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A POLAK MODEL FOR LESOTHO

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1) INTRODUCTION

The Polak Model is widely-known, and simple, way of beginning to model the economy of a typical developing country. Cast within the framework of a small country with fixed exchange rates, it was developed by J. J. Polak in his article "Monetary analysis of Income Formation and Payments Problems" in the November 1957 issue of the IMF Staff Papers. Since then, it has been used extensively, and also extended (especially by researchers working in the IMF) to capture more complicated economic relationships. However, the fact that most IMF country economic models for developing countries use a Polak-style framework is a testimony to its insights, more especially, its usefulness.

This usefulness stems firstly from the fact that its conceptual focus, viz the link between the monetary and the external sectors, deliberately coincided with the two sets of accounts (i.e. balance of payments and monetary accounts) where data in the developing countries was more reliable. Specifically Keynesian models, on the other hand, tended to founder on the rocks of poor real sector - and especially investment - information. The model's focus, of course, also coincided with the IMF's statutory preoccupation with eternal sector balance, and the smooth functioning and development of domestic financial markets. In the terms of practicality, it also allowed IMF researchers to operate a simple model while on country missions before the widespread use of computers.

However, its usefulness also derives the model's basic simplicity. The root of the model is two economic assumptions relating imports, income and money, which are combined with two definitional equations and manipulated to give two estimable reduced-form equations. Thus, the Polak model can be developed as a first step towards setting-up a fuller forecasting and analytical model, including both more complicated monetary and external sector equations, and introduction of real sector dynamics.

2) THE MODEL

The Polak Model in its simplest and most widely used form has four endogenous variables and three exogenous variables. The endogenous variables (with corresponding symbols) are:-

i)	the stock of money	MO
ii)	nominal income	Y
iii)	imports of goods & services	M
iv)	net foreign assets	NFA

while the exogenous variables are:-

i)	exports of goods & services	X
ii)	net capital inflows	CM
iii)	net domestic credit	NDC

(For further explanation of these variables, see Appendix I). Not that in the following set of equations, a "d" in front of a variable means "the change in" that variable, or the value of the variable at time minus the value of the variable at time t - 1 Thus $dNFA = NFA_t - NFA_{t-1}$.
The four basic equations, with explanations, are as follows:

$$y_t = vMO_t \qquad (1)$$

This implies a constant proportional relationship between nominal income Y_t, and the money-stock MO_t. The coefficient of proportionality, v, is better known as the velocity of circulation of money. Given the form of the equation, this implies that the average and marginal income velocities are equal, and are constant. (It could be pointed out that the constancy of the velocity of circulation of money is a crucial assumption in monetarist models of the economy). Thus, any increase in nominal income will equal the increase in the money stock times the velocity of circulation of money.

$$M_t = mY_t \qquad (2)$$

This equation implies a constant proportional relationship between imports M_t, and nominal income Y_t via the coefficient m, which is again better known as the propensity to import out of income. Like equation 1, the lack of a constant in the equation implies that the average and marginal import propensities are the same. It is also assumed that $0 < m < 1$ i.e. an increase in nominal income leads o a proportional increase in imports.

$$dMO_t = dNFA_t + dNDC_t \qquad (3)$$

This is the definitional equation which sets out the standard money supply framework. It is rue by definition, in other words, that over a given time-period t, any change in the money stock must be equal to the change in net domestic credit.

$$dNFA_t = X_t + CM_t - M_t \qquad (4)$$

Equation (4) is the definitional equation underlying the balance of payments. It states that the change in net foreign assets is equal to exports plus net capital flow, minus imports. Both equations 3 & 4 are statements that have to be satisfied over any defined time-period: in essence, they are accounting identities.

The four equations can be manipulated to give income and imports in terms of the exogenous variables (exports, net capital flows and net domestic credit) and the two constants, m and v. The two

equations are known as the reduced form of the model, and are as follows (for their derivation, see Appendix II):

$$y_t = \frac{vQ_t}{(1 + mv)} + \frac{vQ_{t-1}}{(1+mv)^2} + \frac{vQ_{t-2}}{(1+mv)^3} \ldots \frac{vQ_{t-n}}{(1 + mv)^{n=1}} \quad (10)$$

This is reduced form equation for nominal income, which is a function of current and lagged exogenous variable. The reduced form equation for imports is found by substituting equation (2) into equation (10), so that

$$M_t = \frac{mvQ_t}{(1 + mv)} + \frac{mvQ_{t-1}}{(1 + mv)} + \frac{mvQ_{t-2}}{(1 + mv)^3} \ldots \frac{mvQ_{t-n}}{(1 + mv)^{nt1}} \quad (11)$$

The equations can be estimated and the derived values of Y_t and M_t compared with actual nominal income and imports to test whether the model yields accurate predictions.

A. Some Properties of the Reduced Form Equations

Before going to run such a test for Lesotho, however, it is worthwhile examining some of the properties of the reduced form equations. One important point to note is the structure of the lags in equations (10) and (11). Looking at the denominator in both equations, then it is implicit from equations (1) and (2) that both v and m > 0. This being the case, then their product mv>0, and thus (1 + mv) > 1. If (1 + mv)> 1, then as $n \rightarrow \infty$, so $(1 + mv)^{n+1} \rightarrow \infty$. This means that as one moves further away from the current time-period t, the denominator in the lag increases in size. With the numerator constant in both equations (= v & mv), this means that the importance of the exogenous variables in determining current imports and income decreases as one goes back in time. Such a pattern is known as a declining lag structure, and it is important that the model displays this property.

Another point to note - although this time it specifically refers to the import equation - is that for a give value of mv, the import coefficients are the same whatever the separate values of m & v actually are. In other words, in estimating imports, the product mv is important rather than the actual breakdown of the coefficients. Since m = M/Y and v =Y/MO, the mv = M/Y × Y/MO = M/MO i.e. this product excludes national income completely. It therefore follows that one can obtain a valid equation for imports even when national income statistics are known to be of dubious quality.

A final point concerns the way in which the model suggests that the change in any exogenous variable will have on imports and

income. The total effect on either of these can be found by

summing the lags in the appropriate equation. These are as follows:

$$\text{Imports} = \sum_{n=1}^{\infty} \frac{mv}{(1+mv)^n} = 1$$

$$\text{Income} = \sum_{n=1}^{\infty} \frac{v}{(1+mv)^n} = 1/m$$

In the import equation, the sum total of the lags is 1. This implies that any change in the exogenous variables will eventually have an exactly equal effect on imports. In the income equation, however, the lags sum to the inverse of m: thus, the effect of a change in the exogenous variables will depend on the size of the propensity to import out of income: the lower is this prosperity, the larger will be the change in income consequent on a change in the exogenous variables.

3) THE MODEL APPLIED TO LESOTHO

A. The Coefficients

For the definitions and methods used in compiling the data, see Appendix I. From the data shown there, one can calculate the simple m and v coefficients. Table 1 shows the import coefficient for each year, and the average over the period.

