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REAL EXCHANGE RATE VARIABILITY: AN EMPIRICAL ANALYSIS OF THE DEVELOPING COUNTRIES CASE

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ABSTRACT

The purpose of this paper is to investigate the potential role of monetary and real factors in explaining real exchange rate variability in developing countries. For this purpose two indexes of real effective exchange rate variability that measure short-term and long-term variability were constructed for 30 countries. The results obtained, using a generalized least squares procedures on cross section data, indicate that real exchange rate variability has been affected both by real and monetary factors. In particular it was found that more unstable nominal exchange rate policies were reflected in higher real exchange rate instability in the short-run; more unstable domestic credit policies resulted in higher short-term real exchange rate variability; and more unstable external terms of trade also affected positively the degree of real exchange rate instability.

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I. Introduction

During the last few years real exchange rate variability has increased substantially both in developed and developing countries. From a policy point of view, it is important to understand what the main causes of this increased real exchange rate instability are. To the extent that the causes of real exchange rate instability are policy related -- for example, related to the nominal exchange rate system or to the degree of instability of domestic monetary policy -- economic authorities could, in principle, be able to implement policies aimed at reducing this variability. On the other hand, if real exchange rate variability depends on exogenous or structural factors -- like changes in the external teerms of trade -- the domestic authorities will have less maneuvering room to reduce it.[1]

Some earlier papers have analyzed some empirical aspects of the real exchange rate variability problem. For example, Korteweg (1980) discussed the possible sources of real exchange rate instability for a group of OECD countries, and pointed out that there is a presumption that real exchange rate variability had responded to shocks generated both from the monetary and real sides. Helleiner (1981), in an extensive study on exchange rate systems in developing countries, decomposed the sources of real exchange rate variability between external sources, or sources related to exchange rate movements between major currencies, and "other" sources. He found out that even though external sources had been important, in a large number of countries the "other" factors had dominated. Although he doesn't explicitly test other factors he mentions the potential roles of terms of trade changes and domestic monetary policy.

More recently some papers have analyzed the causes of real exchange rate variability within the context of deviations from purchasing power parity

(PPP). Stockman (1983), for example, developed a model to investigate the role of nominal and real disturbances on real exchange rate instability. According to his model, the exchange rate system should be neutral with respect to the degree of exchange rate variability. However, Stockman's results for a group of 38 developed and developing countries reject this proposition, and show that the variability of the real exchange rate has been higher under a floating rate system. Yuravlivker (1982) also found out that, for a group of four developing countries, real exchange rate variability was affected positively by the instability of the nominal exchange rate policy.

DeGrauwe, Janssens and Lelianert (1984) and DeGrauwe and Rosiers (1984) investigated the proposition that real exchange variability is caused by monetary disturbances. DeGrauwe, Janssens and Lelianert (1984), for example, used cross-section data to analyze the effects of inflation and monetary disturbances on real exchange rate instability increases with the variability of inflation and money growth rates. DeGrauwe and Rosiers (1984) developed a model based on Aizenman (1984) to investigate the causes of real exchange rate variability during the more recent period. This model predicts that in addition to monetary disturbances the degree of openness of the economy affects positively real exchange rate instability. Using cross-section data for 39 developed and developing countries for 1970-82 they present evidence that supports the hypothesis that monetary instability enhances real exchange rate variability; their results, however, provide little support to the hypothesis that openness has affected real exchange rate variability. Melvin and Bernstein (1984), on the other hand, analyze the role of real factors (only) on real exchange rate variability. Using cross-country data for 87 countries they regress a measure of variability of a bilateral real exchange rate against an index of exports concentration and a measure of a country's degree

of openness. They find that the coefficients of these two variables are significantly positive.[2]

It is somewhat surprising that most empirical studies dealing with real exchange rate variability have concentrated either on the role of monetary factors, or on the role of real (structural) factors. In theory, however, both types of disturbances will be important in determining real exchange rate variability in the short run.[3] In this paper this problem is tackled directly, by investigating the potential role of monetary and real factors in explaining real exchange rate variability, using cross-country data for a group of developing countries. In this paper a fairly pragmatic approach has been taken. Rather than developing a specific model for explaining real exchange rate variability, implications that emanate from a number of theoretical models are considered in the empirical analysis. In this way a more general set of possible determinants of real exchange rate variability is considered.

