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BALANCE-OF-PAYMENTS CRISES: TIMING THE COLLAPSE OF THE PHILIPPINE PESO*

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The focus of this paper is to undertake an empirical analysis of the Philippine balance of payments and to predict the date of the exchange rate collapse. Domestic credit expansion stimulated speculative attacks against the peso leading to the eventual depletion of the Central Bank's stock of foreign reserves. This was so even though the initial level of reserves suspended the devaluation and artificially defended the peso. Moreover, a domestic credit growth that is faster than the world average given a domestic income growth that is slower than the world average affects the balance of payments negatively.

1. Introduction

The level of international currency that a country's monetary authorities possess has always been crucial in the development process. To many developing economies, a very low stock of foreign reserves has acted as a constraint to the nation's hope for speedy growth. This has been no less true in the light of Philippine economic experience.

On bended knees, the Philippines has to seek official development assistance and has to negotiate for debt rescheduling. It is becoming more and more apparent, however, that the developed countries cannot forever play Santa Claus and help a lame dog over a stile. Beggars always cannot be choosers. Eventually, the country has to learn to gently paddle its own canoe.

This paper attempts to analyze the Philippine balance of payments using an approach that attributes a central role to monetary variables. The monetary model predicts the negative impact of the rate of domestic credit expansion on the central bank's rate of reserves accumulation.

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The next section presents the monetary approach, the speculative attack literature, and the causality test. The succeeding sections provide the empirical results and their implications in economic policy-making.

2. Theoretical Framework

2.1 The Monetary Approach to the Balance of Payments Theory

The strength of the monetary approach to the balance of payments (MABOP) lies in its general perspective. It does not provide a theory on the trade, service, capital, and transfer accounts separately, but lumps all of these and provides a theory of this net sum. The balance of payments which refers specifically to the *below the line* items constitutes a money account. It is for this reason that the monetary approach to the balance of payments regards money as the very core of the analysis of the international adjustment process. Thus, the central feature of the monetary approach is that the balance of payments is essentially, albeit not exclusively, a monetary phenomenon. Although not only money plays a role, money plays the vital role.

The implication of this is that the balance of payments can only be understood if it is analyzed in the context of the demand and supply mechanism in the money market. Any framework of analysis which does not explicitly include money, *prima facie,* should be led to the dustbin of rotten ideas. As Johnson writes:

> The essence of the monetary theory on the balance of payments policy has been stated: balance of payments policies will not produce an inflow of international reserves unless they increase the quantity of money demanded and unless the credit policy forces the resident population to acquire the extra money through the balance of payments via an excess of receipts over outpayments; the balance of payments surplus will continue only until its cumulative effect in increasing domestic money holdings satisfies the domestic demand for money.
>
> Frenkel and Johnson (1977, p. 274)

Two important assumptions underlie the monetary approach: first, that a stable long-run money demand function exists, and second, that arbitrage tends to equate prices accross countries. From the above assumptions, it follows that in the long run, real money demand equals real money supply.

In a small open economy with fixed exchange rate which by assumption does not influence the world price, monetary policy determines only the volume of domestic credit and not the money supply. The endogeneity of money supply means that in the long run an increase in the quantity of money supplied over money demanded generates an outflow of money through the BOP until the quantity returns to its original level. This is often referred to as the automatic adjustment mechanism of the money supply process.

By virtue of Walras' law, we can deduce that any event which causes domestic absorption to exceed the economy's output, i.e., an excess demand for goods, means that there will be a net decumulation of the excess money holdings, resulting in a deficit.

It is assumed that the time period is long enough to allow equilibrium in the monetary market, thus

(1) $M_d = Pf(y,i) = m(R + D) = M_s$

where:

D = domestic credit extended by the monetary authorities
R = foreign asset holdings of the central bank
m = money multiplier
M_d = money demand
M_s = the stock of money supplied
i = interest rate
P = price level
y = real permanent income.

A dot (•) over a variable denotes its growth rate. Solving for the rates of growth, one obtains

(2) $\dot{M}_d = \dot{P} + \varepsilon_y \dot{y} + \varepsilon_i \dot{i} = \dot{m} + [R/\ (R{+}D)]\ \dot{R} + [D/\ (R{+}D)]\ \dot{D}$

where ε_y and ε_i are income and interest rate elasticities, respectively. Rearranging terms, we have

(3) $r\dot{R} = \text{-}(1\text{-}r)\ \dot{D} + \varepsilon_y \dot{y} + \varepsilon_i \dot{i} + \dot{P} - \dot{m}$

where $r = R/\ (R + D)$. Equation 3 will be estimated as

$$R = \hat{\alpha}_{\varnothing} + \hat{\alpha}_1 D + \hat{\alpha}_2 \dot{y} + \hat{\alpha}_3 \dot{i} + \hat{\alpha} \dot{P}_4 + \hat{\alpha}_5 \dot{m} + \hat{u}.$$