Table 1

THE IMPORT COEFFICIENT
(M Million)

	Imports (M)	National Disposable Income (Y)	M/NDI (m)
1979	300.00	492.1	0.61
1980	359.50	586.2	0.61
1981	433.50	655.7	0.66
1982	527.66	791.3	0.67
1983	584.59	908.1	0.64
1984	694.39	1,097.7	0.63
1985	765.14	1,253.7	0.61
1986	867.79	1,381.0	0.63
		Average Ratio:	**0.63**

This suggests that the import coefficient has been very stable over time, and that the equation of the import function. The value of the coefficient m is 0.63. This is very high by world standards, being above the range of values found by Polak and

Boissoneault in their study of 39 countries. (Ratios for comparable land-locked countries were at maximum 0.50, to be in the 0.40s).

The table 2 shows the same calculations for the v coefficient. The final column suggests that rather than remaining constant as the model assumes, the velocity of circulation of money has experienced a secular decline over the period in question. Thus, the average ratio will not perform well as an indicator of the velocity of circulation. However, the consistency of the decline suggests that marginal coefficient of MO with respect to NDI is constant. This can be obtained by performing a simple linear.

Table 2

THE VELOCITY OF CIRCULATION
(M Million)

	Money stock	Ave. Money Stock (MO_t)	NDI (Y_t)	NDI/MO (V)
1978	76.12	-		
1979	95.52	85.82	492.1	5.73
1980	117.13	106.33	586.2	5.51
1981	144.91	131.02	655.7	5.00
1982	185.42	165.17	791.3	4.79
1983	217.04	201.23	908.1	4.51
1984	250.32	233.68	1,097.7	4.70
1985	306.03	278.18	1,253.7	4.51
1986	352.12	329.08	1,381.0	4.20

Average Ratio: 4.87

regression, although the data series presented in the table above is not sufficiently long to generate a safe result. Thus, an expanded data series has been used, which gave the following result:

$$Y_t = 162.85 + 3.77\ MO_t$$
$$(0.08)$$

$R^2 = 0.995$
d.w. = 1.241
n = 12
(Standard error in brackets)

The results of the regression suggest that the coefficient is significant at 1% level, and that the equation fits the data well. The problem to look for, though, is the possibility of autocorrelation. While the small sample (i.e. $n < 15$) properties of the d.w. statistics are not well established, the d.w. of 1.241 above suggests that autocorrelation is not a major problem.

Using this regression, then we can establish v = 3.77.

It may be thought that the introduction of a constant into the money stock equation changes the derived lag structure of the reduced form equations (10) and (11). This, however, is not the case. The revised basic equations are

$Y_t = a + vMO_t$ (1a)

$M_t = mY_t$ (2)

$dMO_t = dNFA_t + dNFC_t$ (3)

$dNFA_t = X_t + CM_t - M_t$ (4)

Lagging equation (1a) gives:

$Y_t - Y_{t-1} = (a + vMO_t) - (a + vMO_{t-1})$ (1a)

$= vMO_t - vMO_{t-1}$

$= v\ dMO_t$ (5)

As this shows, the constant drops out immediately, and the eventual coefficients remain the same. Thus, having derived the two coefficients, it is now possible to establish the values of the lags on the exogenous variables in the reduced form equations predicing imports and income ie equations (10) and (11). These are as follows:

Table 3

THE LAG VALUES

m = 0.63 v = 3.77 mv = 2.38

	Imports (M_t)		**Income (Y_t)**		
	Derivation	Value	Derivation	Value	
t	$mv/(1 + mv)$	0.704	$v/(1 + mv)$	1.117	
t-1	$mv/(1 + mv)^2$	0.209	$v/(1 + mv)^2$	0.331	
t-2	$mv/(1 + mv)^3$	0.602	$v/(1 + mv)^3$	0.098	
t-3	residual	0.025	residual	0.041	
	Total	1.000	Total	**1.587**	(= 1/m)

Note that the coefficients for t-3 are worked out as a residual. Because of the value of m and v for Lesotho, the effect of past values of the exogenous variables on current imports and income declines very quickly. Thus, for imports, 70% of current imports are accounted for by current exogenous variables Q_t; a further 21% by Q_{t-1}, and a further 6% by Q_{t-2} i.e. a total of 97%. Thus, it is possible to sum the rest of the effects into the value of the lag on Q_{t-3} without affecting the main results of the simulations. This is also true of the income lags, where the sum of the residual lags on t-3 is only some 2.5% of the total value of the lags.

B. Testing the coefficients

Having calculated the lags, it is now possible to test the value of the coefficients by computing figures for imports and income, and comparing them with the actual figures.since at least four years data are needed before a computed figure can be generated (due to the lag structure above), then with date starting from 1979, the first computed figure for imports and income is 1982. Thus, there are five years figures for comparison. In the following tables, the first column is the sum of the exogenous variable; the next four columns represent calculations from those variables using the values of the lags established above; the next column is the sum of those calculations. Thus, taking projected imports for 1982:

Total projected imports 1982 = 0.704 × Exogenous variables 1982
+ 0.209 × Exogenous variables 1981
+ 0.062 × Exogenous variables 1980
+ 0.025 × Exogenous variables 1979

Table 4

PROJECTED AND ACTUAL IMPORTS
(M Million)

	Total exog	Q_t	Q_{t-1}	Q_{t-2}	Q_{t-3}	Pro-jected imports	Actual imports	Diff-erence
1979	319.40						300.00	
1980	381.11						359.50	
1981	461.38						433.60	
1982	568.17	399.03	96.20	23.54	8.31	527.88	527.66	-0.22
1983	616.21	433.63	118.46	28.50	9.91	590.51	584.59	-5.92
1984	727.67	512.07	128.48	35.10	12.00	687.65	694.39	6.74
1985	819.85	576.94	151.72	38.07	14.78	781.50	764.14	-17.36
1986	913.88	643.11	170.94	44.95	16.03	875.03	867.79	-7.24

							Absolute Value total =	37.48

Table 5

PROJECTED AND ACTUAL INCOME
(M Million)

	Total exog.	Q_t	Q_{t-1}	Q_{t-2}	Q_{t-3}	Pro-jected income	Actual income	Diff-erence
1979	319.40	1020.81	271.33	71.35	25.44	1388.93	492.1	-46.60
1980	381.11						586.2	
1981	461.38						655.7	
1982	568.17	634.65	152.70	37.37	13.19	837.90	771.3	-46.60
1983	616.21	688.31	188.04	45.24	15.73	937.32	908.1	-29.22
1984	727.67	812.81	203.94	55.71	19.05	1091.51	1097.7	6.19
1985	819.85	915.78	240.83	60.42	23.46	1240.48	1253.7	13.22
1986	913.88	1020.81	271.33	71.35	25.44	1388.93	1381.0	-7.93

Absolute value total = 103.18

Tables 4 and 5 show that the projection method gives an extremely good fit when applied to historical data. The greatest divergence between projected and actual imports occurs in 1985, and is equal to M17.36 million: this, however, is an error of only 2.3 per cent. The largest error for income is found in 1982, and is a greater percentage - 5.9 per cent - of the actual figure. However, the data is worse for the exogenous variables making up this figure than more recent figures, and this may be a reflection of that fact.

