistical Bulletin: March 1982. Central Statistics Office.

Aims and Objectives

In the light of the bold step that was taken by the Government of Botswana by pulling out of the RMA in order to enable itself to acquire the power to use monetary tools to guide, restrict or cajole the economy, this paper seeks to investigate among other things the following:

a. whether since the establishment of BOB (1976) monetary related variables such as exports, capital movements and changes in net domestic credit have had any impact on BOP positions and economic growth. If they have, what are the policy implications of these effects, and for those which seem not to have had any impact, what explanation can be given for this? The impact of these variables on economic growth will be traced through the GDP function and the import function will be used to trace these variables' effect on BOP positions.

b. Parameters estimated in the above functions will be used to determine the levels of strategic policy variables such as changes in domestic credit and money supply that would have been compatible with BOP equilibrium will be determined and policy implications of these results will be examined and analysed.

Analytical Framework and Methodology

This paper draws greatly from a model that was developed by J.J. Polak. This model was further developed and improved by him and L. Boissonneault and some of their IMF colleagues.[1] That model uses changes in domestic credit and elements of BOP and monetary variables to analyse changes in GDP and Imports.

The model is based on the following assumptions which this Paper presumes are likely to hold in the Botswana situation. It assumes a constant demand for money function which, in the classical Quantity Theory of money, would imply a constant velocity of circulation of money. In a developing country like Botswana, where the market for financial assets is highly underdeveloped, the demand for money is mainly for use as a store of value and transactionary purposes. It is therefore likely to remain constant as the interest rate does not play any significant role in influencing the amount of money people would like to hold.

The model further assumes that capital movements, exports and domestic credit are exogenous to the economy. Capital movements are assumed exogenous mainly because of the weak role played by the interest rate in the financial market. Domestic credit is assumed to be a policy variable which can be used by that Government through its control over Commercial Banks.

An Outline of the Model

The model is based on the following seven economic variables: Gross Domestic Product (Y), Imports (M), the Stock of Money (MO), Change in Net Foreign Assets (CNFA), Chance in NET Domestic Credit (CNDC), Exports (X) and Capital Movements (CM). The first four variables (Y, M, MO, CNFA) are assumed endogenous to the model. The last three (X, CM, CNDC) are exogenous. The relation between seven variables can be summarised by the following four equations:

$$M_t = mY_t \quad 0 < m < 1 \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$Y_t = \frac{1}{k} MO_t, \quad 0 < k < 1 \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

$$MO_t = MO_{t-1} + CNFA + CNDC \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

$$CNFA_t = X_t + CM_t - M_t \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Equations (1) and (2) show a casual relationship between Imports and GDP, and GDP and Money Supply respectively. The last two are definitional or identities.

It is clear from the above that there is some simultaneity involved in the two causal equitations as both use endogenous variables as explanatory variables. In Equation (1), while imports depend on GDP, GDP also depends on Imports. It is but a fact that the rapid economic growth that took place in Botswana during the period under study, was to a great extent dependent on imported machinery which played a major role in mining and infrastructural development. Another, but unusual way, GDP in Botswana depends on imports is through the SACUA revenues. Botswana's SACUA revenues come from a common pool of the Customs Union and depend on the ratio of her imports to those of the Common Customs areas as a whole. Botswana receives a first instalment of the revenue which has been accrued in a given year, in the same year. The second instalment comes two years later. But since the second instalment includes adjustment for under-forecasting of the first instalment, marginal increases in imports are only reflected in marginal increases in revenue two years later.

In the second equation there exists some simultaneity between GDP and Money Supply. Money Supply influences GDP through the role it plays in a country's Production Function[3] and its influence on Aggregate Demand. On the other hand, the rate at which the GDP is growing dictates some changes in money supply.

Equations (3) and (4) mainly show that money creation is equal to changes in net foreign assets plus changes in net domestic credit ($\Delta MO = CNFA + CNDC$ . . . . . (5)). Substituting Equation (4) into (3) shows that $MO = MO_{t-1} + X_t + CM_t - M_t + CNDC_t$ . . . . . (6). It follows from this that $\Delta MO_t = X_t + CM_t - M_t + CNDC_t$. . . . . (7). This equation clearly shows that imports are a drain to money creation through the term $- M_t$.[4] This further implies that imports are a drain on GDP via their impact on MO_t. This can be demonstrated by successive substitution of Equation (7) into (3) and then into (2) which yields $y_t = \frac{1}{k}(MO_{t-1} + X_t + CM_t - M_t + CNDC_t)$./. . . . . (8). Since M_t is exogenous to the model and it appears on the right hand side as an explanatory variable, a reduced form of Equation (8) yields the following resutls, $y_t = \pi_1 A_t + \pi_2 MO_{t-1} + U_t$ . . . . . (9) where A_t is the sum of all exogenous variables (X_t, CM_t and $CNDC_t$). This reduced form helps avoid unbiased and inconsistent estimates. The impact of all exogenous variables on Y_t can therefore be traced through Equation (9).

Successive substitution of Equation (4) into (3), then into (2) and finally into Equation (1) yields the following reduced form for imports; $M_t = \pi_3 A_t + \pi_4 M_{t-1} + U_t$ . . . . . (10) where π_3 and π_4 are import impact multipliers. This equation can therefore be used to trace the impact of the exogenous variables on imports.

