A Note on the Demand for International Reserves by Less Developed Countries

By

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Abstract

In this paper, the relationship between the demand for international reserves and the willingness to use expenditure-switching policies is investigated for the case of LDC's. The results show that countries that have been willing to use exchange rate adjustments to correct payments imbalances hold, on average, less reserves than fixed exchange rates LDC's. It is formally shown that these two groups of countries have different demand functions for international reserves, and that they should not be pooled for prediction of other purposes. These results have important implications for the analysis of the adequacy and distribution of international reserves.

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1. Introduction

Empirical studies on the demand for international reserves have usually made a distinction between developed and less-developed countries. In particular, in two recent papers, Frenkel (1978, 1980) has found that these two groups of countries have different demand functions for international reserves.[1/] This is an important finding since it indicates that not all countries should be pooled for prediction (or other) purposes in the analysis of international reserves. Specifically, it would be inappropriate to analyze the "adequacy" of international reserves using common regression estimates for all countries (developed and less developed).[2/]

In this note I investigate whether it is appropriate to pool all less developed countries (LDC's) in the estimation of the demand for international reserves. In particular, the following is investigated: Do countries that have maintained a fixed exchange rate for a long period of time -- and, thus, have to rely almost exclusively on expenditure-changing policies to adjust their balance of payments -- have the same demand function as countries that have used exchange rates adjustments (expenditure-switching policies) to correct payment imbalances?

From a theoretical point ov view, it is expected that countries that are willing to use expenditure-switching policies (i.e., devaluations) would hold, on average, a lower level of international reserves. This proposition has been advanced by a number of authors.[3/] Kelly (1970, p. 656), for example, has stated that "the final option is to alter the peg... Such policy would also require the holding of less reserves on average."[4/] On the other hand,

Makin (1970) has developed an explicit model of the demand for international reserves under some exchange rate flexibility. This model also indicates that countries that are will to use exchange rate adjustments to correct payments imbalances will hold less reserves than fixed rate countries.

The specification of the demand function and the definition of the variables used in the empirical analysis presented in this paper follow the work by Frenkel (1978, 1980). However, the results are not affected by alternative specifications or definitions of the different variables involved.[5/]

2. The Demand for International Reserves by LDC's: 1964-1972

Following Frenkel (1978, 1980), it is assumed that the demand for international reserves is a stable function of a scale variable (imports - IM), an openness variable (the average propensity to import - m), and a payments variability term (σ).[6/] Then, the demand function for international reserves can be represented by equation (1):

$$\log R = a_o + a_1 \log IM + a_2 \log m + a_3 \log \sigma + u \qquad (1)$$

where u is a random term identically and normally distributed. It is expected that $a_1 > 0$, $a_2 > 0$, and $a_3 > 0$.[7/] However, if countries willing to use expenditure-switching policies actually have a different demand function, it would be expected that the a's coefficients will be different for them and for fixed rate countries. Additionally, if countries that are willing to devalue their currency do hold less reserves on average, it would be expected that in a common regression (for all LDC's), the residuals corresponding to these countries would be significantly negative, those for fixed-rate countries being significantly positive.

Tables 1 and 2 present cross-section results both for a group of 23 LDC's that maintained a fixed rate during 1964-1972, and for a group of 18 LDC's

Table 1

The Demand for International Reserves
for Fixed Exchange Rate LDC's
Cross Section Results 1964-1972

