Determinants of LDC Devaluation Decisions: An Exploratory Investigation of Devaluation In Brazil
Parviz Ashghian* William G. Foote ** Reza Saidi***

INTRODUCTION

Despite the rich body of literature on the subject of devaluation, there has been no systematic study to determine the economic variables that have significant impact on the devaluation decisions. The existing theoretical work on devaluation is enriched with the "elasticity approach" initiated by Birdker (1929); the "absorption approach" launched by Alexander (1968); and the "monetary approach" developed by Haber (1959), Johnson (1976), and Modell (1966); and recently by the writings of Dornbusch (1973), Anderson and Takayama (1977), and Gilpin and Schmitz (1965), among many others.

The present empirical studies in the area of devaluation can be divided into two groups. The first group of studies supports the view that devaluation is successful in improving the balance of payments deficit [Ashghian (1985) on the LDCs; Ashghian (1986), and Ashghian and Foote (1988) on advanced countries]; and less developed countries; Connolly and Taylor (1976) on developing countries; and Connolly and Taylor (1979) on mixed sample of developed and developing countries]. These studies use a monetary model and provide positive findings with regard to devaluation. The second group of studies reach conclusions that do not lend support to the effectiveness of devaluation in resolving the balance of payments problems of countries under consideration [Coooper (1971a, 1971b), Brugman and Taylor (1978), Taylor (1981), and Schmidt (1982)].

All of the above studies have analyzed the impact of devaluation on the balance of payments. However, no study has tried to measure the possibility that certain economic variables are more significant in determining devaluation decisions as compared to others, given the balance of payments objective. There are two stages in a country's devaluation decision: the first is the commitment to perform a devaluation. Having decided to devalue, the country then focuses on the amount and direction of devaluation. This paper analyzes the country's discrete choice problem that stems from its announcement to devalue in the context of a monetary approach to the effects of devaluation on economic performance.

A Model of Devaluation Policy Adoption

A country faces uncertain outcomes from the adoption of a devaluation policy. The country is assumed to devalue, or not, based upon the maximization of a social welfare objective function. The following discussion closely parallels the developments in Chow (1983, Ch 3) and Assemply (1985, Ch 9). Denote a policy index p = 1 for no-devaluation policy, and p = 1 for a policy to devalue. Let U(G) be the country's utility function that cardinality ranks preferences for policy p at date t assuming goal G. A linear relationship between the utility of goals, U(G), a vector of economic conditions X, and error, ε, is postulated.

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where $\beta$ is a vector of sensitivities of devaluation preferences to economic conditions. The country chooses the devaluation policy $p$ that yields the highest utility. If $U_B > U_A$, then country should adopt policy $p = 1$. Let the binary variable $D_t$ index the policy choice such that:

$$D_t = 1, \text{ for } U_B > U_A; \text{ adopt or continue devaluation}$$

$$D_t = 0, \text{ for } U_A > U_B; \text{ do not adopt, or discontinue devaluation.}$$

The probability that $D_t = 1$ is a function of the date $t$ economic conditions, and error. Let $P_t$ denote the date $t$ probability such that:

$$P_t = \text{Prob}(D_t = 1) = \text{Prob}(U_B > U_A | X_t, \beta)$$

$$= \text{Prob}(X_t | \pi < X_t, \beta_t > 0)$$

$$= \text{Prob}(\pi < X_t | \pi = X_t, \beta_t = 0)$$

$$= \text{Prob}(\pi < X_t) = F_X(X_t),$$

where $u_t = \pi_t + \epsilon_t$, $\beta_t$, and $F$ the cumulative probability distribution of $u$ evaluated at $X_t$.

The probability that a country will adopt devaluation as a policy is the probability that the country's utility, given decision, exceeds the country's utility of not devaluing. The odds in favor of devaluation are $P_t(1 - P_t)$ at date $t$. Insofar as the odds are a monotonic transformation of $P_t$ with a range from 0 to infinity, negative values are excluded. But we do require a relation that is invariant to sign changes between $P_t$ and $1 - P_t$. Describing the odds in a log-linear function as a function of $x_t = \log(X_t)$ will accomplish this:

$$\log[P_t(1 - P_t)] = \beta_t x_t$$

where $\beta_t$ is the elasticity of the odds in favor of a devaluation. Solving for $P_t$ in (4) we get:

$$P_t = \frac{1}{1 + \exp(-\beta_t x_t)}$$

so that $P_t$ takes on the form of the logistic function. Assuming this functional form for the cumulative probability of devaluation distribution function $F(x)$ we can estimate using logit regression of the binary model

$$D_t = X_t \beta_t + \epsilon_t$$

Given this formulation of the estimation of discrete choices to devalue, what remains before empirical implementation is the appropriate specification of the vector of explanatory variables $X_t$. The next section employs a monetary adjustment model of exchange rates to specify $X_t$.