This Paper seeks to use Equation (9) and (10) to investigate the magnitudes of the impacts and the direction of the causality of the exogenous variables on GDP and Imports by using the regression analysis. This approach is a major departure from the traditional practices of either first obtaining the annual values of m and k by direct division of Imports values by corresponding values of GDP and money supply by corresponding GDP on MO and M_t on y_t to get m and k respectively. These values of m and k are then fed into a standard formula to get the estimated values of Imports and GDP.[5]

Taking a regression of the reduced form has the following advantages over the traditional method:

a. It avoids getting biased and inconsistent resutls which may result from regressing endogenous variables on other endogenous variables.

b. It gives leverage to trace in a much detailed manner the causality that exists between the three exogenous variables (X_t, CM_t $CNDC_t$) and GDP and Imports. This can be done by breaking down Equation (9) into: $Y_t = B_O + B_1 X_t + B_2 CM_t + B_3 CNDC_t + B_4 MO_{t-1} + U_t$ . . . . . (11). Equation (10) can be broken down into $M_t = A_O + A_1 X_t + A_2 CM_t + A_3 CNDC_t + A_4 M_{t-1} + U_t$ . . . . . (12).

c. This approach is more flexible in that new variables can always be added to the analysis whenever it is felt that the model omits some other important variables.

Statement of Hypothesis

Equation (10) implies a linear relationship between M_t and A_t and M_{t-1}. Since A_t contains two major variables (X_t and CM_t) which are not only sources of foreign exchange but also important sources of demand, it is expected that π_3 will be positive and significant. The import dependency of the Botswana economy is expected to give a very high coefficient for A_t. Since Botswana did not have any foreign exchange and import restrictions during the period under study, it is also expected that $CNDC_t$ had a positive and a strong impact on imports since it was also a source of demand for imports. That is mainly due to the fact that Botswana has to import both consumer and producers goods.

π_4 in Equation (10) is difficult to preduct because M_{t-1} has two opposing effects in the Botswana case. As mentioned before, M_t is a drain on money creation, therefore, through its impact on MO_{t-1}, M_{t-1} will have a negative impact on M_t. But as has already been discussed above, Botswana relies on SACUA revenues which are based on her level of imports. It is probable that past levels of imports, through the first SACUA instalment, will influence their future levels through both Income and Foreign exchange effects. It is expected therefore, that M_{t-1} might have a positive impact on M_t. As to which of these two effects is stronger it is difficult to tell a priori. But since the monetary effect is not that automatic, as monetary authorities can always sterilize it, it is expected that SACUA revenues will have a stronger effect and therefore π_4 will be positive.

Regarding Equation (9) $y_t = \pi_1 A_t + \pi_2 MO_t + U_t$ it is expected that the combined effect of the exogenous variables (X_t, CM_t $CNDC_t$) will be positive and significant. Capital movements have been in form of real investment in large projects such as the Shashe project, the diamond mines, roads and some other infrastructural related constructions. In this respect capital movements contributed to real output. The three exogenous variables are also a source of demand as pointed out before and they are therefore bound to have a positive impact on GDP. Since Botswana experienced an export boom during the period under study (due to increases in beef and diamond prices), it is expected that they contributed to GDP growth. This export boom was channelled to increases in demand through salary increases and direct earnings to those households that own cattle.

The Polak Model in its reduced form, implies that the exogenous variables ($CNDC_t$, X_t and CM_t) have identical effects on M_t or Y_t. This Paper rejects this and predicts that, since exports operate mainly through monetary and aggregate demand effects, and $CNDC_t$ operates mainly through aggregate demand effects and to a limited extent through monetary effect but with no foreign exchange effects, the two are not likely to have equal or identical effects on either imports or GDP. Similarly, CM_t have their effects through foreign exchange earnings and real output effects but with limited monetary effects. It is unlikely therefore, that CM_t will have identical effects as those of $CNDC_t$ and X. Equations (11) and (12) will be used to test this hypothesis.

Sources of Data and Definition of Variables

With the exception of GDP data, all data used for estimation purposes in this Paper are from the International Financial Statistics (IFS). The GDP data were obtained from the Botswana Statistical Bulletin in annual form and own method based on some indices were used to break it down into quarterly figures. The method used will be explained in later sections of this Paper.

Variables used are defined as follows:

Net Foreign Assets (NFA) - These represent foreign assets of the banking system. They are composed of bank deposits due to foreign banks less deposits held by foreign banks plus reserves.

Net Domestic Credit (NDC) - These include domestic credit offered by the banking system. Government credit to parastatal organisations is not included.

Capital Movements (CM) - This covers all the items of the balance of payments that are not classified as imports, exports or reserves. The following formula was therefore used in this Paper to derive these figures, $CM_t = M_t - X_t + CNFA_t$

Money Supply (MO) - Includes demand deposits plus currency in the hand of the public. Quasi money is only included in MO_2.

Gross Domestic Product (GDP - These are National Accounts figures given at market prices.

As already indicated above, the GDP figures were not available in quarterly form and so the following method was used to interpolate for the quarterly figures. GDP annual figures by sector were obtained for each year and sectorial indices based on sectorial quarterly data were derived and used to break these annual figures. These sectorial interpolations were then added up to give total GDP quarterly interpolations. The indices were derived as follows:

The Mining Sector Index - Monthly mining output data was used to construct the quarterly weights.

The Manufacturing Sector - Since the Botswana Meat Commission contributes more than 90% to manufacturing, its monthly output data was used to construct quarterly weights for this sector.

Construction - Due to the unavailability of any data on that sector's quarterly production, monthly figures for equipment and machinery imports were used to construct the index.

Electricity and Water - Monthly figures used.