The putative signs and magnitude suggested by the theory are:

$$\alpha_{\varnothing} = \varnothing, \alpha_1 = -1, \alpha_2 = 1$$
$$\alpha_3 < \varnothing, \alpha_4 = 1, \alpha_5 = -1$$

Equation (3) is the reduced form of the model. This equation suggests that the rate of domestic credit expansion has a negative impact on the balance of payments. An increase in the flow of credit will cause the BOP to deteriorate by the same amount because the increased flow will simply be used to purchase foreign goods and assets. The income coefficient is expected to be positive since higher income levels imply greater money balances demanded. Any event which causes the money demand to be greater than the supply of money has a positive impact on the reserves variables. Hence it necessarily follows that when the interest rate causes agents to demand smaller nominal balances, a deterioration of the BOP follows. Using the same reasoning, the price coefficient is positive *a priori* while the multiplier coefficient is expected to be negative.

The reduced form could be expanded to include not only the changes of the domestic economy's aggregate data but those of the rest of the world as well. We would then include the effects of changes in the aggregate data of the country's trading partners.

Assuming constant world prices, interest rates (that is, markets are efficient), and money multipliers, (3) becomes

$$(4) \quad r\dot{R} = -(1-r)\,\dot{D} + \varepsilon_y \dot{y}$$

i.e., the domestic reserves growth is positively related to the income growth and negatively related to the rate of domestic credit expansion. This is to be contrasted with that of the Keynesian model which purports that income has a negative impact on the balance of payments and that the expansion of domestic credit has no effect on the BOP. According to one such theory, domestic credit expansion may even lead to the improvement of the BOP by stimulating investment and productivity, lowering domestic prices, and improving the current account.

For the world economy, the rate of change of the total (world) money demand would then be

$$(5) \quad \dot{M}_d = \Sigma w_i\, \varepsilon_{yi}\, \dot{y}_i + \dot{P} = \Sigma w_i r_i \dot{R} + w_i\,(1-r_i)\,\dot{D}_i$$

where w_i's are the country shares of the world money stock and $\dot{R}$ is the rate of change of international reserve money.

The growth rate in world prices would be

$$(6) \quad \dot{P} = \Sigma w_i r_i \dot{R} + \Sigma w_i (1-r_i) \dot{D}_i - \Sigma w_i \varepsilon_{yi} \dot{y}_i$$

For a domestic economy d therefore, the rate of accumulation of international money is

$$(7) \quad \dot{R}_d = 1/r_d (\dot{P} + \varepsilon_{yd} \dot{y}_d) - (1-r_d)/r_d \dot{D}.$$

Substituting $\dot{P}$ from (6) into (7), we finally have

$$(8) \quad \dot{R}_d = 1/r_d \Sigma w_i r_i \dot{R} + 1/r_d \varepsilon_{yd} \dot{y}_d - 1/r_d \Sigma w_i \varepsilon_{yi} \dot{y}_i - (1 - r_d) / r_d \dot{D}_d + 1/r_d \Sigma w_i (1-r_i) \dot{D}_i$$

which is the equation for the rate of reserves accumulation for an economy taking into account changes in economic activities abroad. Simplifying by assuming that international reserves ratio are the same everywhere, and that income elasticities of demand for money are everywhere unity, we can estimate equation 8 by

$$(8a) \quad \dot{R}_d = \hat{\beta}_\varnothing + \hat{\beta}_1 \dot{R}_w + \hat{\beta}_2 1/r_d (\dot{y}_d - \dot{y}_w) - \hat{\beta}_3 1/r_d (\dot{D}_d - \dot{D}_w) + \hat{u}$$

where the subscripts d and w denote domestic and world variables respectively.

The theory predicts that β_1 is positive which means that the growth rate in the world international reserves component of the monetary base has a positive impact on the domestic stock of foreign assets. β_2 is expected to be positive since the growth rate of domestic real income relative to the world's implies a relatively higher growth of domestic money demand. The negative sign of β_3 indicates that a domestic credit expansion greater than the world's average creates a stock supply of money in the domestic economy that would be expected to spill over onto foreign goods, thus causing a BOP deficit.

We will also estimate an equation of the form

$$(8b) \quad \dot{R}_d = \hat{\beta}_\varnothing + \hat{\beta}_1 \dot{R}_w + \hat{\beta}_2 (\dot{y}_d - \dot{y}_w) - \hat{\beta}_3 (\dot{D}_d - \dot{D}_w) + \hat{u}.$$

$\hat{\beta}_2$ and $\hat{\beta}_3$ are the domestic reserves elasticities with respect to $(\dot{y}_d - \dot{y}_w)$ and $(\dot{D}_d - \dot{D}_w)$ respectively. Theory predicts that $\hat{\beta}_2$ approaches unity while $\hat{\beta}_3$ should not be significantly different from -1.