The above projections of imports and income, though impressively close to the actual values, suffer from the fact that they are generated in-sample i.e. the coefficients used to generate them are derived from those years' data themselves. Another test of the coefficients' predictive power comes by projecting for variables out-of-sample, i.e. for 1987. This tests whether the coefficients are any use in forecasting developments, as opposed to explaining them. The results are presented in the table 6. This shows that, on import side, the fit is very close, with projected imports only M6 million below actual imports. On the income side, however, the problem is that there is no final figure for National Disposable Income for 1987: thus, it is not possible to obtain an accurate forecast error for this item. While preliminary national accounts for 1987 suggests that the projection is an overestimate, it is quite possible that these estimates will be revised upwards.

Table 6

IMPORT AND INCOME FOR 1987
(M Million)

		1987	1986	1985	1984
Exogenous variables, Q_t:		1,053.28	913.88	819.85	727.67
Imports (M_t)			**Income (Y_t)**		
0.704 × Q 1987	=	741.51	1.117 × Q 1987	=	1,176.51
0.209 × Q 1986	=	191.00	0.331 × Q 1986	=	302.49
0.062 × Q 1985	=	50.83	0.098 × Q 1985	=	80.36
0.025 × Q 1984	=	18.92	0.041 × Q 1984	=	29.83
Projected Imports:		1,002.26	Projected Income:		1,589.19
Actual Imports:		1,0188.33	Actual Income:		?

This section of paper has applied the model to Lesotho, and shown that, though simple, the model does appear to satisfactorily explain and predict developments in the variable analysed. The next section shows how the model can be used for the purposes of economic analysis, while the final section deals with criticisms that have been levelled at the Polak model, and how seriously these, affect its use in Lesotho.

4. USING THE MODEL

The model can be used in many ways, of which two are discussed below. The first is to trace the impact of changes in exogenous variable on the external sector balance, money stock, imports and income: for those variables which lie in the control of the domestic authorities, this suggests the magnitude of the effect that various policies will have. The second use is to forecast the likely path of the economy f Lesotho by projecting for values of the exogenous variables and examining the result. This sort of projection allows one to see where the current policies of the authorities are leading the economy, and gives grounds for deciding whether these are worrisome or not.

A. The Magnitude of responses

In this section, the effect of a change in the values of exogenous variables on the other economic indicators will be examined, and the different impact of changes in the values of different variables compared. The first thing to note, though, is that the long-run impact of changes can be derived by looking at the sum of the lag structures of the redued form equations. The fact that, in the import equation, the lags sum to one means

that a change of a given magnitude in one of the exogenous variables will eventually be fully reflected (in absolute value terms) in a change in imports. In the income equation, though, the lags sum to 1/m. With M = 0.63, then the effect of an increase of M10 million in one of exogenous variables will be an increase of roughly M16 million in income in the long run. This calculation shows how the import propensity of the economy is a crucial determinant in income formation: if, for example, Lesotho's import propensity was only 0.4, then the income increase consequent on a rise of M10 million in an exogenous variable would be M25 million. Because such a large magnitude of the income response is very small by international standards.

The model, however, also enables us to look at the time-path of the response of the endogenous variable (M and Y), the derived variables (dNFA and dMO), and the underlying stock figures (NFA, NDC and MO) to a change in the values of the exogenous variables (X, CM, and dNDC). To do this, I have set up a 'Lesotho in equilibrium' model, represented by time t in the following tables, from which changes are assumed to occur. In this equilibrium state, national income equals M1,500 million and imports (given an import propensity of 0.63) equal M945 million. The foreign sector is in balance because exports equal M745 million and capital inflows equal M200 million. Thus, there is no change in net foreign assets in the equilibrium model. The stock of net foreign assets is sufficient to cover 13 weeks 9 (i.e. 3 months) of imports, and equals M236 million. The money stock needed to service national income, given a velocity of circulation of 3.77, is M398 million and thus the stock of domestic credit is M162 million. In equilibrium, there is no change in this stock; thus dNDC equals 0.

Given the position of the economy at time t, we can look at the time-path of response to a change in the values of the exogenous variables. Table 7 compares the process and outcome of a lasting increase in the dNDC with an autonomous and lasting increase in exports, on the economy of Lesotho. In the former, we can imagine that the authorities decide to expand domestic credit by M20 million a year from t + 1 but the expansion does not affect the export sector, nor does it induce any extra capital inflows. Because of this, external sector (X + CM) receipts are constant.

Table 7

I AUTONOMOUS AND LASTING INCREASE IN DNC
(M Million)

		t	t+1	t+2	t+3	t+4	Total
Exog-	X(t)	745	745	745	745	745	
enous	CM(t)	200	200	200	200	200	

	dNDC(t)	0	20	20	20	20	100
Endog-	M(t)	945	959	963	965	965	
enous	Y(t)	1,500	1,522	1,531	1,531	1,531	
Other	dNFA(t)	0	-14	-18	-20	-20	-92
	dMO(t)	0	6	2	1	0	8
Stocks	NFA	236	222	204	184	164	
	NDC	162	182	202	222	242	
	MO	398	404	406	406	406	
NFA: weeks of M		13.0	12.0	11.0	9.9	8.8	

II. AUTONOMOUS AND LASTING INCREASE IN EXPORTS
(M million)

		t	t+1	t+2	t+3	t+4	Total
Exog-	X(t)	745	765	765	765	765	
enous	CM(t)	200	200	200	200	200	
	dNDC(t)	0	0	0	0	0	0
Endog-	M(t)	945	959	963	965	965	
enous	Y(t)	1,500	1,522	1,529	1,531	1,531	
Other	dNFA(t)	0	6	2	1	0	8
	dMO(t)	0	6	2	1	0	8
Stocks	NFA	236	242	244	244	244	
	NDC	162	162	162	162	162	
	MO	398	404	406	406	406	
NFA: weeks of M		13.0	13.1	13.2	13.2	13.2	

N.B. Errors in totals are due to rounding.

As the table shows, the results are as follows. The increase in NDC has the immediate effect of expanding MO. An increase in the nominal money stock results in an expansion of nominal Y (via equation (1)), which then sucks in imports (via equation (2)). However, the fact that the external sector receipts (X + CM) are

not affected means that the overall balance turns negative, net foreign assets start to fall, and thus the overall impact on the money supply is reduced. On account of the lags in the adjustment of income and imports, though, the impact of the increase in NDC is not fully worked through until t+3. At this point, however, income and imports have fully adjusted to the domestic credit expansion, and have reached M1,531 million and M965 million respectively. The imports increase of M20 million causes NFA to fall by M20 million: thus, the increase in NDC being exactly offset by the fall in NFA and the money stock is no longer increasing. As NFA is decreasing, so Lesotho's import cover become increasingly inadequate: thus this represents an unsustainable pattern of development, since the increase in national income being induced by the rise in domestic credit is only achieved by mortgaging off the net foreign assets of the country.