Wholesale and Retail - Equipment and machinery figures were deducted from the total quarterly import figures and the results were used to construct the index. Given the fact that almost all goods sold by wholesale are imported, this method was not a bad way for estimating quarterly contribution of this sector to GDP. For the Agricultural Sector, Government Sector and Financial Sector, no quarterly data were available. It was therefore assumed that these sectors' contribution to GDP was in a linear trend and this trend was used to interpolate for these sectors.

Econometric Estimations and Interpretation of Results

Times series data, such as those used in this Paper, are normally subject to serial correlation. Serial correlation understates the standard errors of the regression coefficients resulting in the inflation of the t-statistics. This might result in the over optimistic conclusion that the explanatory variables have a significant effect on the dependent variable while in actual fact they do not. Investigations using the Durban H test revealed that all regression results in this Paper suffered from serial correlation and so the Cochrane-Orcutt Iterative Technique was used to correct for this.

a. The Import Function

The first step in the estimation of the import function was to estimate the import aggregated functions and the results were as follows:

i. The Aggregated Import Function in Nominal Terms

M_t =	0.10	+ $0.304A_t$	+ $0.703M_{t-1}$	+ e_t
Std. Errors	(2.41)	(0.0709)	(0.083)	
t-Stat.	(0.046)	(4.292)	(8.497)	
R^2 = 0.978	DW Stat. =	2.58	Df = 15	

ii. The Aggregated Import Function in Real Terms

In order to take into account inflationary effects on the model, real values for M_t and A_t and M_{t-1} were used and the results were as follows:

RM_t =	0.006	+ $0.455RA_t$ +	$0.526RM_{t-1}$
Std. Error	(4.281)	(0.078)	(0.106)
t-Stat	(0.002)	(5.682)	(4.962)
R^2 = 0.918	DW Stat. =	2.5	Df = 16

The estimation of Equation (19) both in nominal and real terms reveals a strong and positive relation between imports and aggregated term A_t. This supports the hypothesis that an increase (decrease) in any of the exogenous variables will lead

to an increase (decrease) in imports. Since Equation (10) is in reduced form, the A_t regression coefficient of 0.304 implies that an increase in A_t by P1.00 will lead to an increase in imports by P0.304: it is an import impact multiplier. The results show that the impact multiplier in the real terms case is larger than in the nominal terms case.

The M_{t-1} regression coefficient is also positive and statistically significant at the 5% level. As explained above, this coefficient is expected to be negative due to the impact of imports on money supply. It has also been explained, however, that the accrual of SACUA revenues in a lagged form is likely to make this coefficient positive.

The second step in the estimation of the import function was to disaggregate the above function and regress X_t, CM_t, $CNDC_t$ individually in order to capture the individual impacts of these variables on imports. As in the above case, the regressions were run both in nominal terms and real terms and the results were as follows:

a. In Nominal Terms

M_t =	0.176 +	0.330X_t +	0.274CM_t +	0.270$CNDC_t$ +	.636M_{t-1} + e_t
Std. Error	(2.661)	(0.09)	(0.01)	(0.143)	(0.09)
t-Stat.	(0.066)	(3.669)	(2.766)	(1.882)	(7.701)

R^2 = 0.970 DW Stat. = 2.500 Df = 14

b. In Real Terms

RM_t	0.246	0.507RX_t	0.329RCM_t +	0.401$RCNDC_t$ +	0.522RM_{t-1} + e_t
Std. Error	(3.907)	(0.095)	(0.123)	(0.167)	(0.105)
t-Stat.	(0.063)	(5.325)	(2.678)	(2.402)	(4.965)

R^2 = 0.929 DW Stat. = 1.995 Df = 15

As expected, in both cases, the results show that exports, capital movements and domestic credit are all positively related to imports. They are all statistically significant in the real terms function, and $CNDC_t$ is not significant in the nominal terms function. The results further show that, of the three exogenous variables, exports have the strongest impact on imports. That is not surprising as the Botswana mining sector, which is exclusively an export sector, is a major contributor to GDP.

The disparity in the impacts of exports, capital movements and domestic credit on imports clearly proves that the assertion by Victor Argy and Polak that X_t, CM_t and $CNDC_t$ have identical effects on imports is not supported by data. The effect is identical only in terms of the direction of the causality and not in terms of the magnitude of the causality.

The reason why $CNDC_t$ is not statistically significant in the nominal terms regression is not difficult to determine in Botswana's case. Unlike in most countries where both parastatals in Botswana do not get their credit from banks but from the Government through the Public Debt Service Fund. Furthermore, at least during the period under study, instead of borrowing from the Commercial Banks, the Government actually lent to Commercial Banks. It follows from this that the $CNDC_t$ data do not represent the total credit taking place in the economy. It is, therefore, bound to reveal a weak impact of $CNDC_t$ on imports.

It is also possible however, that in a multiple regression like this one, the explanatory variables might be highly correlated with each other. It is possible for example that, through their impact on the money supply, exports may be highly correlated to domestic credit. This may lead to multi-collinearitv which would inflate the standard errors of the regression coefficients resulting in low t-values. This further leads to the conclusion that some of the explanatory variables have no significant impact on the dependent variable while in actuality they do.[6] In view of the likelihood of the existence of multi-collinearity in the model, some tests using the correlation coefficient matrix and the Glauber-Farrer method were made and the results are shown in Tables 2 and 3. The results of the tests reveal that $CNDC_t$ is not highly correlated with any of the other explanatory variables but instead that X_t and M_{t-1} are highly correlated. It is clear from these tests that the t-values of X_t and M_{t-1} are the ones that have been understated and not that of $CNDC_t$.