2.2 *Timing the Collapse of the Philippine Peso: Modelling the Probability of a Devaluation*

The above model shows that domestic credit expansion has a negative impact on the monetary authorities' stock of foreign money. The reserves level gradually declines as residents dispose of their excess money balances in exchange for foreign money. At a critical point, however, there will be a sudden speculative attack on the home currency as agents realize that the bank facing reserves paucity cannot forever defend the domestic currency.

Innovations in economic theory have shown that the date of the attack can be endogenously determined by analyzing the agents' rational speculative behavior[1]. This subsection aims at modelling the timing of devaluations forced on active crawling peg systems facing reserve hemorrhage.

It is assumed that total monetary wealth, held in either home or foreign currency, is constant in real terms:

(9) $W = \omega E = M + F$

where E is the exchange rate and F is the amount of monetary wealth held in foreign currency. Moreover, the fraction of monetary wealth held as domestic money balances declines with higher rates of the pre-announced exchange rate depreciation:

(10) $M = æW = æ\omega E;\ æ = æ\ (1/E\ .\ dE/dt)$

[1]The first paper on the speculative attack literature was by Salant and Henderson (1978). Their idea was expanded to a perfect-foresight switch from a fixed to a floating rate regime by Krugman (1979) while Flood and Garber (1984a, 1984b) delved on the stochastic version of the attack. Obsteld (1984) studied devaluations while Connolly and Taylor (1984) studied collapsing crawling peg systems and the impact of these on the relative price of traded goods. Montiel (1984) noted the transition from post-crisis to long-run equilibrium price levels. Blanco and Garber empirically (1986) tested the model and computed for the one-step-ahead devaluation probabilities.

Central bank intervention in the foreign exchange market sets the exchange rate depreciation equal to γ, while domestic credit expands at a rate $\gamma+\delta$:

(11) $E = \bar{E}\, e^{\gamma t}; \quad D = \bar{D}\, e^{(\gamma+\delta)t}$

where δ is the excess growth of domestic credit. A bar over a variable denotes its initial equilibrium value.

To simplify, the monetary multiplier is set equal to 1 in such a way that

(12) $\bar{M} = \bar{R} + \bar{D} = æ\,(\gamma)\,\omega\bar{E}$

At the time of the attack, foreign reserves are depleted instantaneously. As a result,

(13) $\bar{D}\, e^{(\gamma+\delta)t} = æ\,(\gamma+\delta)\,W$ and $W = \omega\bar{E}\, e^{\gamma t}$.

Substituting for W, we have

(14) $\bar{D}\, e^{(\gamma+\delta)t} = æ\,(\gamma+\delta)\,\omega\bar{E}\, e^{\gamma t}$.

The date of the occurrence of the exchange rate crisis, t^*, can be predicted by dividing (14) by (12), multiplying the results by $(\bar{R}+\bar{D})/\bar{D}e^{\gamma t})$, taking natural logarithms and dividing by δ:

(15) $t^* = (ln\ [\dfrac{æ\,(\gamma+\delta)}{æ\,(\gamma)}\ \dfrac{\bar{R}+\bar{D}}{D}\ ])/\delta.$

Thus, the timing of the crisis is clearly an increasing function of the fraction $æ(\gamma+\delta)/æ\,(\gamma)$, i.e., the collapse occurs sooner with a greater sensitivity of the money demand with respect to the expected rate of inflation. Also, the greater the rate of excess growth of domestic credit (δ) and the smaller the initial stock of international reserves relative to credit ($\bar{R}/\bar{D}$), the sooner is the Central Bank forced to give up the peg. With a relatively constant sensitivity of money demand, the timing of the attack could be estimated as:

$$\hat{t}^* = \hat{\alpha}_{\varnothing} - \hat{\alpha}_1\,(\dot{D} - \dot{E}) + \hat{\alpha}_2\bar{R}/\bar{D} + \text{error term.}$$

Equivalently, the probability of devaluation is an increasing function of the growth of domestic credit. It is an increasing function of the relative stock of international reserves. Thus,

$$\hat{PDEV} = \hat{b}_{\varnothing} - \hat{b}_1 (\dot{D} - \dot{E}) + b_2 \bar{R}/\bar{D}) + \text{error term.}$$

2.3 Testing for Exogeneity

Implicit in the MABOP model are the assumptions of exogeneity of the determinants of the money balances. Some critics, however, presented certain controversies over the accuracy of the assumptions. When these assumptions are incorrect, Geweke (1978, p. 163) argued that "the otherwise identifying restrictions imposed on structural equations may not be sufficient to identify those equations, estimation procedures will be inconsistent, and the model cannot adequately portray the dynamics of the system it seeks to describe." This subsection then investigates on this potential bias using Granger-type test of causation detection.