(OLS)

$$\log R_n = a_o + a_1 \log IM_n + D_2 \log M_n + a_3 \log \sigma_n + U_n$$

Year	Constant	$\log IM_n$	log m	log σ	R^2	S.E.
1964	-1.591	1.088	.626	.303	.883	.569
	(1.339)	(.249)	(.304)	(.201)		
1965	-.472	.876	.610	.372	.860	.600
	(1.339)	(.249)	(.374)	(.212)		
1966	-.100	.647	.604	.677	.868	.594
	(1.181)	(.230)	(.303)	(.204)		
1967	.032	.633	.784	.757	.874	.607
	(1.139)	(.219)	(.333)	(.192)		
1968	.237	.578	.685	.750	.870	.603
	(1.129)	(.216)	(.326)	(.187)		
1969	-.101	.642	.573	.679	.873	.589
	(1.061)	(.202)	(.206)	(.187)		
1970	.009	.486	.401	.816	.838	.677
	(1.185)	(.226)	(.345)	(.205)		
1971	-.715	.689	.313	.656	.869	.597
	(1.051)	(.225)	(.309)	(.212)		
1972	-.205	.740	.400	.471	.862	.597
	(1.187)	(.254)	(.190)	(.225)		

Note: Standard errors in parentheses.

Table 2

The Demand for International Reserves by LDC's That Have Occasionally Adjusted Their Parity

Cross Section Results 1964-1972
(OLS)

$$\log R_n = a_o + a_1 \log IM_n + a_2 \log M_n + a_3 \log \sigma_n + U_n$$

Year	Constant	$\log IM_n$	$\log M_n$	$\log \sigma_n$	R^2	S.E.
1964	-1.885 (1.666)	.973 (.345)	-.544 (.346)	-.111 (.239)	.703	.722
1965	-1.956 (1.599)	.984 (.324)	-.636 (.356)	-.155 (.237)	.712	.701
1966	-2.078 (1.499)	.992 (.307)	-.606 (.357)	-.149 (.230)	.726	.465
1967	-1.922 (2.357)	1.012 (.484)	-.094 (.513)	-.005 (.349)	.534	1.005
1968	-1.309 (.879)	.942 (.183)	.273 (.204)	.199 (.162)	.897	.396
1969	-1.701 (1.135)	.936 (.250)	-.225 (.220)	.071 (.241)	.876	.457
1970	-2.877 (1.373)	1.173 (.301)	-.511 (.248)	-.167 (.280)	.878	.474
1971	-3.002 (1.331)	1.189 (.288)	-.411 (.231)	-.084 (.263)	.878	.455
1972	-.884 (1.174)	.714 (.260)	-.287 (.215)	.360 (.244)	.919	.424

Note: Standard errors in parentheses.

that devalued their currency at least once during the same period.[8] As may be seen, the results obtained are very different for both groups of countries. The results for fixed exchange rate LDC's are very satisfactory. All of the coefficients have the expected signs, and most (excluding the constants) are significant. These results contrast sharply with those obtained by Frenkel (1980) for a group of 32 LDC's that included both fixed-rate and devaluation countries. In particular, while Frenkel found that the variability and average propensities to import coefficients (a_3 and a_2) were almost never significant during these years, the results reported in Table 2 show that for almost all of the years, they were highly significant. Furthermore, the values of the different coefficients for fixed-rate LDC's (Table 1) are very similar to those obtained by Frenkel (1980) for developed countries.

On the other hand, the results for those LDC's that have adjusted their parity are more similar to Frenkel's previous findings. As may be seen, the level of imports is the only coefficient that is significant for all years. Its value is, for all the years, not significantly different from one, suggesting that these countries do not have economies of scale in the holdings of reserves.[9] [10]

In order to formally test the difference between the demand functions for these two groups of countries, pooled time-series cross-section equations were estimated.[11] In Table 3 the results obtained for both groups are reported.[12] These results were then used, together with those from a common regression (for all countries), to compute an F statistic to test whether both groups of countries could be pooled.[13] The result of this F-test was 17.943,

Table 3

Pooled Regressions for
Fixed Rate Countries and Countries
that have Occasionally Adjusted their Parity

$$\log R_{nt} = a_o + a_1 \log IM_{nt} + a_2 \log M_{nt} + a_3 \log \sigma_{nt} + U_{nt}$$