Contrary to previous work, in this paper the possible role of terms of trade instability is explicitly taken into account. Although some authors have recognized the theoretical importance of terms of trade movements in explaining real exchange rate variability, the few empirical studies on the subject have not taken this variable explicitly into account.[4] Also contrary to previous work -- which has concentrated on bilateral rates -- this paper uses a measure of variability of the real effective exchange rate. This paper uses a more general estimation method than previous studies. In particular, homoscedasticity is not imposed; the error's variance is allowed to vary across countries. Finally, in this paper measures of both short-run and long-term (or long-wave) real exchange rate variability are used in the regression analysis.

II. Real Exchange Rate Variability in Developing Countries: An Overview

During the last 15 years or so real exchange rate variability has increased substantially.[5] However, this higher instability has not affected all countries alike. In fact, here have been extremely large cross-country differences in real exchange rate instability. The extent and characteristics of real exchange rate variability for a selected group of developing countries are illustrated in Tables 1 and 2.

Table 1 presents, for a group of 30 developing countries, data on the mean, variance, coefficient of variation, minimum and maximum values for an index of real effective exchange rate. (See below for an exact definition of this index.) For most countries these statistics were computed using data for the period between the third quarter of 1971 and the second quarter of 1984. From these figures -- and especially the minimum-maximum values -- it is apparent that during the recent period real exchange rate variability has been substantial. The case of Sri Lanka is the most dramatic, where the difference between the maximum and minimum values of the index exceeds 150 points. This contrasts sharply with, for example, Mauritius where this difference was only 19 points. The striking difference in real exchange rate variability across countries can be better illustrated by the ratio of the highest to the lowest coefficient of variation of the real exchange rate. For this period this ratio was almost equal to nine!

Table 2 contains the same variables for the same group of countries for the period between the first quarter of 1965 and the second quarter of 1971. These indexes also show an important cross-country variability in the real exchange rate for this earlier period. It is interesting to compare Tables 1 and 2. As can be seen, the degree of real exchange rate variability, as measured by the coefficient of variation of the effective real exchange rate

Table 1: REAL EFFECTIVE EXCHANGE RATE VARIABILITY IN SELECTED DEVELOPING COUNTRIES: THIRD QUARTER 1971 -- SECOND QUARTER 1984

	Period	Mean 1975=100	Variance	Coefficient Variation	Minimum	Maximum
Bolivia	Q371-Q184	98.99	440.71	0.212	46.48	153.45
Brazil	Q371-Q284	107.55	316.15	0.165	83.41	151.22
Chile	Q371-Q284	81.03	593.06	0.301	25.76	109.42
Colombia	Q371-Q284	84.20	83.53	0.109	68.87	100.79
Cyprus	Q371-Q284	104.89	112.41	0.101	84.69	117.83
Dominican Rep.	Q371-Q184	96.60	33.06	0.059	78.37	107.28
Ecuador	Q371-Q284	96.24	68.80	0.086	80.91	112.72
El Salvador	Q371-Q284	89.80	222.90	0.166	55.63	110.52
Ethiopia	Q371-Q383	81.01	130.12	0.141	64.95	108.61
Greece	Q371-Q184	99.20	14.42	0.038	91.83	111.56
Guatemala	Q371-Q183	97.38	20.85	0.047	88.43	108.88
Guyana	Q371-Q483	90.82	127.71	0.124	64.07	105.38
Honduras	Q371-Q284	94.51	70.25	0.089	75.76	106.44
India	Q371-Q383	114.22	225.69	0.132	90.20	132.56
Israel	Q371-Q383	107.79	186.57	0.127	85.70	135.76
Kenya	Q371-Q383	100.16	29.66	0.054	90.05	111.76
Korea	Q371-Q383	90.78	43.30	0.072	79.58	110.68
Malaysia	Q371-Q284	106.63	62.05	0.074	92.75	123.42
Mauritius	Q371-Q383	101.35	25.35	0.050	94.26	113.94
Mexico	Q371-Q284	117.34	281.29	0.143	93.36	154.89
Pakistan	Q371-Q284	102.24	225.19	0.147	55.77	134.98
Paraguay	Q371-Q284	92.91	322.05	0.193	53.15	112.62
Peru	Q371-Q284	126.43	578.95	0.190	93.31	177.13
S. Africa	Q371-Q284	99.54	69.64	0.084	83.78	114.65
Thailand	Q371-Q284	100.96	38.63	0.062	89.36	115.45
Tunisia	Q371-Q284	105.59	98.43	0.094	87.47	119.21
Turkey	Q371-Q184	107.33	202.20	0.132	87.40	142.09
W. Samoa	Q371-Q184	121.03	186.13	0.113	94.38	150.28
Yugoslavia	Q371-Q284	101.83	125.55	0.110	89.43	132.34
Sri Lanka	Q371-Q383	165.05	5376.21	0.444	72.84	256.45

Sources: For all countries, except Chile, the raw data used to construct these indexes were obtained from the IFS. For Chile, they were obtained from Universidad de Chile (1983). For details on the data, see Section III.1.