The Granger test[2] of detecting the direction of causality between two time-series variables, x and y, involves estimating the following regressions:

$$y_t = \sum_i^n \phi x_{t-i} + \sum_j^n \psi_j y_{t-j} + u_t$$

$$x_t = \sum_i^m \zeta_i x_{t-i} + \sum_j^m \zeta_j y_{t-j} + v_t$$

where u_t and v_t are taken to be uncorrelated white noise series.

Hsiao (1981) had noted that the appropriate number of lags should be based on the minimum Akaike final prediction error (FPE) criterion, and suggested estimating

$$y_t = c + \sum_i^n \phi_i x_{t-i} + \sum_j^n \psi_j y_{t-j} + time + u'_t$$

[2]This test will be used despite its criticisms (see Zellner, 1979). Alternative tests of causality detection are provided by Sims (1972), Wu (1973), and Hsiao (1981), among others.

$$x_t = c + \sum_i^m \zeta_i x_{t-i} + \sum_j^m \zeta_j y_{t-j} + time + v'_t$$

if we have a non-stationary data. Suppose we suspected that the domestic credit was not econometrically exogenous in (3). Specifically we may wish to test the hypothesis that the authorities sterilized reserve inflows by means of the test outlined above.

Where y is the reserves variable and x the credit variable, we say that there is *unidirectional causality* running from domestic credit (reserves) to reserves (domestic credit) if $\Sigma\, \varnothing_i$ ($\Sigma\, \Im_i$) is statistically different from zero and $\Sigma\, \psi_j$ ($\Sigma\, \zeta_j$) is not statistically different from zero.

Biodirectional feedback is indicated when the sets of reserves and domestic credit coefficients are both statistically different from zero.

Independence is suggested when the coefficients are not statistically significant in both regressions.

Similarly, if *FPE* (*R*) > *FPE* (*R,D*), then *D* causes *R*; if *FPE* (*D*) > *FPE* (*R,D*), then *R* causes *D*.

Taylor (1990) had noted that when Granger causality runs from the reserves variable, providing that the structural error terms are orthogonal, the relevant least-squares estimators may be asymptotically unbiased. This is so even though the authorities sterilize reserve inflows and the reserves variable Granger–causes the domestic credit variable.

3. Econometric Evidence

In this section we test the propositions of the model outlined previously. First, we test the assumption of the existence of a staple long-run money demand function. Then we proceed with the ordinary least-squares (OLS) estimation of the Philippine balance of payments and the probability of major adjustment in the rate of exchange.

Most of the basic data (see Appendix) are from IMF *International Financial Statistics* (IFS) and the Central Bank Department of Economic Research.

3.1 *The Basic Model*

The basic model developed previously was

$$\dot{R} = \hat{\alpha}_{\emptyset} + \hat{\alpha}_1\dot{D} + \hat{\alpha}_2\dot{y} + \hat{\alpha}_3\dot{i} + \hat{\alpha}_4\dot{P} + \hat{\alpha}_5\dot{m} + e.$$

Letting $\dot{R}$ = dlog (R), $\dot{D}$ = dlog (DC), etc. and taking into account that the intercept is expected asymptotically to approach Ø, it becomes

$$\text{dlog}\,(R) = \hat{\alpha}_1\,\text{dlog}\,(DC) + \hat{\alpha}_2\,\text{dlog}\,(YP) + \hat{\alpha}_3\,\text{dlog}\,(DR) + \hat{\alpha}_4\,\text{dlog}\,(CPI) + \hat{\alpha}_5\,\text{dlog}\,(MULT) + e$$

where DC is the domestic credit, YP is permanent income, DR is the discount rate, CPI is consumer price index, and $MULT$ is multiplier.

A model of the form

$$[R/H]\,\text{dlog}\,(R) = \hat{\alpha}'_1\,[DC/H]\,\text{dlog}\,(DC) + \hat{\alpha}'_2\,\text{dlog}\,(YP) + \hat{\alpha}'_3\,\text{dlog}\,(DR) + \hat{\alpha}'_4\,\text{dlog}\,(CPI) + \hat{\alpha}'_5\,\text{dlog}\,(MULT) + e$$

will also be estimated. H is equal to $R + DC$.

The regression results (see Table 1) show significant explanatory power for the monetary model. The demand for money equation is impressive, with an adjusted R^2 of 0.99. The insignificant value of the interest rate coefficient suggests that if the discount rate reflects the opportunity cost of holding money, then the demand for monetary balances is not responsive to interest rate changes. Hence, the money demand is Friedman-type rather than Keynesian. From this result, we could also expect that in the BOP equation, the interest rate variable will have an insignificant effect in the balance of payments.