This result can be compared with the situation where, due to a shift in world demand for merchandise exports, or a rise in demand for Basotho mine labour, total exports rise permanently by M20 million to M765 million from t+1 onwards. Again, income and imports will react with a lag, reaching their respective values of M1,531 million and M965 million by t+3. However, because of the lagged reaction, during time t+1 and t+2 external receipts are greater than external payments, and hence the stock of NFA increases. This increase is sufficient to 'cover' the increase in

imports: thus, the increase in national income could be considered as sustainable. With no increase in NDC, the money stock rise by the same amount as dNFA, to M406 million.

This sort of simulation is useful for two reasons. Firstly it gives us a feel for magnitudes of developments in the economy of Lesotho, and, secondly it allows some sort of policy-rankings to occur. However, the drawback of this sort of analysis is its simplicity, and the danger that significant effects are being overlooked resulting in incorrect conclusions being drawn. In the model as outlined above, a problem comes with the assumption that a change in one exogenous variable has no effect on others since this will frequently be incorrect. For example, an increase in NDC that raises imports will have a lagged effect on CM via increased customs revenues. This will offset the fall in NFA to some extent. Likewise, if the increase in NDC is going on government borrowing to finance capital expenditure as counterpart funds, it may well be that this will result in a rise in capital inflows from lending agencies/donor organisations and hence a concomitant increase in CM.

Table 8

I. TEMPORARY INCREASE IN NDC NOT TARGETED AT THE EXPORT SECTOR

(M Million)

		t	t+1	t+2	t+3	t+4	t+5	Total
Exog-	X(t)	745	745	745	745	745	745	
enous	CM(t)	200	200	200	200	200	200	
	dNDC(t)	0	20	0	0	0	0	20
Endog-	M(t)	945	959	949	946	946	945	
enous	Y(t)	1,500	1,522	1,506	1,502	1,501	1,500	
Other	dNFA(t)	0	-14	-4	-1	-1	0	-20
	dMO(t)	0	6	-4	-1	-1	0	0
Stocks	NFA	236	222	218	217	216	216	
	NDC	162	182	182	182	182	182	
	MO	398	404	400	399	398	398	
NFA: weeks of M		13.0	12.0	11.9	11.9	11.9	11.9	

II TEMPORARY INCREASE IN NDC TARGETED AT THE EXPORT SECTOR

(M Million)

		t	t+1	t+2	t+3	t+4	t+5	Total
Exog-	X(t)	745	761	771	775	775	775	
enous	CM(t)	200	200	200	200	200	200	
	dNDC(t)	0	20	0	0	0	0	20
Endog-	M(t)	945	970	971	974	975	975	
enous	Y(t)	1,500	1,540	1,541	1,545	1,547	1,547	
Other	dNFA(t)	0	-9	0	1	0	0	-8
	dMO(t)	0	11	0	1	0	0	12
Stocks	NFA	236	227	227	228	228	228	
	NDC	162	182	182	182	182	182	
	MO	398	409	409	410	410	410	
NFA: weeks of M		13.0	12.1	12.1	12.2	12.2	12.2	

The effect that some sort of link between expgenous variable will have on changing the outcome of projections is shown in table 8. In the first projection, there is a temporary increase in domestic credit of M20 million in t+1 which is used to finance government recurrent expenditure and which has no effect on CM or X, while in the second, the same increase in domestic credit is targetted at the export sector. This leads to a lagged response

from exports of (0.8 x dNDC) in t+1, (0.5 x dNDC) in t+2 and (0.2 x dNDC) in t+3 i.e the total magnitude of the response of exports to the increase in NDC is 1.5, or a total figurem of M30 million.

In the first scenario, the M20 million dNDC in t+1 leads to a temporary, but declining, increase in imports in t+1 to t+3. By the time the total effect is worked through, imports are back at their level of t, although the sum of imports over the time-period is M20 million more than it otherwise would have been. Likewise, income displays the same trajectory, and the total sum of income over the time-period is M31 million more than it otherwisewould have been. However, because there is no effect on external receipts, the import increase leads to a fall in NFA by the eventual amount of M20 million. By the end of the time-period, then there has been a temporary increase in imports and income accompanied by a switch in money of M20 million between domestic credit and foreign assets.

In the second scenario, however, the result is quite different. The response of exports to the dNDC means that a permanently higher level of X is reached, at M775 million. With a lag, imports also reach the higher level of M975 million, as does income at M1,547 million. The increase in exports also offsets the drop in net foreign assets: instead of falling by M20 million, the drop is only M8 million. With the income increase also comes a rise in the stock of money from M398 million to M410 million. Thus, in this scenario, there is a permanent rise in imports and income due to the permanent increase in exports which is a result of the initial stimulus of M20 million in NDC. The foreign assets position of the country is also more secure.

Hence, what Table 8 shows is the danger of drawing conclusions from such a simple modelling process. One must be sure that one is capturing all the interactions at work between exogenous variables, otherwise the endogenous variables will be miscalculated. However, if we can be sure of this, then the model does offer a simple way of deriving broad policy conclusions: for example, that an increase in domestic credit targeted at the export sector is likely to be considerably more productive than one just borrowed for government recurrent expenditure purposes.

B) <u>Forecasting</u>

The above represents one use of the Polak model, namely the analysis of absolute effects in the economy following a change in one of the exogenous variables. However, another (perhaps more potent) use is to forecast likely developments in the economy of Lesotho, given current policies and economic trends. To do this, the Lesotho in equilibrium model developed above is abandoned, and instead actual figures are used for the economy up to the year 1987. From 1988 onwards, projections are made of likely

developments in all of the exogenous variables to determine the value of the endogenous variables.

Such projections are done in table 9, for two different scenarios: weak control over credit, and sharp control over credit. Credit is chosen as the crucial variable for two main reasons: firstly, because credit is the only exogenous variable that the central authorities have a real measure of control over; and secondly, because credit control is the focus of most IMF models and the centrepiece of adjustment programmes. Before discussing the two different scenarios, however, the assumptions underlying the other exogenous variables are explained. Firstly, one should remember that, for forecasting purposes, the model concerns itself with nominal variables (from which the coefficients are worked out) rather than constant price, or real variables. Thus, I have assumed an inflation rate of 10 percent per annum for 1988 and after: this means for example that Labour Income, which is projected to have zero real growth, is growing by 10 percent a year in nominal terms. However, for the other component of exports, merchandise exports, I have assumed 10 percent real growth over the period 1988 to 1992, a projection based on the strong performance of manufactured exports in the recent years.