Table 2: REAL EFFECTIVE EXCHANGE RATE VARIABILITY IN SELECTED DEVELOPING COUNTRIES: FIRST QUARTER 1965 -- SECOND QUARTER 1971

	Period	Mean 1975=100	Variance	Coefficient Variation	Minimum	Maximum
Bolivia	Q165-Q271	96.29	92.44	0.100	86.97	114.92
Brazil	Q165-Q271	87.00	85.15	0.106	76.61	116.67
Chile	Q165-Q271	34.13	10.21	0.094	28.90	42.27
Colombia	Q165-Q271	73.25	45.73	0.092	55.65	81.47
Cyprus	Q165-Q271	87.33	3.65	0.022	84.66	92.41
Dominican Rep.	Q165-Q271	99.46	7.50	0.028	95.07	105.33
Ecuador	Q165-Q271	88.53	76.19	0.099	79.96	107.51
El Salvador	Q165-Q271	85.80	5.66	0.028	82.04	90.47
Ethiopia	Q165-Q271	82.27	2.86	0.021	78.51	84.70
Greece	Q165-Q271	87.57	4.08	0.023	84.66	91.48
Guatemala	Q165-Q271	86.83	4.33	0.024	82.66	91.98
Guyana	Q165-Q271	68.26	14.64	0.056	62.90	74.73
Honduras	Q165-Q271	80.10	6.37	0.032	75.53	84.59
India	Q165-Q271	86.12	90.34	0.110	67.75	99.38
Israel	Q165-Q271	87.22	23.16	0.055	79.32	93.49
Kenya	Q165-Q271	89.27	7.69	0.031	85.23	95.55
Korea	Q165-Q271	81.25	78.98	0.109	70.99	98.18
Malaysia	Q165-Q271	97.93	6.09	0.025	93.14	102.67
Mauritius	Q165-Q271	89.46	11.22	0.037	85.62	98.41
Mexico	Q165-Q271	109.05	6.17	0.023	105.70	113.65
Pakistan	Q165-Q271	57.56	6.87	0.046	54.91	62.68
Paraguay	Q165-Q271	98.02	19.24	0.045	90.54	106.30
Peru	Q165-Q271	97.84	30.46	0.056	87.15	111.68
S. Africa	Q165-Q271	85.21	8.48	0.034	81.82	90.35
Thailand	Q165-Q271	87.65	6.41	0.029	83.89	91.93
Tunisia	Q165-Q271	90.25	10.44	0.036	85.77	95.62
Turkey	Q165-Q271	81.74	336.86	0.225	66.25	110.04
W. Samoa	Q165-Q271	111.18	7.21	0.024	105.87	115.99
Yugoslavia	Q165-Q271	100.94	69.16	0.082	88.84	117.27
Sri Lanka	Q165-Q271	70.08	22.15	0.067	62.51	77.03

Sources: See Table 1.

index, has increased substantially in the later period. In 27 out of the 30 countries the coefficient of variation is higher for the more recent period (1971-84) with the only exceptions being Ecuador, Korea and Turkey.

III. Empirical Results

In this section results obtained from the stimation of real exchange rate variability equations, using cross-section data, are presented. The estimations were performed using data both on short-term real exchange rate variability and long-term (or long-wave) real exchange rate variability.[6] The long-wave variability index was computed using annual data for the 30 countries in Table 1, for period 1972-83. The short-term variability indexes were computed using quarterly data for a smaller group of countries (26) for 1972-83. The group of countries used was determined by the availability of data; only a relatively small set of countries had quarterly data for the most important variables. It would be expected that the monetary factors would play a more prominent role in explaining the short-term real exchange rate variability, and that real or structural factors would be more important in the explanation of long-wave variability.[7]