TABLE 2

Summary of the Correlation Coefficients Matrix

Correlation Coefficients between	Value
X_t and CM_t	0.442
X_t and $CNDC_t$	- 0.0099
X_t and M_{t-1}	0.883
CM_t and M_{t-1}	- 0.528
CM_t and $CNDC_t$	- 0.351
$CNDC_t$ and M_{t-1}	0.158

TABLE 3

The Glauber-Farrer Test

Regression of	F-Value	R^2	Conclusion
X_t on CM_t, $CNDC_t$, M_{t-1}	22.33	0.78	Reject Ho.
CM_i on X_t, $CNDC_t$, M_{t-1}	5.275	0.416	Reject Ho.
$CNDC_t$ on X_t, CM_t, M_{t-1}	3.44	0.28	Accept Ho.
M_{t-1} on X_t, CM_t, $CNDC_t$	31.336	0.834	Reject Ho.

Ho: There is no multicollinearity

The high correlation between X_t and M_{t-1} (0.88) can be explained by a close examination of Equation (6): $MO_t = MO_{t-1} + X_t + CM_t - M_t + CNDC_t$. This equation clearly shows that autonomous changes in imports will lead to changes in MO_t. From this we can speculate that a fall in MO_t resulting from an increase in M_t may lead to a decline in aggregate demand. The decline in aggregate demand may lead to a decrease in the domestic consumption of traded goods which may finally lead to future increases in exports. In this way, past changes in imports will affect future levels of exports and therefore result in a high correlation coefficient between X_t and M_{t-1}. The only commodity that qualifies for this explanation in Botswana is beef as it is the only major export which is also consumed domestically.

The third step in the estimation of the import function was to determine elasticities of imports with respect to exports, capital movements and changes in domestic credit. This was done by taking natural logs of all these variables and regressing the results accordingly. This approach has a slight advantage over the previous approach in that instead of giving import impact multipliers, it gives import elasticities which may be more useful in policy analysis. The results of the regression were as follows:

i. $LnM_t = 0.238\ lnX_t + 0.094\ lnCM_t + 0.016\ lnCNDC_t + 0.717\ lnM_{t-1} + e_t$

Std. Error	(0.079)	(0.029)	(0.019)	(0.079)
T-Stat.	(3.02)	(3.208)	(0.87)	(9.12)

$R^2 = 0.972$ DW Stat. = 1.75 Df = 16

As in the former case, the signs of the regression coefficients are as expected and all variables except $CNDC_t$ are significant. It is even clearer in this case that imports respond more to changes in exports than to changes in any of the other explanatory variables. The results indicate that while a 1% change in exports leads to a 0.24% change in imports a 1% change in capital movements leads only to a 0.09% change in imports. Implied in these results is that economic policies directed towards changing exports will be more useful for stabilisation purposes than those directed towards attracting foreign capital and changing domestic credit.

b. The GDP Function

Similar steps to those taken in the estimation of the import function were taken in estimating the GDP function. However, in order to take into account the proportionality that exists between GDP and MO as portraved in Equation (2) ($Y = \frac{1}{k} MO_t$), all the regressions were done through the origin. The results are as follows:

i. aa. The Aggregated Income Function in Nominal Terms

$Y =$	$0.35A_t$ +	$1.503MO_{t-1}$ +	e_t
Std. Error	(0.154)	(0.2244)	
	(2.30)	(6.164)	

$R^2 = 0.938$ DW Stat. = 2.132 Df = 16

bb. The Aggregated Income Function in Real Terms

$RY =$	$0.417RA_t$ +	$1.59RMO_{t-1}$ +	e_t
Std. Error	(0.140)	(0.257)	
t-Stat.	(2.97)	(4.511)	

$R^2 = .549$ DW Stat. = 2.26 Df = 16

In both the nominal and real terms estimations, the signs are as expected and the coefficients are statistically significant. This confirms the hypothesis that exports, capital movements and changes in net domestic credit have a positive impact on GDP. The positive MO_{t-1} coefficient signifies the importance of money in the production function and how monetary policies at a given period of time can affect future changes in GDP. The Real GDP Function shows a relatively low R^2. Normally when R^2 is low and t-values are high it indicates that some important variable has been omitted. An attempt to use the two stage least squares method to include imports in the function yields some unsatisfactory results.

A comparison between the A_t coefficient in the GDP function and that of the import function reveals that changes in A_t have a stronger impact on GDP than on imports. While a P1.00 increase in A_t leads to a P0-35 increase in GDP it will lead to only a P0.30 in imports. The closeness of these two coefficients illustrates the openness and import dependency of the Botswana economy as portrayed in the introduction.

ii. aa. The Disaggregated Income Function in Nominal Terms

$Y =$	$0.557X_t$	$0.254CM_t$ +	$0.556CNDC_t$ +	$1.345MO_{t-1}$
Std. Error	(0.243)	(0.183)	(0.297)	(0.283)
t-Stat.	(2.29)	(1.393)	(1.874)	(4.755)

$R^2 = 0.946$ DW Stat. = 2.067 Df = 14

bb. The Disaggregated Income Function in Real Terms

$$RY = 0.884RX_t + 0.392RCM_t - 0.086RCNDC_t + 1.08RMO_{t-1} + e_t$$

Std. Error	(0.205)	(0.211)	(0.169)	(0.259)
t-Stat.	(4.315)	(0.186)	(-0.506)	(4.178)

$R^2 = 0.067$ DW Stat. = 2.012 Df = 14

The regression results for the nominal income function shows the expected signs except in the real income function in which the $CNDC_t$ coefficient is unexpectedly negative. However, since this coefficient is not statistically significant, we cannot conclude that the results imply that $CNDC_t$ is negatively related to GDP.