(OLS)

	constant	log IM_{nt}	log M_n	log σ_n	R^2	S.E.
Fixed Rate Countries	-.372 (.352)	.715 (.069)	.547 (.103)	.602 (.061)	.858	.579
Countries that Occasionally Adjusted Parity	-2.270 (.467)	1.065 (.097)	-.347 (.098)	-.056 (.081)	.767	.608

Note: Standard errors in parentheses.

formally indicating that both groups of countries cannot be pooled.[14/] Finally, the residuals from the common regression were analyzed to test the hypothesis that, after correcting for scale, openness and variability, countries that are willing to adjust their parity hold less reserves than fixed-rate countries. The average value of these residuals was significantly negative for the devaluation countries; -.152 with a standard deviation of .053, and significantly positive for fixed-rate countries -- .117 with a standard deviation of .042. This result confirms the hypothesis that countries that are willing to use expenditure-switching policies hold less reserves, on average, than fixed-rate countries.

3. The "Adequacy" of International Reserves Held by LDC's

Estimates of demand functions for international reserves have often been used to analyze the "adequacy" of the reserves held by different countries and the distribution of international liquidity.[15/] Most of these studies compare actual reserves with "desired" reserves, as derived from some demand function, to determine if a country's holdings are adequate. However, if the demand function used as a benchmark for the comparison does not correspond to the actual demand function for a group of countries, the results from these adequacy studies will be misleading.[16/] In particular, as long as these adequacy studies do not make a distinction between countries that are willing to adjust their parity and countries that have ruled out exchange adjustments as a policy tool, their results will incorrectly show that devaluation countries hold inadequate levels of reserves.

The adequacy or inadequacy of reserve holdings for a particular country can be measured by comparing actual reserves held and desired reserves as

calculated from the estimated demand function. Then, following Kenen and Yudin (1965), the excess holdings of (gross) reserves can be computed (in log terms) as:

$$E_{nt} = \log \hat{R}^*_{nt} - \log R_{nt} \qquad (2)$$

where $\hat{R}^*_{nt}$ are desired or "computed" reserves and R_{nt} are actual reserves. If E is negative, then that particular country faces a shortfall of reserves. It is clear from equation (2) that the computation of $\hat{R}^*_{nt}$ is critical to determining whether a country has an excess or a shortfall of reserves. This fact is illustrated in Figure 1. Figure 1.a presents the distribution of E_{nt} for the 18 LDC's that have adjusted their parity, using the estimated coefficients of their own demand function (Table 3) to compute log R^*_{nt}. On the other hand, Figure 1.b presents the distribution of E_{nt} for the same group of countries using the coefficients estimated in the common demand function (for all countries), reported in footnote 11, to computed log R^*_{nt}.

As may be seen, the distribution of E_n looks quite different under the alternative computation of R^*_n. While E_n appears to be symmetrically distributed around zero (no excesses or shortfalls), when the specific demand function for these countries is used, its distribution is to the left when the common demand function coefficients are used to estimate log R^*_{nt}. Figure 1.b, then, would indicate that, on average, the holding of reserves of this group of LDC's is on the "inadequate" side. However, when it is recognized that countries willing to alter their parity want to hold a lower level of reserves, this result no longer holds, as figure 1.a indicates.

4. Conclusions

This paper has extended the existing empirical work on the demand for international reserves by analyzing the case of 41 LDC's. In particular, it