The item capital flows poses more of a problem for projections, since it is mainly comprised of loan disbursements and unrequited transfers, both of which can be fairly variable quantities. Given recent trends and Ministry of Finance projections, it seems reasonable to assume that both loan disbursements and Customs Revenues will increase quite rapidly over the next two years: thus, I have assumed that capital flows grow by M45 million in 1988, and M50 million in 1989. After this they are projected to grow by 5 percent in real terms.

Having projected X and CM, we are left with dNDC. As stated above, this is a crucial variable in the IMF Structural Adjustment Facility. Despite this, it is clear there is likely to be an enormous increase in credit in 1988, since monetary figures show an increase of M93 million in total credit in the eleven months to November 1988. Thus, I have assumed that dNDC will be M100 million in 1988, in both scenarios. In the first scenario, the government deficit implicitly remains high and is not covered by foreign borrowing: hence the decline in dNDC is slow, falling to M50 million in 1989. After this, they are projected to grow by 5 percent in real terms.

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The results of these projections for the economy are shown in table 9. Both scenarios have the same result for 1988. (It must be remembered that the projections for the endogenous variables in 1988 include the lagged effect of changes in exogenous variables from 1985 onwards.) Though nominal income growth is impressive at 16.1 per cent, this growth is largely caused by the rapidity of the credit expansion. By boosting imports considerably, this also leads to a serious shortfall in the external sector, resulting in a fall in NFA of M33 million. This seriously affects Lesotho's import coverage, which falls to 6.9 weeks if this fall in reserves occurred solely in the NFA of the Central Bank, then official NFA would fall to only M97 million, or 4.3 weeks of import coverage.

After 1988, the model's predictions depend on which path dNDC follows. If credit restraint is weak, then 1989 sees a further fall in foreign assets combined with moderate growth of 11.1 per cent in nominal income, as import growth continues to outstrip the growth in exports and capital flows. However, the credit restraint has its effect on imports and income from 1990 onwards, with the external balance turning positive and growth falling to 10.7 percent. By 1992, growth has recovered to 12.4 percent, and external receipts are greater than imports by M32 million, allowing a rise in import coverage for the first time.

In contrast, the sharp control over credit scenario shows a deeper fall in growth in 1989 and 1990 to 9.9 and 10.5 percent respectively, although growth is marginally higher in 1991 and 1992. The difference comes in the external balance. The credit restraint reduces the growth rate of imports so that NFA fall by only M3 million in 1989, and rise more strongly from 1990 onwards than in weak control case. The import coverage also rises accordingly, reaching a more comfortable 7.8 weeks by 1992. It is to be noted, of course, that the fact that credit has to be controlled so sharply in order to reach such a target arises from the fact that credit is massively overshooting in 1988, following substantial rises in 1986 and 1987: in fact, at the end of 1988, the stock of NDC is projected to have increased by 230 percent over its level at the end of 1985.

Thus, the model also gives us a way of projecting developments in the economy of Lesotho given current trends. Such projections

serve to highlight some of the policy choices that the authorities must take if, as in the case with Lesotho, certain developments seem to be adverse. This sort of modelling capability is absent in Lesotho at the present time, and results both in a limited time-horizon of policy choices, and actions taken without full knowledge of their macroeconomic impact.

Table 9

PROJECTING THE ECONOMY OF LESOTHO

(M Million)

i) Weak Control over credit

		Actual	P R O J E C T E D					
		1987	1988	1989	1990	1991	1992	Total
Exog-	X(t)	754	840	937	1,047	1,171	1,312	
enous	CM(t)	246	291	340	392	453	523	
	dNDC(t)	53	100	70	50	50	50	320
Endog-	M(t)	1,018	1,164	1,294	1,432	1,604	1,803	
enous	Y(t)	1,591	1,847	1,053	2,273	2,546	2,861	
Other	dNFA(t)	-18	-33	-17	7	20	32	9
	dMO(t)	35	67	53	57	70	82	329
Stocks	NFA	188	155	138	145	165	197	
	NDC	199	299	369	419	469	519	
	MO	387	454	507	564	634	716	
NFA: weeks of M		9.6	6.9	5.6	5.3	5.3	5.7	
Nominal Y Growth		15.2	16.1	11.1	10.7	12.0	12.4	

ii) Sharp Control Over Credit

		Actual	P R O J E C T E D					
		1987	1988	1989	1990	1991	1992	Total
Exog-	X(t)	754	840	937	1,047	1,171	1,312	
enous	CM(t)	246	291	340	392	453	523	
	dNDC(t)	53	100	50	30	30	30	240
Endog-	M(t)	1,018	1,164	1,280	1,414	1,585	1,783	
enous	Y(t)	1,591	1,847	1,030	2,244	2,515	2,829	
Other	dNFA(t)	-18	-33	-3	25	40	52	81
	dMO(t)	35	67	47	55	70	82	321
Stocks	NFA	188	155	152	177	217	269	
	NDC	199	299	349	379	409	439	
	MO	387	454	501	556	626	708	
NFA: weeks of M		9.6	6.9	6.2	6.5	7.1	7.8	
Nominal Y Growth		15.2	16.1	9.9	10.5	12.1	12.5	

5) DRAWBACKS OF THE MODEL

Though the above analysis has demonstrated the great uses that such a simple model can provide Lesotho, it is as well to realise that the Polak model has come in for heavy criticism largely because of its simplicity. The validity of some of these

criticisms mean that we must interpret the results of the model with caution.

i) **Prices in the model**

As mentioned previously, the model is set entirely in nominal, or current price variables. However, it does not have a method for endogenously generating price changes, and thus forecasting involves making assumptions about future rates of inflation. The problem this causes is that it implicity assumes that any real income growth that occurs is feasible ie. it does not put pressure on prices from the supply-side of the economy. This assumes the existence of unemployed resources, and a smooth production process. While the former exists in Lesotho, there would certainly appear to be various bottlenecks e.g. in the skilled labour and housing markets, which might prevent a smooth increase out put. Such bottlenecks would themselves put pressure on the price-level, and reduce the real impact of nominal income growth. Hence, one must keep in mind the conditions of the economy's supply curve when predicting rises in real income so as to avoid the possibility of over heating in various sectors.

ii) **The monetary Focus**

Another criticism has concerned the allegedly 'monetarist' character of the model. In part, this change has arisen from the fact that the monetary model of the balance of payments (a widely used model in current economics) grew out of, and still shares similarities with, the Polak model. However, it has been rightly pointed out that the monetary model itself is not 'monetarist' but widely used in Keynesian economic models as well as monetarist ones (although its direction can be to reduce the effectiveness of domestic fiscal policy).

As to the Polak model, the one 'monetarist ' assumption is the constancy of the velocity of circulation. However, as discussed below, this in effect is an assumption about the stability of the money demand function (although in a somewhat singular form). Again it has been pointed out that such stability is a prerequisite for predictability, and therefore is a crucial need for modelling purposes. If the demand for money is not stable, then both Keynesian and monetarist models are in trouble.