In both functions capital movements and changes in domestic credit are not statistically significant at the 5% level. As explained in the import function, domestic credit data do not represent the total credit taking place in the economy.

The insignificance of CM_t on GDP can be explained by examining the way in which the CM data were derived. These data were derived by using the formula $CM = CNFA_t + M_t - X_t$. Since $CNFA_t$ is likely to consist of import credits to the Botswana economy, it means that CM_t is also likely to consist of these. Since import credits increase imports without necessarily increasing GDP, it is therefore possible that the impact of CM_t on GDP is likely to be weak even though it is strong on imports.

An investigation for multicollinearity reveals a negative correlation between X_t and $CNDC_t$ of -0.622 and a positive correlation between CM_t and MO_{t-1} of 0.558. To the extent that parastatals do not compete for bank credit with the private sector, the main borrowers are likely to be big farmers and private companies. It is possible therefore that during periods when beef export earnings increase, big farmers' demand for credit declines and during slack periods (due to foot and mouth disease) their demand for credit increases. This might result in a negative correlation between exports and $CNDC_t$ yielding the large negative correlation coefficient of -0.622.

iii. aa. The Nominal GDP Elasticity Function

$$LnY = 0.270LnX + 0.052LnCM_t + 0.03LnCNDC_t + 0.852MO_{t-1} + e_t$$

Std. Error	(0.101)	(0.036)	(0.242)	(0.1005)
t-Stat.	(2.671)	(1.450)	(1.242)	(8.482)

$R^2 = 0.950$ DW Stat. = 1.886 Df = 14

bb. The Real GDP Elasticity Function

$$LnRY = 0.517LnRX_t + 0,013LnRCM_t + 0.010LnCNDC_t + 0.852LnMO_{t-1} + e_t$$

Std. Error	(0.104)	(0.048)	(0.027)	(0.118)
t-Stat.	(4.973)	(0.274)	(0.365)	(5.526)

$R^2 = 0.708$ DW Stat. = 2.004 Df = 14

The results of the GDP elasticity function reveal that in both cases GDP is not elastic to changes in domestic credit and capital movements. Explanations for this which were given in earlier sections still hold in these two functions. A comparison between the GDP and M_t function reveals that GDP is more elastic with regard to export changes than imports.

Since the reduced form of the Polak model is over-identified, m and k values which are needed for projection purposes could not be recovered. Therefore, the two-stage-least-squares method was used to estimate m and k and the results were:

$$M_t = -23.44 + 0.81Y_t + e_t$$

t-Stat. (-1.552) (8.01)

$R^2 = 0.727$ DW = 0.764 Df = 18

$$Y_t = -9.01 + 2.133MO_t + e_t$$

t-Stat. (0.44) (7.71)

$R^2 = 0.778$ DW Stat. = 1.10

Both results show the expected signs and a strong relationship. As expected, the propensity to import is less than 1. The propensity to import of 0.81 clearly shows how import dependent the Botswana economy is.

The GDP results show that k = 2.133 which means that as expected $\frac{1}{k}$ is less than 1 (0.468).

c. Test for the Stability of the Two Functions

The period after 1978 was characterised by major changes which are likely to have affected aggregate demand in the Botswana economy. During the period 1978/79 there was an export boom which was both a consequence of the increase in diamond prices and the increase in production. During the same period SACUA revenues increased by 50%.[7] (Budget Speech: 1979). Furthermore, as a consequence of the export boom and the political elections which were due to take place, there was a major upward revision of the salary structure in the economy. All of these factors are likely to have changed the propensity to import (m) and the velocity of circulation of money (k). Since the proportion of an increase in credit, exports and capital movements that leaks to imports and GDP is directly related to the propensity to import and the velocity of circulation of money (Polak and Argy),[8] it means that if the two functions were affected by these changes, the leakages of credit, exports and capital will be higher than those portrayed by the estimated functions. It is therefore important that the stability of the functions should be tested before their results are used for projections and policy analysis. In this regard the dummy variable test for the period 1976-1978 and 1979-1981 was made and the results were as follows:

i. Import Functions:

M_t =	-6.546 +	1.99D	+0.379A_t +	0.073DA_t +	0.737M_{t-1}
Std. Error	(6.430)	(10.047)	(0.098)	(0.105)	(0.088)
t-Stat.	(-1.01)	(0.198)	(3.3884)	(-0.686)	(8.4)

R^2 = 0.977 DW Stat. - 2.83 Df = 13

RM_t =	8.068 +	9.262D +	.462RA_t	-0.127DRA_t +	0.33M_{t-1} + e_t
t-stat.	(7.83)	(9.588)	(0.100)	(0.125)	(0.039)

R^2 = 0.935 DW Stat. 2.137 Df = 14

ii. GDP Function:

Y=	-42.189 +	77.42D +	0.728A_t	- 0.729DA_t +	1.699MO_{t-1}
Std. Error	(16.554)	(20.935)	(0.195)	(0.223)	(0.284)
t-Stat.	(-2.549)	(3.698)	(3.736)	(-3.269)	(5.985)

R^2 = 0.972 DW Stat. - 1.83 Df = 14

RY =	21.238 +	43.26D +	0.291RA_t	+ 0.287DRA_t +	0,663RMO_{t-1} + e_t
Std. Error	(16.731)	(16.076)	(0.158)	(0.216)	(0.248)
t-Stat-	(1.269)	(2.691)	(1.847)	(-1.325)	(2.679)

R^2 = 0.873 DW Stat. - 1.96 Df = 16

The insignificance of the D_t and DA_t coefficients reveal that neither the intercept or the scope of the import function was affected and so it remained stable. This implies that the propensity to import was not affected by the changes that took place during the period after 1978.