Turning to the estimation of the MABOP reduced form, we could generalize that the regression possesses the hypothesized relationships. Too much expansion of domestic credit causes BOP deficits because residents dispose of their excess money holdings by demanding foreign goods. An increase in real growth affects the BOP positively, contrary to what the Keynesian model predicts. The interest rate, as hinted earlier, indeed does not affect the BOP significantly. A higher inflation rate which depletes real money balances increases the demand for money and therefore affects the BOP positively. The

Table 1 - Philippine Balance of Payments, 1969-89 (Annual Data)

Equation No	1 Money demand equation	2 Reserves equation 1	3 Reserves equation 2
Explanatory variables			
dlog (*DC*)		-0.253 (-0.63)	
d/H dlog (*DC*)			-3.23 (-2.83)[a]
dlog (*YP*)	(2.63)[a] (5.13)	1.932[c] (1.45)	1.915[c] (2.15)
dlog (*DR*)	(-0.0177) (-0.249)	0.0088 (0.11)	-.007 (0.112)
dlog (*CPI*)		1.181[c] (1.32)	2.63[a] (3.01)
dlog (*MULT*)		-0.909[a] (-10.9)	-0.866[a] (-13.73)
$\bar{R}^2$	0.99	0.906	0.937
S.E. of regression	0.117	0.119	0.097
F-stat		46.97[a]	71.0[a]

a - significant at 0.01
b - significant at 0.05
c - significant at 0.10

multiplier coefficient, which approximates the expected value of unity, confirms that an increase in the supply of money translates to an increase in demand in the goods market proportionately.

As the results suggest, adopting equation 2 would probably result in misspecification error arising from data measurement problems. Equation 3 appears to be a better model than equation 2 since the R^{-2}, T and F statistics increased significantly.

While the regressions possess the expected signs of the coefficients, it fails in depicting some of the putative magnitudes. This limitation is probably due to our small sample size. Equation 3 is not ideal in terms of depicting the *a priori* magnitudes. Nonetheless, the signs conform with the theory and the statistics are significant.

3.2 *Monetary Market Development and the Philippine Balance of Payments*

In this subsection OLS estimates of equation 8 are presented. The following group of eight countries was considered as "rest of the world": United States, Japan, Germany, United Kingdom, Singapore, South Korea, Netherlands, and Australia. The choice of the countries is based on their trade relations with the Philippines.

The Philippine balance of payments was tested using annual data for the period 1969-89. The estimation results are presented in Table 2. Regression equation 1 estimates (8a). As expected, the income coefficient is positive and the domestic credit coefficient is negative. This indicates that Philippine BOP deficit will grow faster if its domestic credit grows faster than the world average, or its real growth is below the world average.

Regression number 2 estimates equation (8b). It is quite impressive since the credit and income coefficients not only possess the hypothesized relationships but also have the putative signs suggested by the theory. The elasticity with respect to the income variable is not significantly different from unity and the elasticity with respect to the credit variable approximates -1.

Since our interest lies in the significance of the hypothesized relationships rather than in forecasting, we decided to accept the low R^2s. The Durbin-Watson test for autocorrelation lies in the zone of indecision. Nevertheless, the Cochrane-Orcutt iterative procedure was used and we came up with regression equations 3 and 4.

3.3 *The Probability of an Exchange Rate Collapse*

Estimating the probability of a devaluation involves a regression with a dummy dependent variable. The regressand takes the value 1 whenever the rate of depreciation exceeds five percent, 0 otherwise. This is acceptable since quarterly data was applied. Hence $PDEV = 1$ in observations 1972.2, 1975.3, 1977.4, 1982.4, 1983.1, 1983.2, 1983.4, 1984.2, 1984.4, 1986.1, 1990.3, and 1990.4. The total number of observations equals 84.

Table 2 - World Money Market Developments and the Philippine Balance of Payments, 1969-89 (Annual Data)
Dependent Variable is dlog ($PFA)

Number of Regressions	Constant	dlog (SWFA)	dlog (SWFA) r	dlog (Yd-Yw)	dlog (Yd-Yw) r	dlog (Dd-Dw)	dlog (Dd-Dw) r	AR(1)	R^2 F
1 a)	0.215[b]		0.088		0.368[b]		-0.518[b]		0.34
	(0.116)		(0.618)		(0.148)		(0.236)		2.87
	(1.856)		(0.143)		(2.478)		(-2.199)		
b)	0.207[b]		0.152		0.361[b]		-0.505[b]		0.338
	(0.116)		(0.622)		(0.149)		(0.236)		2.89
	(1.775)		(0.245)		(2.419		(-2.135)		
2 a)	0.1564[d]	0.3915		1.059[c]		-0.9[c]			0.22
	(0.12)	(0.654)		(0.676)		(0.553)			1.613
	(1.288)	(0.59)		(1.566)		(-1446)			
b)*	0.1475[b]	0.464[d]		1.045[c]		-0.786[c]			0.23
	(0.12)	(0.654)		(0.68)		(0.556)			1.673
	(1.215)	(0.708)		(1.536)		(-1.412)			
3 a)	0.252[b]		-0.219		0.385[b]		-0.547[b]	2.27[d]	0.33
	(0.141)		(0.647)		(0.18)		(0.255)	(0.285)	1.872
	(1.787)		(-0.338)		(2.14)		(-2.145)	(0.94)	
b)*	0.242[b]		-0.142		0.377[b]		-0.534[b]	0.255[d]	
	(0.14)		(0.657)		(0.18)		(0.258)	(0.286)	0.33
	(1.725)		(-0.217)		(2.093)		(-2.07)	(0.891)	1.841
4 a)	0.206[d]	-0.199		0.9741[d]		-1.131[b]		0.396[c]	0.3
	(0.156)	(0.645)		(0.742)		(0.545)		(0.297)	1.71
	(1.323)	(-0.308)		(1.309)		(-2.078)		(1.418)	
b)*	0.198[d]	-0.1253[d]		0.967[d]		-1.11[b]		0.383[c]	0.3
	(0.154)	(0.659)		(0.751)		(0.533)		(0.28)	1.692
	(1.287)	(-0.19)		(1.287)		(-2.006)		(1.35)	