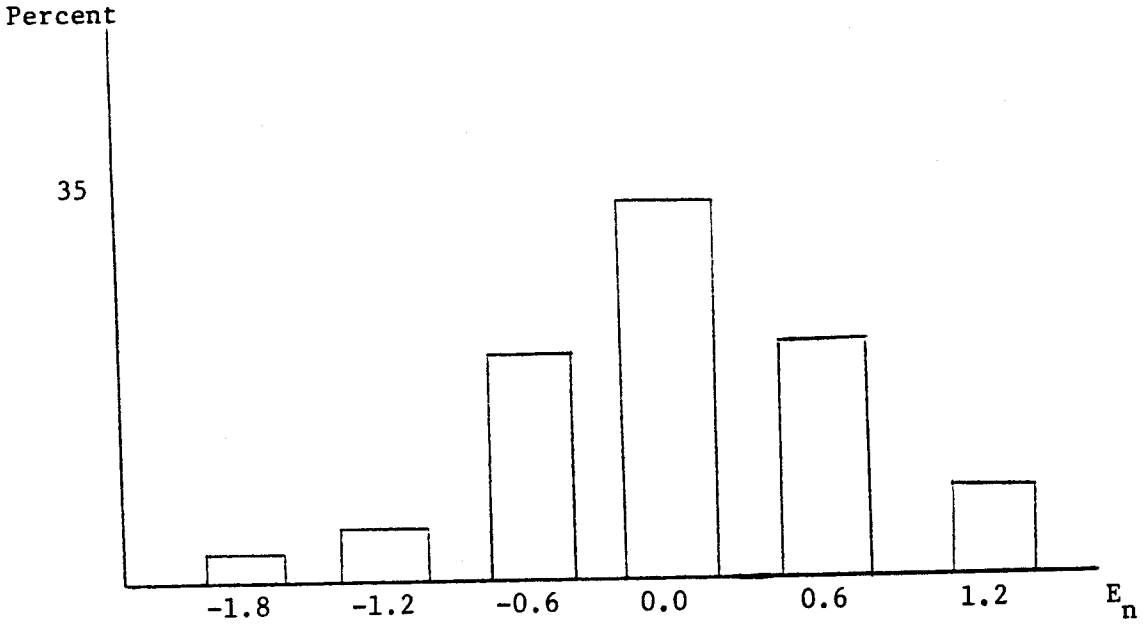

Figure 1.a

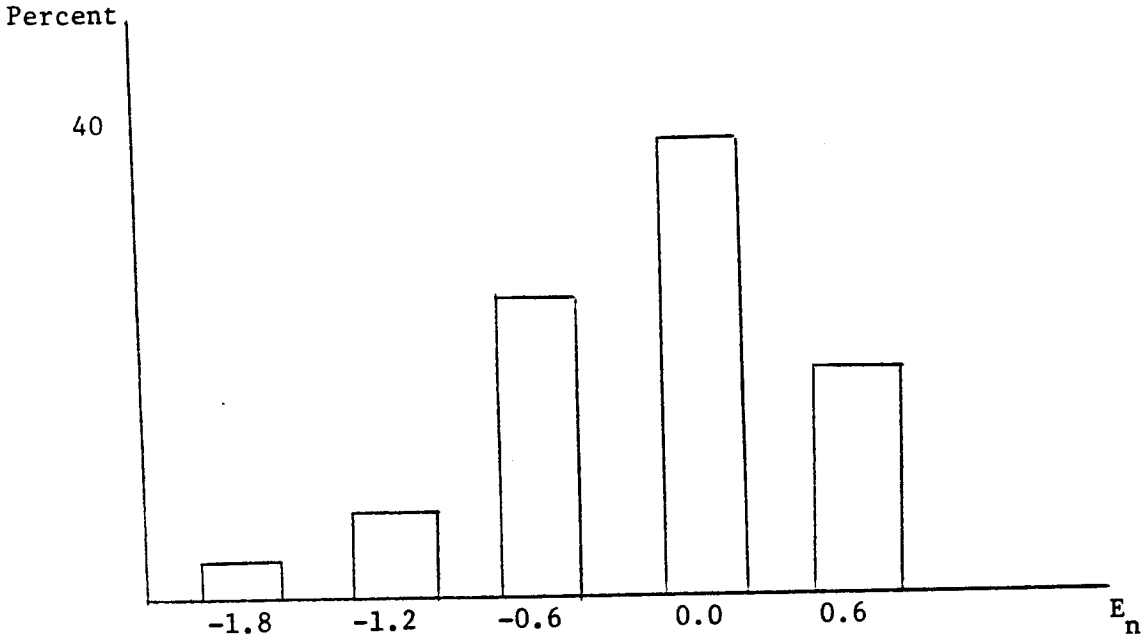

Figure 1.b

Figure 1

The Distribution of Reserves
Under Alternative Estimates of $\hat{R}^*_n$

was shown that LDC's that have been willing to adjust their parity to correct payments imbalances hold, on average, less reserves than fixed exchange rate LDC's. The empirical analysis formally showed that all LDC's should not be pooled for prediction or other purposes in the analysis of international reserves.