The GDP function result reveals that it was only affected in nominal terms but not in real terms. This implies that those changes after 1979 contributed more to price changes than to real production.

Policy Implications of the Results

Balance of Payment positions of open economies with undiversified export sectors, like that of Botswana, are usually vulnerable to fluctuations in capital movements and export prices. A sudden decrease in export earnings or foreign capital inflows would lead to BOP deficits which might have further adverse effects on other sectors of the economy. On the other hand, Equation (6) ($MO_t = MO_{t-1} + X_t + CM_t - M_t + CNDC_t$) shows that an increase in exports and CM_t will not only lead to increases in the BOP surplus but will also lead to increases in the money supply. Once the money supply increases in excess of its demand, this will lead to price increases or/and increases in the demand for imports. If prices increase this may result in an adverse effect on the export sector and the general production level in the economy. It is therefore important that the monetary and credit policies must be used to guard against adverse effects on both the BOP position and economic growth.

The Polak model tries to provide a framework through which disturbances in BOP and money supply due to international fluctuations can be dealt with. According to the model, domestic credit is the only policy variable out of the three exogenous variables. Export and capital movements are assumed to be difficult to affect in the short-run due to the weak role played by the interest rate and structural rigidities.

The manner in which domestic credit operates can better be understood by looking at Equation (10) ($M_t = \pi_3 A_t + \pi_4 M_{t-1}$) where $A_t = CNDC_t + X + CM_t$ . . . . . (13). Substituting Equation (13) in (10) yields $M_t = \pi_3 (X_t + CM_t + CNDC_t) + \pi_4 M_{t-1}$ . . . . . (14). By Equation (4) we know that $CNFA_t = X_t CM_t - M_t$ and that at BOP equilibrium $CNFA_t = 0$. Substituting Equation (14) into Equation (4) and setting the result to zero and finally solving for $CNDC_t$ yields $CNDC_t = \frac{1 - \pi_3}{\pi_3} (CM_t + X_t) - \frac{\pi_4}{\pi_3} M_{t-1}$ . . . . . (15) (IMF:1981). This equation determines the level of domestic credit which will be compatible with BOP equilibrium. Using the estimates of π_3 and π_4 this formula was used to determine the level of changes in domestic credit that would have been compatible with BOP equilibrium in Botswana during the periods under study. The results are as shown by CC in Table 4, Column 5. Substituting CC in Equation (13) yields $CCM_t = \pi_3 (X_t + CM_t + CC) + \pi_4 M_{t-1}$ which gives the level of imports which would have been compatible with BOP equilibrium. These results are shown in Table 4, Column 8. Substituting CC and CCM in Equation (6) yields $CCMO_t = MO_{t-1} + X_t + CM_t - CCM_t + CC_t$ which gives the levels of money supply that would have been compatible with BOP equilibrium at given levels of X_t and CM_t. The level of GDP that would have resulted at BOP equilibrium is determined by Equation (1): $CCY = \frac{1}{k} (CCMO)$. The coefficient $\frac{1}{k}$ was estimated by using the two stage least squares procedure and substituted into Equation (1) yielding the results which are shown in Table 4, Column 14.

To facilitate analysis, Table 4 is divided into Part A, which shows results for selected periods during which there were BOP deficits, and Part B which shows results for those periods during which there were high BOP surpluses. Domestic credit results (Column 4-6) show a clear distinction between what would have happened during the deficit periods in order for an equilibrium to be reached and what would have happened during the surplus period. CC results in Part A indicate that the deficit would have been removed by a decrease in domestic credit. Part B, on the other hand, indicates that an equilibrium would have been achieved by increasing credit. These results clearly show that an expansion of domestic credit in excess of the demand for money will lead to BOP deficits. Once excess money supply develops the public will try to get rid of it by increasing their demand for imports. By Equation (4) ($CNFA_t = X + CM_t - M_t$) we know that when M_t increases CNFA will decrease eventually resulting in a BOP deficit. The economy, therefore responds to excess money supply by exporting its money through BOP deficits (Guitian in IMF: 1977).[9] Also implied in these results is the message that whenever an economy is faced with a BOP deficit it must cut down on its domestic credit or ration it to the more strategic sectors. This will reduce the money supply and the demand for imports. The results also show that at given levels of exports and capital movements a BOP deficit may rise not because of changes in exports or capital movements, but because of excessive monetary expansion.

Theoretically, a BOP deficit will be self-correcting in that it will lead to a decrease in the money supply which will lead to increases in the interest rate which will attract foreign capital. As already mentioned in earlier sections of this Paper, in many developing countries interest rates do not play a major role in the attraction of foreign capital and so their BOP deficits are not likely to be self-correcting.