[a]- significant at 0.01
[b]- significant at 0.05
[c]- significant at 0.1
[d]- significant at 0.25
* These equations include Philippine data in the definition of "world" variables.

Before interpreting the results presented in the table, we remark on the following features of the linear probability (LPM) model: (a) non-normality of the error term, (b) heteroscedasticity, (c) the possibility of the estimated probabilities to be > 1 or < 0, and (d) low R^2 not to be a measure of goodness-of-fit test. Since the sample size is large, problems (a) and (b) are solved asymptotically. As for (c), whenever $\hat{PDEV}$ goes beyond the bounds, the value 0.99 (0.01) is substituted. Finally, it is worth noting that although the R^2s are seemingly low, they are significant on the basis of the F test because of the large sample size.

The results confirm the expectations suggested by the theory. The intercept 0.2435 of the LPM equation (1) gives the probability of devaluation given "zero" reserves and no expansion in domestic credit. The slope 0.069 of the credit variable implies that, *ceteris paribus*, a unit increase in the growth of credit increases the probability by magnitude 0.069. Likewise, an increase in the stock of reserves

Table 3

$$
\begin{array}{llllll}
\text{LPM: (1)} & \hat{PDEV} = & 0.2435^{a} + & 0.069\ GDC^{b} & - & 0.20287\ ROVERD^{b} \\
 & \text{s.e.} = & (0.0713) & (0.00376) & & (0.0896) \\
 & t = & (3.414) & (1.83) & & (-2.264) \\
\multicolumn{6}{l}{R^2 = 0.0917 \quad \bar{R}^2 = 0.07 \quad SER = 0.34 \quad F = 4.087 \quad DW = 1.78}
\end{array}
$$

$$
\begin{array}{llllll}
\text{(2)} & \hat{PDEV} = & 0.2959^{a} + & 0.0839\ EXCGD^{b}_{t-10} & - & 0.2476\ ROVERD^{a} \\
 & & (0.0777) & (0.0039) & & (0.094) \\
 & t = & (3.81) & (2.156) & & (-2.6385) \\
\multicolumn{6}{l}{R^2 = 0.14 \quad R^2 = 0.1157 \quad SER = 0.337 \quad F = 5.77 \quad DW = 1.98}
\end{array}
$$

$$
\begin{array}{lllll}
\text{LOGIT:} \log(\hat{ODDS}) = & -0.8539^{c} + & 0.0451\ GDC^{c} & - & 2.2126\ ROVERD^{b} \\
 & (0.6) & (0.0298) & & (1.0615) \\
t = & (-1.4176) & (1.51) & & (-2.08437)
\end{array}
$$

no of iterations = 3 log likelihood = -30.497676

[a]-significant at 0.01
[b]-significant at 0.05
[c]-significant at 0.10
SER - standard error of the regression
GDC - domestic credit in growth rate
EXCGDC - growth rate of domestic credit minus the growth rate of the exchange rate
ROVERD - CB foreign assets over CB domestic credit

relative to credit decreases the probability of a devaluation by more than 20 percent. In the Philippines, the artifically high reserves level temporarily suspended the collapse of the home currency. The high magnitude of this coefficient is probably one reason why the government got addicted to foreign financing and defended the peso. However, as foreign financing got harder to acquire, the inevitable end of the peg occurred. It is suggestive that because we have relatively no control over external sources in the long run, a strong peso can only be maintained by controlling credit growth.

LPM equation 2 was estimated by maximizing the explanatory power of the model. It was found that the appropriate number of lags for the excess growth of domestic credit (EXCGDC) was 10. This could be interpreted as follows: holding all other things constant, it takes only about two-and-a-half years (ten quarters) for excessive credit expansion to raise the probability of speculative attacks against the home currency. Again, LPM (2) confirms that international money paucity hastens the crisis.