These results are important in at least two respects. First, they indicate that a distinction should be made between these two groups of countries when determining the adequacy and distribution of reserves.[17/] Failure to do this will result in predicting that those countries that are willing to use expenditure-switching policies hold reserves below their needs. Second, these results may help explain why empirical analyses (i.e., Heller and Kahn, 1978) on the demand for reserves under alternative regimes have not found a major change in LDC's' attitude after the international monetary system turned towards a (managed) floating regime. In fact, if a large number of LDC's considered in those studies already before 1973 were willing to use the exchange rate as a major adjustment tool, it is not surprising that their attitude did not change significantly when the international monetary system moved towards greater exchange-rate flexibility. Additionally, the results reported in this paper can help to explain one of the questions that Frenkel addressed in the concluding remarks of his 1978 paper: "[Why do] the residuals from the estimated equations reveal the existence of persistent negative residuals for some countries (e.g., the United Kingdom and New Zealand), and positive residuals for others (e.g., Switzerland) [?]" (page 128). In fact, both New Zealand and the United Kingdom had used exchange rate adjustment even before 1973 to correct payments imbalances, while Switzerland had traditionally ruled out a devaluation as a policy tool. The answer to this question, then, is that these countries do not belong to the same group and have different demand functions for international reserves.[18/]

FOOTNOTES

1/ Among the studies on the demand for international reserves that have made an explicit distinction between developed and less developed countries, see Kelly (1970), Clark (1970b), Hippel (1974), Heller and Kahn (1978) and Bilson and Frenkel (1979). Heller and Kahn (1978) also make a distinction between oil-producing and non-oil-producing LDC's.

2/ Ripley and Suss (1974), for example, have used a common demand function to analyze the "needs" of reserves for 104 countries. Their results, however, are heavily biased by the assumption that all countries have the same demand function for international reserves.

3/ See, for example, Kelly (1970), Clark (1970a), Hippel (1974), Makin (1974), Bird (1978) and Crockett (1978).

4/ Kelly (1970), Flanders (1971) and Hippel (1974) have tried to capture the effect of different attitudes towards exchange rate adjustments. In order to do this, they used indices that measured the "willingness" to alter the peg. Their results, however, were not conclusive. Recently, on the other hand, some studies have focused on the demand for international reserves under alternative exchange regimes. See, for example, Frenkel (1978, 1980), Heller and Kahn (1978) and Saidi (1981).

5/ For alternative specifications and definitions of the relevant variables, see Edwards (1981).

6/ Theoretically, the opportunity cost of holding reserves should also be included in the demand function. However, since most empirical studies have failed to find a significant coefficent, in this study we have followed Frenkel (1978,

1980) and omitted this variable. It should be noted, however, that Iyoha (1974) and Frenkel and Jovanovic (1981) have been able to find significant coefficients for the cost of holding reserves term. See the Appendix for the exact definition and sources of the data used.

7/ The rationale for these signs is the following: the larger the level of trade a country is engaged in, the higher will be the level of reserves it will demand ($a_1 > 0$); the more open the economy is to the rest of the world, the more vulnerable to external shocks it will be and, thus, the higher the desired level of reserves ($a_2 > 0$); and, the more variable external payments are, the higher the desired reserves for precautionary motives ($a_3 > 0$). It should be noted, however, that some authors (i.e., Heller, 1964; Heller and Kahn, 1978) have associated the average propensity to import (m) with the adjustment cost, postulating a negative coefficient.