Results in Part B of Table 4 clearly show that moving from a BOP surplus to an equilibrium requires an increase in domestic credit since domestic credit which is compatible with the BOP equilibrium is lower than that for a BOP surplus. This implies that an expansion of credit or the money supply which fails to meet the economy's demand for money might lead to a decrease in the demand for imports which may finally lead to a BOP surplus. The cost of such action can be seen by comparing Columns 14 and 13. These columns show that BOP surpluses are associated with lower GDP than at BOP equilibrium. This has serious implications for the Botswana Government's intention that, because of the high uncertainties it faces, it has to accumulate large reserves which can be used during periods of high need. The results show that this accumulation cannot take place without a cost. Since BOP surpluses are associated with low GDP, one might conclude that surplus may, in the long-run, affect the general production in the economy. When this happens the accumulation of reserves will have killed the goose that laid the golden egg, the export sector.

For imports and the money supply, Part A shows that BOP equilibrium is associated with lower levels of imports and money supply than those that exist at deficit levels. Part B on the other hand, shows that moving from a BOP surplus to equilibrium entails an increase in imports and in the money supply.

One important point to note from the Table 4 results is that although it is true that moving from a deficit to a surplus requires a decrease in credit and moving from a surplus to equilibrium requires an increase in domestic credit, it is not true that the larger the deficit the more decrease in credit you need. For example in 1978Q1 deficits of P9.44m would have required credit to decrease by P40.159m while in 1981Q3 a deficit of P15.01 required a decrease in domestic credit by only P31.353m. This is because, even though they are held constant, exports and capital movements still play a role in the determination of the actual level of credit that should take place. This implies that if we were to drop the rigid Polak assumption that in the short-run exports cannot be influenced, in those economies whose exports have a high supply elasticity and a low demand elasticity, devaluation combined with proper monetary and credit policies would give a stronger tool for stabilisation.

In real life it is, however, one thing to determine an amount of domestic credit that can be compatible with the BOP equilibrium and it is another thing to be able to actually achieve the set target. It is much easier to decrease credit than to increase it. Credit can be easily decreased by using conventional methods such as increasing required cash ratios, fixing prohibitive lending rates and fixing credit ceilings. Increasing credit on the other hand, involves providing incentives to borrowers who may or may not respond to the incentives. So as far as credit policy is concerned, we can pull on the string, but we cannot push on it. Credit policy might therefore be useful in decreasing the BOP deficit but not for reducing a BOP surplus. This point is further reinforced by the fact that during the period under study, Botswana Commercial Banks experienced excess liquidity and so it would have been very difficult to decrease the surpluses by increasing credit.

Conclusion

In concluding, one might want to address the question whether, judging from the results of the estimation of the model for Botswana, the pulling out of Botswana from the RMA was of any policy benefit. Regression results of Equations (9) and (11) indicate that changes in exports, capital movements and credit together have a significant impact on both GDP and Imports. Since these three variables are

components of the money supply, proper management of them would serve as a valuable monetary tool which can help bring about a healthy BOP position and economic growth. This is important because as Rudolf R. Rhomberg has stated, ". . . . inappropriate monetary policies may deprive an economy part of the fruits of its development effort, no matter how excellent the development program is in other respects" (IMF: 1977 Pg. 163).[10] In this respect, findings of the Paper have raised a reminder that the benefit derived from accumulation of reserves is not without costs. Results in Table 4 have shown that BOP surplus is associated with lower GDP than at the equilibrium.

The 1983 Budget Speech indicates that during the period 1981/82 when Botswana experienced BOP problems due to a downturn in the diamond market, contractionary credit and therefore monetary policies were taken and the results by the end of the year were positive. This on its own represents the extra economic tool Botswana acquired by pulling out of the RMA.

Adjusting the exchange rate, a policy that works on imports and exports, is one extra tool Botswana acquired by pulling out of the RMA. Botswana made good use of this tool at least twice since 1976. In 1977 when it realised that imported inflation from South Africa was "eroding the living standards in Botswana"(Budget Speech 1978)[11] the Pula was revalued by 5%. Surveys that were administered some months after this revaluation reported that this action had helped to limit the rise in cost of living. The Pula was revalued again in 1979 when the U.S. Dollar was declining. This also helped in correcting for imported inflation. IN 1982 when the diamond prices went down, the Pula was devalued in order to stabilise the BOP position. As already mentioned, the results were positive.

While one realises that net domestic credit taken separately does not have a strong impact on imports and GDP, the explanation given for this suggests a need for institutional transformation. The fact that parastatals do not compete for Banking System's Credit has been given as an explanation for the weak impact. It seems only reasonable to suggest that in order for strong monetary control system to be achieved, parastatals must compete for bank credit with the private sector. Not only would this have helped to remove the excess liquidity but it would have also helped to develop a strong banking system which can be relied on in terms of monetary policy effectiveness. The need for a strong competitive banking system has been demonstrated by the argument that it is difficult to increase domestic credit, so in a highly competitive banking system, credit can be useful as a monetary policy tool.

The reason given for the high correlation between M_{t-1} and X_t has great implications for planning strategies. The reason makes planners aware of the fact that autonomous changes in imports at one stage may have serious implications for the export sector in the future and, therefore necessary preparations can be made to guard against the negative effect of such a result and to prepare in the best possible way for exploiting any benefit that might accrue.

Simulations in Table 4 have shown that capital movements play a major role in monetary policy though they are assumed difficult to influence in the short-run. One important thing to note however,is that though interest may not be used to attract foreign capital, domestic policies can be used to retain and avoid the outflow of capital. This may help to minimise fluctuations in BOP and the money supply.

While the Polak model assumes that domestic credit is the only policy variable, it has been the feeling of many economists that revaluation, devaluation, export taxes and subsidies, can all be used to affect exports. Results of the model have proven that exports have a stronger effect than any of the other variables on imports and GDP. Thus an effort by the Government of Botswana to try to diversify this sector and to increase its ability to affect this sector may be of great policy benefit.