The logistic distribution function (LOGIT) equation involved estimating the logarithm of the odds in favor of devaluation (that is, log $((\hat{PDEV} / (1-\hat{PDEV}))$. For all the three equations, the results are consistent -- too much rate of credit change increases the likelihood of devaluations while relative abundance of foreign assets suspends the collapse. We note that we can compute the probability of devaluation by taking the antilog of the estimated log (*ODDS*) and solving for $\hat{PDEV}$. For example, in 1983.4 where *GDC* = 25.618 and ROVERD is 17.48, $\hat{PDEV}$ is approximately equal to 80 percent.

3.3 Detecting the Direction of Causality

The Granger test for causality was applied to find out about the nature of causality between the growth rate of foreign assets *(GFA)* and the growth of domestic credit *(GDC)* by the monetary authorities for the quarterly period 1970.1 to 1991.1. Table 4A shows the *FPEs* of the reserves and the credit variables. Minimizing the *FPEs* gives the optimum number of lags of the two variables: 13 for *GFA,* and 1 for *GDC.*

As we can see, treatment of *GDC* as the input reduces the *FPE* of the reserves equation, and treatment of *GFA* as the input reduces the FPE of the domestic credit equation. Since *FPE (GFA) > FPE (GFA,* *GDC)*, then we say *GDC* causes *GFA;* since *FPE (GDC) > FPE (GDC, GFA)*, then *GFA* causes *GDC.*

Table 4

A) The FPE of fitting a one-dimensional autoregressive process

Lags	FPE (GFA)	FPE (GDC)
1	619.133	102.324
2	639.942	104.141
3	619.409	107.955
4	643.333	117.738
5	641.837	114.400
6	645.812	116.550
7	671.878	119.560
8	686.838	124.580
9	717.129	129.874
10	723.395	135.178
11	715.747	138.083
12	609.096	139.768
13	604.131	142.174
14	614.788	144.072
15	641.203	144.079

B) The optimum lags of the manipulated variable and the FPE of the controlled variable

Controlled variable[a]	Manipulated variable	Optimum lag[b]	FPE
GFA (13)	GDC	1	590.284
GDC (1)	GFA	1	98.608

a) the optimum number of lags are in parentheses
b) the optimum lag for the manipulated variable

Summary:
FPE (GPA) = 604.131
FPE (GFA, GDC) = 590.284
FPE (GDC) = 102.324
FPE (GDC,GFA) = 98.608

Doing a standard F test on the Granger causality equations yields the following results:

Direction of causality	*F*	*Decision*
GFA => GDA	1.683[b]	Do not reject
GDC => GFA	1.954[a]	Do not reject

[a] - significant at 0.1
[b] - significant at 0.25

The results confirm that we can not reject the hypothesis that domestic credit expansion causes international reserves flow with 90 percent confidence. Also, we say with 75 percent confidence that the credit variable Granger-causes the reserves variable to a lesser extent thereby suggesting sterilization activities by the government during the period. As noted earlier, this does not necessarily imply the existence of potential bias in the estimation of the MABOP reduced form.

4. Summary of Findings and Concluding Comments

The task of this paper was to investigate and to articulate on the Philippine balance of payments experience. The empirical results confirmed the proposition of the monetary approach and supported the view that international reserves flow can not be understood without explicit reference to the monetary market in the Philippines and the rest of the world.

The following were the major findings:

(1) The domestic credit expansion affected the level of international reserves negatively and stimulated speculative attacks on the peso;

(2) The demand for money was insensitive to the discount rate and therefore changes in the interest rate did not significantly affect the balance of payments;

(3) Although external financing somehow suspended the collapse of the peso, it was an ineffective tool for defending the exchange rate since foreign funds were not in the control of a less developed country like the Philippines. The monetary authorities must control its domestic credit expansion if it wants to strengthen the peso.

Since the country's major trading partners (e.g., Japan and the United States) have high real growths, the policymakers must ensure that in the long run the country must at least have a domestic credit expansion that does not exceed its partners'.

Indirectly, the organizational structure of the Central Bank has played a role in the balance-of-payments experience of the country. With a Central Bank that is in the control of the executive branch in the government, the Philippines had failed in controlling credit growth. Further research could be focused on the impact of the degree of centralization of the monetary authorities on the monetary and fiscal policies in general, and the level of international reserves in particular.