The possible roles of monetary and real factors in the explanation of real exchange rate variability is analyzed by estimating the following log-linear equation:[8]

$$(1) \qquad \log v_n = \alpha_o + \sum_i \beta_i \log m_{in} + \sum_j \gamma_j \log x_{jn} + \varepsilon_n,$$

where v_n is an index of real exchange rate variability for country n, α_o, β_i and γ_j are parameters, the m_{in}'s represent monetary sources of real exchange rate variability, x_{jn} are the real or structural sources of real exchange rate variability and ε_n is the error term. Since equation (1) refers to cross-section data, homoscedasticity is not imposed. In particular,

it is assumed that:

$$E(\varepsilon) = 0,\ E(\varepsilon\varepsilon') = \begin{bmatrix} \sigma_1 & 0 & \cdots & 0 \\ 0 & \sigma_2 & & \vdots \\ \vdots & & \ddots & \vdots \\ & & & \sigma_n \end{bmatrix}$$

III.1 The Data

Most studies of real exchange rate instability have concentrated on bilaterial real exchange rates.[9] A problem with this practice, however, is that it ignores possible important sources of real exchange rate instability related to variations of exchange rates across trade partners. In this paper, however, this problem is avoided by constructing a large data set for real effective exchange rates for this group of developing countries.[10] For each country j the REER was constructed in the following way:

$$(2) \qquad REER_t = \frac{\left[\sum_{j=1}^{k} \alpha_j E_{cjt}\right]\left[\sum_{j=1}^{k} \alpha_j P^*_{jt}\right]}{P_t}$$

where $REER_{it}$ is the index of the ral effective rate in period t and is a proxy for the relative price of tradables with respect to nontradables in country n; E_{cjt} is an index of the nominal rate between country j and the domestic country c in period t; $j = 1,\ldots,k$ refers to the k partner countries used in the construction of the REER index; α_j is the weight corresponding to partner j in the computation of REER; P^*_{jt} is the price index of the j partner in period t; and P_t is the price index of the home country in period t.

In the construction of this real effective exchange rate index the following procedure was followed. (1) The weights (α's) were trade weights

constructed using data from the International Monetary Fund Direction of Trade for 1975. (2) The ten larger partners in 1975 were used for the construction of the index for each country. (3) The partner countries' WPIs were used as the P^*_{jc}'s and the home country CPI was used for P_t. While these assumptions are somewhat arbitrary, they are defendahle. First, for most countries 1975 was a fairly normal year and, consequently, its use as a base to compute the α's is reasonahle. Second, using the ten larger partner countries covers, for most countries, well above 80% of total trade. Moreover, the inclusion of other partners into the computation adds insignificant coverage to the REER indexes, without affecting in a noticeable way the behavior of the index. Also, using trade weights provides a more general view of the evolution of the degree of competitiveness of a country than using import or export weights.

The real exchange rate variability index for country n was constructed as the coefficient of variation of the log of the real effective exchange rate:

$$(3) \qquad v_n = \{\sum_i^k [e_{ni} - (\sum_i^k e_{ni}/k)]^2/k\}^{1/2}/\bar{e}.$$

Where $i = 1,\ldots,k$ refers to the number of periods used in the computation of v_n, e_{ni} is the logarithm of the real effective exchange rate, and $\bar{e}$ is the average of e_n. The advantage of this index of instability is that it is mean free. This is an important property when dealing with cross-country studies of real exchange rate variability, since different countries can have significantly different means during a given period.[11]

In the regressions the following real or structural variables were used: (1) An openness index. For each period openness was measured as the average propensity to import. The index was then constructed as the average value of the average propensity to import during the relevant period. Melvin and Bernstein (1984) have suggested that this variable will positively affect real

exchange rate instability. For the data sources, see the Appendix.
(2) Variability index of the log of the terms of trade. The terms of trade are defined as the ratio of export to import prices, and for all countries, except Chile, the raw data were obtained from the IFS. The variability index was computed as the coefficient of variation of the log of terms of trade.[12] Katseli (1984), Mussa (1984) and Edwards (1985), among others, have pointed out that the external terms of trade will affect real exchange rate movements. (3) In some long-wave variability regressions, the coefficient of variation of real GDP growth was also incorporated as a proxy for real productivity shocks (Korteweg (1980) and Helleiner (1981)).[13]