TABLE 4

A summary of CNDC, MO, M and GDP Level that would have been compatible with BOP equilibrium

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Year	CNFA	CNFA	ΔCNF	CNDC	CC	CNDC	ΔM	CCM	ΔM	MO	CCMO	ΔMO	Y	CCY	ΔY	X	CM
PART A - Balance of Payment Deficit Periods																	
1977Q1	-4.2	0	4.2	2.34	-9.7	-12.04	47.05	42.859	-4.191	43.15	33.811	-9.34	70.87	63.109	-7.761	36.582	6.26
1978Q2	-9.47	0	9.47	1.59	-39.00	-40.59	53.31	43.88	-9.43	46.06	19.2	-26.86	83.62	31.11	-52.56	35.752	8.118
1978Q3	-21.47	0	21.47	29.84	-24.12	53.96	129.09	107.64	-21.45	103.91	63.87	-40.04	194.925	127.225	-67.7	91.73	15.89
1980Q3	-21.47	0	15.01	30.67	-0.683	-31.353	172.15	157.10	-15.05	119.56	107.777	-11.79	N/A	22.879	N/A	94.228	62.912
1981Q4	-38.40	0	34.80	27.08	-86.342	-113.422	164.85	130.32	-34.53	114.76	32.941	-81.89	N/A	61.254	N/A	51.627	78.423
1982Q1	-21.19	0	21.19	-18.06	-83.39	-65.33	145.37	124.21	-21.16	114.53	31.11	-83.42	N/A	54.35	N/A	72.522	51.658
PART B - Balance of Payment Surplus Period																	
1976Q4	20.24	0	20.24	-4.85	42.955	38.1	47.44	67.69	20.25	43.52	45.53	2.01	71.0	88.106	17.106	35.108	32.27
1978Q2	19.81	0	19.81	-6.32	64.852	58.532	66.03	85.849	19.819	59.45	111.536	52.08	92.58	228.897	136.407	52.136	33.714
1979Q2	48.69	0	48.69	-13.72	140.90	122.18	105.52	154.216	48.696	80.50	215.292	134.792	171.441	450.209	278.768	105.668	48.542
1979Q4	9.03	0	9.03	-1.10	9.94	11.04	105.42	114.709	9.289	82.11	84.501	2.391	162.24	171.23	8.99	85.402	29.048
1982Q2	98.82	0	98.82	-25.33	211.89	237.22	152.69	251.52	98.83	121.7	326.41	204.71	N/A	687.2186	N/A	123.46	128.05

APPENDIX I

Basic Data Used (in Pmillion)

	Y	M	X	NFA
1976Q3	79.4400	46.0800	42.7320	44.4600
1976Q4	73.7210	47.4400	35.4080	64.7000
1977Q1	73.5660	47.0500	36.5870	60.5000
1977Q2	84.0700	52.6500	41.8280	66.8000
1977Q3	90.6750	57.7500	40.1180	67.6300
1977Q4	87.1300	62.9600	33.0670	83.1400
1978Q1	83.5900	53.3100	35.7520	73.7000
1978Q2	92.8000	66.8300	52.1260	93.5100
1978Q3	109.410	75.4200	46.8700	101.340
1978Q4	144.450	83.7600	48.7520	124.630
1979Q1	132.600	83.6900	74.2340	132.000
1979Q2	147.730	105.520	105.668	180.690
1979Q3	171.660	109.320	90.3380	203.460
1979Q4	163.390	105.420	85.4020	212.490
1980Q1	182.000	116.360	92.7840	219.020
1980Q2	172.350	119.030	88.0180	264.770
1980Q3	201.515	129.090	91.7300	243.300
1980Q4	201.330	146.320	112.777	254.460
1981Q1	188.770	141.370	97.0780	259.750
1981Q2	204.700	156.750	93.6380	267.560
1981Q3	.000000	172.150	94.2280	252.550
1981Q4	.000000	164.850	51.6270	217.750
1982Q1	.000000	145.370	72.5220	196.560
1982Q2	.000000	159.160	128.699	295.380

Basic Data Used (in Pmillion)
(continued)

	CNFA	CNDC	P
1976Q3	44.4600	32.3300	125.626
1976Q4	20.2400	-4.85000	125.625
1977Q1	-4.20000	2.34000	125.627
1977Q2	6.30000	4.04000	125.626
1977Q3	.830000	10.2800	125.554
1977Q4	15.5100	-11.7100	125.555
1978Q1	-9.44000	1.59000	125.518
1978Q2	19.8100	-6.32000	125.558
1978Q3	7.83000	-1.13000	160.684
1978Q4	23.2900	-9.10000	202.785
1979Q1	7.37000	7.80000	160.675
1979Q2	48.6900	-13.7200	160.675
1979Q3	22.7700	-2.09000	192.753
1979Q4	9.03000	-1.10000	192.185
1980Q1	6.53000	18.1700	191.980
1980Q2	45.7500	-5.71000	191.980
1980Q3	-21.4700	29.8400	193.231
1980Q4	11.1600	-8.31000	193.208
1981Q1	5.29000	2.40000	193.232
1981Q2	7.81000	11.0100	193.232
1981Q3	-15.0100	30.6700	.000000
1981Q4	-34.8000	27.0800	.000000
1982Q1	-21.1900	-18.0600	.000000
1982Q2	98.8200	-25.3300	.000000
	1	2	3

Footnotes

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