Finally, the polak model, though using monetary data, can converge with Kynesian models under some fairly plausible conditions in the developing countries. Keynesian models usually include exports, private investment and government expenditure as exogenous variables, while the Polak model uses exports, capital flows, and change in net domestic credit. In a developing country, however, the sum of changes in private investment and government expenditure are very likely to have a close relationship with domestic credit creation and capital inflows

because the letter equals the combined borrowing requirement of the private sector and government not met by lending from the non-bank private sector. If lending for private investment and for government expenditure from the non-bank private sector is low (as it is likely to be in Lesotho) then the two models converge.

iii) **the Aggregated Coefficients**

One of the key steps made in transforming the basic equations into reduced form equations is the rounding up of the exogenous variables X, CM and dNDC into one composite variable, Q. This has the effect of assuming that all the separate exogenous variables have the same effect on imports and income as each other. However, this may not be the case: for example, project-related capital inflows may have such a higher import content than private sector, domestic production-oriented bank lending. In this case, the stability of the model in the past could be explained by a constant ratio between and within the three exogenous variables: projections would, however, be impaired by any such change which increase the importance of, say, a highly import-intensive sector. Thus, one useful extension to the model would be to disaggregate the exogenous variables into their three separate constituents, so that their different effects on imports and income could be calculated. This would imply a different value of lag structures for each separate variable, and would thus further highlight preferred policy measures.

However, it is arguable that this disaggregation does not go far enough, and that the dNDC should be further broken down into its constituent parts, i.e. credit to the private sector, and credit to government. This is also a weakness of the model, especially with regarded to policy formulation. For example, if it is credit to the private sector that is running away, then any Central Bank needs to consider interest rate policy/credit controls etc. However, if it is government credit that is overshooting, then one needs to examine government revenue and expenditure in order to try and control the situation. Furthermore, in terms of generating the original coefficients, there may well be quite different implications for imports and income in credit directed to the private sector as against credit directed to government.

Thus, the high state of aggregation in the model is both a strength and a weakness. It is a strength in that it allows for simplicity and hence ease of construction (for example, by avoiding multiple regression and reducing the errors contained in the individual figures), but it has the disadvantage of obscuring important issues and ignoring possible sources of divergence.

iv) The Fixed Coefficients

Absolutely fundamental to the model is the assumption that the import and velocity of circulation coefficients are fixed. Thus, any argument to the contrary causes considerable problems for the Polak model's construction, and actual evidence to the contrary destroys its explanatory and predictive power.

The first relationship to consider is the money/income equation. In its Polak form, it looks suspiciously like the definitional equation MV = PT i.e. money times velocity of circulation equals prices times transactions. However, because it is cast as a behavioural equation, the assumption of constant velocity is really an assumption about the money demand viz that money demand is a constant function of income. As money demand functions go, this is an extraordinarily narrow one since, firstly, it is cast in nominal terms and secondly, it ignores the effect of interest rates in changing the propensity to hold money (which is how the velocity of circulation, v, can more properly be seen).

However, while modelling money demand in developed countries is a highly complicated (and controversial) procedure, the Polak model's money demand function has been defended as an appropriate approximation in developing countries. These countries, it is argued, are characterised by a lack of marketable instruments which tends to make money demand highly insensitive to interest-rates except, perhaps, at the extremes. Since individuals cannot easily switch between the instruments there are, then what will affect money demand is increases in income. In Lesotho, the only effects on money demand that a change in interest rates can have is a shift from bank holdings to government bonds: this sort of change - given the low holding of government bonds by the non-bank private sector - is almost non-existent. Any shift between categories of bank deposit is captured in the broad money supply definition, M2. Thus, it is not unreasonable to exclude interest rates from a money demand function in Lesotho.

However, this does not mean that the specification in the Polak model is necessarily correct: to prove that the demand for money is a stable function of income, we must examine the actual evidence. In this light, Lesotho's money demand does seem relatively stable, especially when compared with other developing countries. The fact, though, that is some years the actual money demand has deviated significantly enough from the money demand function generated by the regression (especially in the year 1984) does mean one has to be cautious when performing projections.

The other relationship to examine is the imports/income one. Here, however, the data seem fairly conclusive for Lesotho: the import coefficient has remained a very stable function of income and furthermore, as noted above, the marginal propensity to import is only slightly below the average propensity to import. The problem, though, comes in assuming that this coefficient will

remain stable in the future. Suppose, for example, that the authorities decide to try and alleviate the restriction on the economy which the high import leakage entails, and carry out a programme of successful import-substitution from 1989 onwards. This has the effect of reducing the import coefficients by 2 percentage points year-by-year until the coefficient falls to 0.55 by 1992. The effects of such a policy are shown in table 10. The changed lag structure is demonstrated in the first part of the table: from this, one can see that as the import coefficient falls, so the total income response to an increase in the exogenous variables increases to the point where we get an 82 percent response of income over and above the change in exogenous variables, as opposed to a 59 percent response at present. Furthermore, though the total import response remains 1, the change in distribution of the lags means that an increase in exports or capital flows induces a higher increase in net foreign assets than would otherwise be the case.

Given such a drop in the import coefficient, then, the macroeconomic projections appear in the second part of table 10. Underlying the projections of the exogenous variables lie the same assumptions as the same control over credit scenario in table 9, and it is with these projections that comparisons should be made. Looking at the endogenous variables, we can see that imports are consistently lower in table 10 than in table 9: income growth, however, is substantially greater, with growth rates of 2 to 3 percent higher per anum in declining import coefficient projections. The result of the reduced imports is a much stronger performance of net foreign assets, whose net increase in 1988-92 is double that in table 9. Indeed, the recovery of NFA suggests that by the end of the projection period, the authorities could start to expand domestic credit again while attaining balance in the external sector.

Of course, these are not projections about likely developments, but they do illuminate a problem concerning any projections, namely, that if a model highlights a policy problem (e.g. Lesotho's import dependency), then actions taken by the authorities to deal with the problem (e.g. import-substitution) may invalidate the predictive power of the model itself. Thus, again, in using the Polak model, one must be cautious in

Table 10

PROJECTING WITH CHANGING COEFFICIENTS

i) The changing Lag structure

		1988	1989	1990	1991	1992
	m	0.63	0.61	0.59	0.57	0.55
	v	3.77	3.77	3.77	3.77	3.77
	mv	2.38	2.30	2.22	2.15	2.07
Imports	Q(t)	o.704	0.697	0.690	0.682	0.675
	Q(t-1)	0.209	0.211	0.214	0.217	0.220
	Q(t-2)	0.062	0.064	0.066	0.069	0.071
	Q(t-3)	0.025	0.028	0.030	0.032	0.034
Income	Q(t)	1.117	1.143	1.169	1.197	1.227
	Q(t-1)	0.331	0.346	0.363	0.380	0.399
	Q(t-2)	0.098	0.105	0.112	0.121	0.130
	Q(t-3)	0.041	0.046	0.051	0.056	0.063

ii) The Projections

		Actual	P R O J E C T E D					
		1987	1988	1989	1990	1991	1992	Total
Exog-enous	X(t)	754	840	937	1,047	1,171	1,312	
	CM(t)	246	291	340	392	453	523	
	dNDC(t)	53	100	50	30	30	30	240
Endog-enous	M(t)	1,018	1,164	1,270	1,396	1,558	1,752	
	Y(t)	1,591	1,847	2,065	2,340	2,703	3,143	
Other	dNFA(t)	-18	-33	7	43	66	83	165
	dMO(t)	35	67	57	73	96	113	405
Stocks	NFA	188	155	162	204	270	353	
	NDC	199	299	349	379	409	439	
	MO	387	454	511	583	679	792	
NFA: weeks of M		9.6	6.9	6.6	7.6	9.0	10.5	
Nominal Y Growth		15.2	16.1	11.8	13.3	15.5	16.3	

Assumptions:

Inflation - 10% per annum. **Exports** - 0% real growth in labour Income, 10% real growth in manufactured goods exports. **Capital Imports** - 1988, growth of M45 million; 1989, growth of M50 million; 1990 onwards, 5% real growth.