A Monetary Specification

A new standard monetary adjustment model of the determination of exchange rates is used to specify the vector of explanatory variables $X_t$. In logarithmic terms let:

$$s = p - p_t$$

where $s$ is the exchange rate in home currency units, $p$ is the home price, and $p_t$ is the world (sticky) price. Equation (7) is simply a statement of purchasing power parity relationship between exchange rates and prices. Home and world (denoted by asterisked variables) real money demand follows:

$$m = p + ay - b; \text{ } m_t = p_t + ay_t - b_t$$

where $m$ is real balances, $y$ is gross domestic product, and $i$ is the interest rate. In (8) we assume for expository reasons only that monetary demand price, income and interest rate elasticities are equal across countries. Substituting (8) into (7) we have:

$$s = (m - m_t) - ay - y_t + b(\pi - \pi_t)$$

Transforming $p$ to $i$, the inflation rate, and imposing uncovered interest parity implies that changes in exchange rate expectations follow the relation:

$$\Delta e = i - r^* = x - x^*.$$  

Depositing (10) into (9) allows us to express exchange rates as:

$$s = (m - m_t) - ay - y_t + b(\pi - \pi_t).$$

On the assumption that a country derives utility from balance of payments goals relative to devaluation policies, we can use the exchange rate determination model in (11) to formally identify the logistic regression in (6). The equilibrium money market relation requires that:

$$m = r + c$$

where $r$ is real international reserves, and $c$ is real domestic credit. Substituting (12) into (11) we have:

$$s = (r - r_t) + (c - c_t) - ay - y_t + b(\pi - \pi_t).$$

By definition the balance of payments surplus or deficit is $b = r - r^*$, so that from (13) we have:

$$s = (c - c_t) + ay - y_t + b(\pi - \pi_t).$$

On the assumption that a country derives utility from balance of payments goals, then the logistic model becomes:

$$\text{Prob}(U_B = p = 0) | (U_B = 1) | F(b, c, y, x_t)$$

where all asterisked variables are subscripted in a constant term. From equation (14) we can infer that a rise in inflation rate and rate of domestic credit formation worsens balance of payments in the other hand, a rise in the rate of growth of the gross national product and the exchange rate improves balance of payments.

DATA AND EMPIRICAL RESULTS

We collected binary data on devaluation decisions by Brazil from various issues of Pick's Currency Yearbook monthly for 1969 to 1971 (fixed exchange rate regime), and 1972-1991 (flexible exchange rate regime). A zero is assigned to a month in which Brazil did not devalue; a one is assigned for a month of observation of devaluation. The non-qualitative data comes from various issues of International Financial Statistics. Exchange rates are reported from line $b$, the so-called free rate. Domestic credit is reported quarterly on line 32. We interpreted monthly observations at constant growth during the quarter. International reserves are monthly observations on line 14. Money supply is constructed from lines 14 plus 32. Line 66 reports the monthly consumer price index. Unfortunately, only annual measures of national product or income are reported during the years of this sample.

To estimate the logistic model of equation (15), we form the logarithm of the ratio of date $t$ to date $t-1$ exchange rates, domestic credit and price index for use as independent variables. The model is estimated, using Maximum Likelihood estimation technique. A maximum likelihood procedure available through SAS's PROC CATMOD is used to estimate the logistic qualitative response of Brazil to economic conditions.
through the vehicle of devaluations. In running the models, only a variable-by-variable analysis is possible due to the severe collinearity of the explanatory variables. Table 1 reports the results of the logistic regressions for 1969-1971 period.