8/ In this study, fixed-rate countries were defined as those that adjusted their parity less than 1% a year. For the case of devaluation countries, only those that had a devaluation of at least 15% were considered. See the Appendix for a list of the countries considered in each group.

The time period considered in this study was chosen in order to avoid the complications that arise once the international monetary system turned to a (managed) floating system in early 1973.

9/ Olivera (1969) and Claasen (1974) have suggested that there are economies of scale in the holding of reserves. Recently, Saidi (1981) has tested this hypothesis for the Canadian case. His results indicate that, for the Canadian case, the "square-root" hypothesis cannot be rejected.

10/ These equations were also estimated using Zellner's seemingly unrelated regressions procedure. The results -- available from the author -- support the OLS findings reported here.

11/ Rigorously, these equations should only be pooled if the demand functions are stable through time. In order to test for stability through time, F-tests were computed. Their values are F(32.175) = .438 for fixed-rate countries and F(32.130) = .648 for devaluation countries, indicating that the demand functions for both groups have been stable through this period.

12/ The results reported in Table 3 were obtained using variables in nominal terms. However, if variables are expressed in real terms, the results are not affected. See Edwards (1981).

13/ The results obtained from the common regression are:

$$\log R_{nt} = \underset{(.297)}{-1.056} + \underset{(.061)}{.819} \log 1M_{nt} + \underset{(.074)}{.173} \log m_n + \underset{(.054)}{.374} \log \sigma_{nt} \qquad R^2 = .784 \quad S.E. = .657$$

14/ The critical value of the F-test with 4 and 361 degrees of freedom is, at the 99 percent level, 3.02.

15/ See, for example, Kenen and Yudin (1965), Bird (1978, ch. 5), and Ripley and Suss (1974).

16/ Of course, not all studies on the adequacy of international reserves suffer from this shortcoming. Kenen and Yudin (1965), for example, have confined their analysis to the case of developed countries.

17/ Notice that this is a relevant distinction even in the 80's, where a large number of LDC's still maintain a fixed exchange rate with respect to some major currency. Of course, these countries are floating vis-a-vis the rest of the currencies.

18/ In this paper, we have abstracted from the dynamic adjustment problem. In Edwards (1981), it is shown that devaluation LDC's correct discrepancies between desired and actual reserves faster than fixed-rate LDC's. This result supports Clark's (1970a) model on the existence of a trade-off between the level of reserves and the speed of adjustment.

APPENDIX

A. Data Sources

International Reserves: Taken from the International Financial Statistics tape. The nominal series correspond to line 1.d of the IFS.

Real Income: Measured as GNP in domestic currency units, converted into U.S. $ using the average exchange rate. The raw data was taken from the IFS tape.

Average Propensity to Import: Defined as the ratio of imports (line 71.d of the IFS) to GNP.

Variability Measure (σ): Defined as the standard deviation of the trend adjusted changes of reserves for previous 14 years and the level of imports.

Thus, σ_T is measured as the square root of

$\sigma_T^2 = \sum_{t=T-14}^{T} (R_t - R_{t-1} - \hat{\beta}_T)^2/14$, where $\hat{\beta}_T$ is the estimate of the time trend of reserves of that country over the previous 15 years.

B. Countries Considered

Fixed Rate Countries	Devaluation Countries
Burma	Bolivia
Costa Rica	Colombia
Dominican Republic	Ecuador
El Salvador	Ghana
Egypt	Guyana
Greece	Iceland
Guatemala	India
Haiti	Indonesia
Honduras	Israel
Iran	Jamaica
Iraq	Korea
Jordan	Pakistan
Malaysia	Peru
Mexico	Philippines
Morocco	Spain
Nicaragua	Sri Lanka
Nigeria	Trinidad
Paraguay	Turkey
Portugal	
Syria	
Sudan	
Thailand	
Venezuela	

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