Interpreting the results of projections in case the value of one of the structural parameters is subject to a shift. However, that one needs to be cautious in analysing the projections does not mean that they are of no use in providing clues about the likely direction of the economy. It does suggest, however, that for more effective method of projecting likely developments, more complicated relationships are needed which include more variables, and thus reduce the uncertainty surrounding the value of future coefficients (assuming, that is, that the addition of extra variables allows more stable coefficients to merge).

v) Credit as an Instrument of Control

The final criticism of the model concerns its focus on the change in net domestic credit as the control policy variable. By selecting X, CM and dNDC as exogenous variables, the Polak model in effect picks out dNDC as the target variable, since it is this that is most easy to control by the domestic authorities. (NB. noted above was the fact that these three, though modelled as independent variables, might in fact be interdependent e.g. the link between domestic credit to government, and capital inflows). Despite a long literature from the IMF asserting the primacy of credit control over broader, monetary targeting, dissenting voices have remained. In particular, Fleming has argued that, just because gross credit creation and imports are observed to move together, does not mean that controlling credit will reduce imports: rather he suggests that credit developments occur as a response to a response to changes in the need for money caused by changes in imports. Furthermore, the effects of controlling credit may also be offset by changes in the velocity of circulation. Again, the observed constancy of the velocity of circulation during a period of uncontrolled credit may be due to the responsiveness of credit and capital movements to changes in the demand for money, thus rendering changes in the velocity of money unnecessary. Once credit is controlled, however, it does not follow that the velocity of circulation would remain constant.

If these criticisms are correct, then there would be a major flaw in the projections made above, since the institution of credit restraint envisaged in them would change the lag structure through a change in the velocity of circulation. However, the question of whether the velocity of circulation in Lesotho does become more variable during a period of credit control is something that can only be discovered after such a period, although evidence from other countries does not conclusively suggest that such a relationship exists.

As mentioned beforehand, the virtue of the Polak Model, and the reason why it has become comparatively popular, is its ease of

construction and comprehensibility to those not highly advanced in modelling techniques. Thus, if it provides an accurate analysis of, and useable projections for, the economy of Lesotho, there are good reasons for adopting it is a first stage in a macromodelling process.

While, as we saw, the model does provide an accurate analysis of past trends, it has not been possible to sufficiently test the projections to see if the polak model constructed in the paper works in out-of-sample-periods. Inasmuch as a model's predictive power can only be tested in this way, then the use of the Polak model in projecting the economy of Lesotho, and in demonstrating the effect of policy changes, remains to be seen. Furthermore, the model has been criticised on number of grounds. While some of these criticisms could be incorporated in extensions to the model (such as the disaggregation of the exogenous variables to capture different magnitudes of changes), others require a more complicated modelling process (eg. the introduction of real sector dynamics), and possibly a different type of model. Criticisms of a fundamental kind (eg. of the constancy of the coefficients) can only be settled by resource to empirical evidence, and this requires the collection of further years' data. Until sufficient time has passed to establish the constancy or non-constancy of the coefficients, these criticisms cannot be either accepted or refuted.

Thus, at best it can be said that the jury is out on the question of confirming the accuracy of the model. In the interim, though, t is possible to see two further uses of the Polak modelling procedure. The first is as an instructive device. Even if the coefficients are not constant (and prediction not possible), the analysis carried out in constructing the model is useful in that it presents an often unappreciated link between the monetary and the external sectors. Certainly in developed countries, the appreciation that monetary analysis can be as important as real sector analysis in determining the movements of the economy has spread dramatically in the last 20 years, and such analyses are important in developing countries too. Secondly, the description presented above gives a very crude representation of the sort of analysis that the IMF does of a country's economy (though it leaves out two important aspects viz the government budget deficit and external debt analysis). In this period of SAF credit ceilings, net foreign asset targets, government deficit targets, and growth forecasts, it is important to understand how some of these are related and how one might go about devising such an economic programme oneself. Indeed, only with such understanding and capabilities can the authorities in Lesotho effectively argue their corner in such negotiations.

APPENDIX I

Data Requirements of the Model

The period used in collecting data has been 1978-86, which gives eight observations (1979-86) for estimating the reduced form equations after calculating the change in net domestic credit as an exogenous variable. The reason for selecting this time-period is that pre-1978 monetary data is suspect, while 1987 real data is not yet finally available. The method behind the compilation of the data is explained in Appendix II. It is obvious that the unreliable nature of much of the non-monetary statistical base in Lesotho renders the conclusions of the paper as even more tentative than they would otherwise be.

A Eternal Sector

For the purposes of the analysis, external sector transactions are consolidated into four accounts: exports payments, import payments, capital movements, and reserve movements. All the items are expressed in domestic currency.

i) Exports

This covers merchandise exports, receipts from the export of services, net investment income, and labour income.

ii) imports

This covers payments for merchandise imports, plus shipment costs, the import of other services, and food grants.

iii) Capital Movements

This section covers all items in the balance of payments that are not included in the above two categories, or in reserve movements. Thus, this section includes official and private unrequited transfers as well as the normal capital items. Errors and omissions are also allocated to this item.

iv) Reserve Movements

These are standard items in the Balance of Payments for Lesotho ie. Changes in the commercial banks and the Central Banks holdings of net foreign assets.

B Monetary Data

Apart from foreign assets, derived above, the monetary sector comprises net domestic credit and money stock. The latter of these are made up of notes and coins in circulation, demand and

call deposits, and savings and time deposits (ie. M2). When calculating the velocity of circulation, the average stock of money is used ie. (MO_t + Mot-1)/2 rather than the end-period stock of money, Mo_t. The other item is net domestic credit. This is calculated as a residual item ie. the difference between net foreign assets and the money stock. Thus, Other Items Net are absorbed into net domestic credit.

C Real Sector Data

the real sector data comes from the national accounts. The targetted variable here for Lesotho is National Disposable Income, which equals Net National Product plus Net transfers to Lesotho. However, no Net National Product figures are available in Lesotho (as in most developing countries) because of the difficulty of measuring the provision for capital depreciation. Thus, Gross National Product figures have been used instead.