**TABLE 1**

Logistic Regression of Devaluation Decisions

<table>
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<tr>
<th>Const.</th>
<th>EX</th>
<th>EX1</th>
<th>INF</th>
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<th>MS</th>
<th>MS1</th>
<th>L.R.</th>
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**TABLE 2**

Logistic Regression of Devaluation Decisions

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<th>INF1</th>
<th>MS</th>
<th>MS1</th>
<th>L.R.</th>
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<td>0.15</td>
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</tr>
</tbody>
</table>

**EX=log(average exchange rate/t-1 exchange rate); EX1=log one month of date t EX; INF=log(average consumer price index/t-1 consumer price index); INF1=log one month of date t INF; MS=log(average t money supply/t-1 money supply); MS1=log one month of date t MS; const. intercept; first number is estimate, second is chi-squared statistic, third is probability of significance; L.R.=likelihood ratio.

Measurment likelihood ratios indicate the overall usefulness of the variables in explaining devaluation response. Probabilities of significance greater than 10% show promise of significant explanation. Each variable's elasticity of response to the odds of devaluation have estimates distributed in chi-squared with 1 degree of freedom. Significant differences occur with probabilities of significance less than 10%.

From Table 1, current and lagged one month exchange rates and money supply growth significantly affect the odds of a devaluation decision. Positive signs on EX and EX1 indicates that a decrease in the current and lagged exchange rates, that is, a decrease in the value of foreign currencies in terms of domestic currency, worsens balance of payments. (See equation 16.) This increases the odds in favor of devaluations (See equation 15). More specifically, a 10% decrease in the current month will result in a 15.5% increase of the odds in favor of a devaluation. If there is a decrease in the month previous to devaluation, then there is a 15.1% increase of the odds in favor of a devaluation. However, with respect to home inflation, there can not be corroborated any significant relationship between devaluation decisions and the consumer price index.

Finally, with money supply defined as international reserves plus domestic credit, a 10% increase in the growth of the money supply correlates with a 6.9% decline in the odds of a devaluation decision in the same month. Similarly in the month prior to devaluation, a 10% increase in the money supply is associated with a 13.5% decline in the odds of a devaluation occurring. On the other hand, as the money supply increases, currency "naturally" becomes less valuable, so that in effect there is a deprecation of the currency. With a naturally occurring deprecation there are less odds in favor of a devaluation decision.

Given the 1972-1991 data (the floating exchange rate regime), we were only able to examine 1972 to 1974 period. This is because the qualitative response model employed here could not be applied to the data for the periods after 1974, in particular for the period of 1980s. This is due to the fact that there were only devaluations of Brazil's currency. This situation makes it impossible to run a logit regression model in which it requires a dichotomous dependent variable (at least two response, devalue or non-devalue). Results for the period 1972 to 1974 are presented in Table 2. None of the variables considered are significant for the period 1972 to 1974. This finding is in contrast to the results for the period of fixed exchange rates of 1969 to 1971. This indicates that during the floating exchange rate the weak currency of Brazil depreciated so quickly that no policy was effective to control it. Therefore, the policy makers with no other choice but the decision of constant devaluations. This situation is even more severe in the later period, namely 1980s, in which Brazil currency was devaluated daily.

**CONCLUSION AND FUTURE WORK**

This paper constructs a qualitative response model of the less developed country's devaluation decision in a monetary adjustment framework. Current depreciations are accompanied by a high probability of devaluation. The devaluation decision is further very sensitive to the existence of current and lagged exchange rate depreciations. It is as if the country realizes the ongoing depreciation and then makes a formal announcement of this economic fact in the form of an official devaluation.

On the other hand, growth of international reserves and domestic credit has an opposing effect on the probability of a devaluation decision. Increases in reserves indicate a move away from balance of payments deficits toward surpluses with trading partners. More domestic credit signals relatively "easy" monetary policy.
a situation often directed toward fueling economic growth. Both changes indicate an economy that grows in real terms. Thus there ought to be less of a probability of devaluation in these scenarios. With the data set here employed the money supply effect on devaluation is less than half of the exchange rate effect for the period of 1969 to 1971. However, for the period after 1971 when floating exchange rate was established, we found no significant effect of these variables. This indicates that during the floating exchange rate period policy makers may not be able to significantly control a weak currency from depreciation followed by the official devaluation.

While there is much else occurring in the economy than can be excised from an examination of the monetary model's variables, the lack of reliable monthly data plagues the research effort in this area. However, future work will endeavor to employ 'black market' exchange rate data and the econometric issue of simultaneity bias in quantitative response models. This latter problem involves the use of instrumental variable techniques to examine the collinearity and serial correlation of the explanatory variables.

REFERENCES


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