APPENDIX

Data Definition

CPI	= consumer price index (line 64 of IFS) will be the price variable, with 1985 as the base year. Ideally the measure should reflect only the price changes in the tradeable goods sector. For lack of better substitute, the *CPI*, it is hoped, will give suggestive results.
DC	= domestic credit extended by the Philippine monetary authorities which is the sum of IFS lines 12a, 12b, 12e, and 12f.
DR	= end-of-period discount rate which will be the proxy for the opportunity cost of holding money. The choice is not arbitrary since the earliest data on the treasury bill, deposit, and the ending rates started in 1976.
D_d	= the sum of the dollar values of the domestic credit extended by the Central Bank of the Philippines (CBP) to the central government, deposit money bank, official entities, and other financial institutions. IFS lines 12a, 12b, 12e, and 12f divided by IFS line ae.
D_w	= $\Sigma_{i=1}^{8}(DC_i / ER_i)$; where DC_i is the sum of the dollar values of the domestic credit to the central government, the deposit money banks, and other institutions of the monetary authorities of country *i*. The countries we include on the basis of their trade relations with the Philippines are United States, Japan, Germany, United Kingdom, Singapore, South Korea, Netherlands, and Australia.
ER	= domestic currency per US dollar, end of period.
EXCGDC	= excess domestic credit growth. It is computed by subtracting the growth of the exchange rate from the growth of the total credit extended by the CBP (*GDC*). Basic data are from IFS lines ae, 12a, 12b, 12e, and 12f.
GDC	= rate of domestic credit expansion is computed by taking the growth rate of DC.
GFA	= growth rate of foreign assets is derived by taking the rate of change of IFS line 11.
H	= high-powered money (line 14 of the IFS).
M	= stock of money supply is narrowly defined (M1) (IFS line 34).

MULT = money multiplier which is computed by dividing the money supply with the base money (M/H).

PDEV = probability of devaluation is a dummy variable which takes a value 1 for the quarters 1972.2, 1975.3, 1977.4, 1982.4, 1983.1, 1983.2, 1983.4, 1984.2, 1984.4, 1986.1, 1990.3, and 1990.4.

R = the foreign assets of the monetary authorities (IFS line 11) which will represent the level of international reserves.

ROVERD = foreign assets divided by domestic credit extended by the Philippine monetary authorities. (line 11)/(line 12a + 12b + 12e + 12f)

YP = the permanent real income (using 1985 prices). This is a weighted average of this year's real income and those of the last three years. The weights given are 0.4, 0.3, 0.2, and 0.1 with the later years getting the heavier weights. No attempts are made to maximize the model's explanatory power.

Y_d = domestic real income with 1985 as the base year (IFS 99 a.p)

Y_w = $\Sigma_{i=1}^{8}(y/ER_i)$ where y_i is the real GNP of country i. 1985 will be the base year.

$PFA = dollar value of Philippine foreign assets which is line 14 divided by line ae.

$WFA = the dollar value of the world foreign assets = $\Sigma_{i=1}^{8}(FA_i/ER_i)$ where FA_i is the foreign assets held by country i.

References

Blanco, Herminio and Garber, Peter (1986), "Recurrent Devaluation and Speculative Attack Against the Mexican Peso," *Journal of Political Economy*, 94: 1:148-166.

Connolly, Michael and Taylor, Dean (1984), "The Exact Timing of the Collapse of an Exchange Rate Regime and Its Impact on the Relative Prices of Traded Goods," *Journal of Money, Credit and Banking*, 16 (May): 194-207.

Flood, Robert P. and Garber, Peter M. (1984), "Collapsing Exchange Rate Regimes: Some Linear Examples," *Journal of International Economics*, 17 (August) 1-13.

Flood, Robert P. (1984), "Gold Monetization and Gold Discipline," *Journal of Political Economy* 92, (February): 90-107.

Frenkel, Jacob and Johnson, Harry, eds. (1977), *The Monetary Approach to The Balance of Payments*, London: Allen and Unwin.

Geweke, John (1978), "Testing the Exogeneity Assumption in the Complete Dynamic Simultaneous Equations Model," *Journal of Econometrics,* 7 (April): 163-185.

Hsiao, Cheng (1981), "Autogressive Modelling and Money-Income Causality Detection," *Journal of Monetary Economics,* 7:85-106.

Krugman, Paul (1979), "A Model of Balance of Payments Crisis," *Journal of Money, Credit and Banking,* 11 (August): 311-325.

Montiel, Peter (1984), "Credit and Fiscal Policies in a Global Monetarist Model of the Balance of Payments," *IMF Staff Papers,* December : 685-708.

Obsteld, Maurice (1984), "Balance of Payments Crisis and Devaluation," *Journal of Money, Credit and Banking*, 16 (May): 208-217.

Salant, Stephen W. and Henderson, Dale W. (1978), "Market Anticipation," *Journal of Political Economy,* 86 (August): 627-48.

Sims, Christopher A. (1972), "Money, Income and Causality," *American Economic Review,* September: 540-552.

Taylor, Mark P. (1990), *The Balance of Payments: New Perspective in Open-Economy Macroeconomics,* England: Edward Elgar.

Wu, De-min (1973), "Alternative Tests of Independence Between Stochastic Regressors and Disturbances," *Econometrica,* (July): 773-750.

Zellner, A. (1979), "Causality and Econometrics," in *Three Aspects of Policy and Policymaking: Knowledge, Data and Institutions,* ed. K. Brunner and A. Meltzer, Amsterdam: North Holland, pp. 9-54.