Polak Model - Raw Data

i) Imports

	Import f.o.b.	Other Trans. Net	Ship-ment	Travel Debit	Other Off Net	Sub-total	Food Grants	TOTAL
1978	195.90	0.00	0.00	3.20	0.00	199.10	7.20	206.30
1979	273.00	1.70	10.50	5.50	9.30	300.00	0.00	300.00
1980	331.90	1.90	11.10	6.20	8.40	359.50	0.00	359.50
1981	398.60	2.40	16.60	6.50	9.50	433.60	0.00	433.60
1982	485.29	3.60	19.85	6.51	12.41	527.66	0.00	527.66
1983	537.60	4.91	21.96	6.86	13.26	584.59	0.00	584.59
1984	639.13	5.41	25.73	8.89	15.23	694.39	0.00	694.39
1985	700.33	6.91	27.88	11.10	17.92	764.14	0.00	764.14
1986	779.33	9.26	31.23	17.83	30.14	867.79	0.00	867.79

Net **ii) Money Supply**

	Money Stock	Domestic Credit	Net Foreign Assets	Other Items Net Credit	Net Domestic
1978	76. 12	27.71	44.20	-4.21	31.92
1979	95.52	35.98	56.12	-3.42	39.40
1980	117.13	48.88	71.15	2.90	45.98
1981	144.91	94.89	74.04	24.02	70.87
1982	185.42	119.30	102.12	36.00	83.30
1983	217.04	121.43	129.36	33.75	87.68

1984	250.32	125.50	179.01	54.19	71.31
1985	306.03	166.90	216.59	77.46	89.44
1986	352.12	223.74	206.42	78.04	145.70

iii) **National Income**

	GNP	Net Unrequited Transfers	NDI
1978	385.1	28.8	413.9
1979	422.5	69.6	492.1
1980	502.3	83.9	586.2
1981	583.2	72.5	655.7
1982	742.1	49.2	791.3
1983	818.2	89.9	908.1
1984	957.9	139.8	1097.7
1985	1084.7	169.0	1253.7
1986	1230.5	150.5	13.81.0

iv) Exports

	Exports f.o.b.	Services	Net investment income	Labour income	TOTAL
1978	28.70	7.70	-1.00	154.30	189.70
1979	38.90	11.10	-0.70	178.90	228.20
1980	46.60	15.30	0.00	205.00	266.90
1981	44.60	18.80	-0.20	255.00	318.20
1982	40.56	23.25	-5.10	378.00	436.71
1983	34.64	25.24	2.14	421.00	483.02
1984	41.79	27.92	11.30	475.86	556.87
1985	49.99	31.58	15.13	499.04	595.74
1986	57.95	35.54	-0.26	583.59	676.82

v) **Capital Inflows**

	Total imports	Total Exports	Trans fers	Cap- ital	Total Capital	dNFA
1978	206.30	189.70	28.80	10.42	39.22	22.62
1979	300.00	228.20	69.60	14.12	83.72	11.92
1980	359.50	266.90	83.90	23.73	107.63	15.03
1981	433.60	318.20	72.50	45.79	118.29	2.89
1982	527.68	436.71	49.17	69.86	119.03	28.08
1983	584.59	483.02	89.92	38.89	128.81	27.24
1984	694.39	556.87	139.76	47.41	187.17	49.65
1985	764.14	595.74	168.99	36.99	205.98	37.58
1986	867.79	676.82	150.54	30.26	180.80	-10.17

vi) Exogenous Variables

	NDC	dNDC	Exports	Capital	TOTAL
1979	33.40	7.48	228.20	83.72	319.40
1980	45.98	6.58	266.90	107.63	381.11
1981	70.87	24.89	318.20	118.29	461.38
1982	83.30	12.43	436.71	119.03	568.17
1983	87.68	4.38	483.02	128.81	616.21
1984	71.31	-16.37	556.87	187.17	727.67
1985	89.44	18.13	595.74	205.98	819.85
1986	145.70	56.26	676.82	180.80	913.88

APPENDIX II

This appendix presents the simple algebraic derivation of the reduced form equations (10) and (11) from the initial equations (1) - (4). The basic equations are:

$$Y_t = vMO_t \quad (1)$$

$$M_t = mY_t \quad (2)$$

$$dMO_t = dNFA_t + dNDC_t \quad (3)$$

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

Lagging equation (1) by one period:

$$Y_{t-1} = vMO_{t-1} \quad (1')$$

Substituting (1') from (1):

$$Y_t - Y_{t-1} = vMO_t - vMO_{t-1}$$
$$= vdMO_t \quad (5)$$

Substituting (3) into (5):

$$Y_t - Y_{t-1} = v(dNFA_t + dNDC_t) \quad (6)$$

Substituting (4) into (6):

$$Y_t - Y_{t-1} = v\ (X_t + CM_t - M_t + dNDC_t\ ) \quad (7)$$

Simplify by assuming that $Q_t = X_t + CM_t + dNDC_t$ i.e. collecting up the exogenous variables:

$$Y_t - Y_{t-1} = v\ (Q_t - M_t)$$
$$= vQ_t - vM_t \qquad (8)$$

Substituting (2) into (8):

$$Y_t - Y_{t-1} = vQ_t - mvY_t$$
$$.. \ Y_t + mvY_t = vQ_t + Y_{t-1}$$
$$.. \ Y_t\ (1 + mv) = vQ_t + Y_{t-1}$$
$$.. \ Y_t = \frac{vQ_t}{(1 + mv)} + \frac{Y_{t-1}}{(1 + mv)} \qquad (9)$$

However, since after lagging (9) we get:

$$Y_{t-1} = \frac{vQ_{t-1}}{(1 + mv)} + \frac{Y_{t-2}}{(1 + mv)} \qquad (9\ )$$

Then substituting (9') into (9) gives:

$$Y_t = \frac{vQ_t}{(1 = mv)} + \frac{vQ_{t-1}}{(1 + mv)^2} + \frac{Y_{t-2}}{(1 + mv)^2} \qquad (9'\square)$$

It is clear that this process of lagging and substitution eventually results in the reduced from equation for income, viz:

$$y_t = \frac{vQ_t}{(1 + mv)} + \frac{vQ_{t-1}}{(1 + mv)^2} + \frac{vQ_{t-2}}{(1 + mv)^3} \ ... \ \frac{vQ_{t-n}}{(1 + mv)^{n+1}} \qquad (10)$$

The reduced form equation for imports is found by substituting equation (2) into equation (10), so that

$$M_t = \frac{mvQ_t}{(1 + mv)} + \frac{mvQ_{t-1}}{(1 + mv)^2} + \frac{mvQ_{t-2}}{(1 + mv)^3} \ ... \ \frac{mvQ_{t-2}}{(1 + mv)^{n+1}} \qquad (11)$$