In terms of monetary (or nominal) variables, the following were included in the regressions: (a) Index of money (M1) growth instability. Most models of real exchange rate behavior and/or deviations from PPP have pointed out that monetary instability is an important source of real exchange rate variability. The index was constructed as the coefficient of variation in M1 growth. (b) Instability of domestic credit growth. This variable was introduced in the analysis as an alternative measure of monetary instability. The reason for this is that in some countries -- domestic credit is the monetary aggregate more closely controlled by the conomic authorities. The raw data were taken from the IFS, and the instability index was constructed as the coefficient of variation of domestic credit growth. (c) Index of volatility of domestic inflation. With other things given, a more variable domestic rate of inflation is expected to result in a higher real exchange rate variability (see Korteweg (1980)). Again the raw data were taken from the IFS and the instability index was computed as the coefficient of variation of the rate of inflation. (d) Index of volatility of nominal exchange rate policy. Two alternative indexes were constructed. The first was defined as

the coefficient of variation of the rate of devaluation of the nominal effective exchange rate. The second index was defined as one plus the standard deviation of the rate of devaluation of each domestic currency with respect to the U.S. dollar. There are also two reasons for defining this second index in this way. First, most developing countries have traditionally used the U.S. dollar as a benchmark to formulate their exchange rate policies. Second, since some countries have maintained a fixed rate with respect to the dollar throughout the period, the standard deviation of this rate of devaluation is zero and cannot be logged.[14] (3) Average level of domestic inflation. A number of authors, including Aizenman (1984) have pointed out that higher inflation levels will be translated into higher variability of the real exchange rate. All these variables were constructed from raw data obtained from the IFS.

III.2 Results for Long-Wave Real Exchange Rate Variability

In this section results obtained from the estimation of equations of the type of (1), using instability indexes constructed with annual data are reported. The regressions were performed using data for the 30 countries of Table 1 for 1972-83, and were estimated using the generalized least squares procedure suggested by Horn, Horn and Duncan (1975) to estimate heteroscedastic variances. This method was used since the analysis of the residuals obtained from OLS regressions indicated the presence of heteroscedasticity.

The following notation was used:

σ_τ: variability of terms of trade index

OP: openness index

σ_c: index of instability of domestic credit policy

σ_D: index of instability of the nominal rate of devaluation with respect to the U.S. dollar

σ_{DER}: index of instability of the rate of devaluation of the nominal effective rate

σ_M: index of instability of domestic monetary policy

σ_π: index of instability of inflation

σ_τ: index of instability of the external terms of trade

σ_g: index of variability of real GDP growth

π: average level of inflation during the relevant period.

In Table 3 the results for 1972-83 appear. Since the alternative measures of monetary instability used here are highly collinear, they were introduced in the regressions one at a time. The results obtained are quite interesting.[15] First, and contrary to previous results (i.e., DeGrauwe and Rosiers (1984)) it was found that real or structural factors have played a prominent role in explaining long-wave real exchange rate instability. More specifically, the main source of explanation of real exchange rate variability across countries during this period was the instability of the countries' external terms of trade. This variable was significant at conventional levels in all the equations where it was included. Second, these results also suggest that during this period the instability of the nominal exchange rate policy — measured through the variability indexes of the nominal rate of devaluation -- played a marginal role in explaining real exchange rate variability. Third, other measures of monetary instability -- the variability indexes of domestic credit growth, money growth and of inflation -- do not appear to have played an important role.

In some sense it would appear that the results contradict the findings reported by DeGrauwe and Liniart (1984) for a different period and group of countries. This contradiction, however, is more apparent than real, since they used short-term instability indexes, whereas Table 3 results deal with

Table 3: LONG-WAVE REAL EXCHANGE RATE INSTABILITY -- 1972-83 (GENERALIZED LEAST SQUARES)

Const.	$\log\sigma_{DC}$	$\log\sigma_{DER}$	$\log\sigma_{D}$	$\log\sigma_{\tau}$	logOP	$\log\sigma_{\pi}$	logπ	$\log\sigma_{M}$	$\log\sigma_{g}$	R^2	F
-2.675	0.250	0.239	--	0.494	-0.251	--	--	--	--	0.911	63.9
(-2.510)	(0.745)	(1.672)	--	(1.702)	(-1.027)	--	--	--	--		
-1.346	0.300	--	1.316	0.732	-0.150	--	--	--	-0.267	0.902	54.1
(-1.436)	(0.892	--	(1.931)	(2.324)	(-0.539)	--	--	--	(-1.820)		
-2.223	0.350	--	--	0.691	-0.129	--	0.375	--	-0.316	0.915	51.1
(-1.911)	(0.896)	--	--	(2.030)	(0.410)	--	(1.348)	--	(-1.863)		
-0.488	--	--	--	0.795	--	0.718	-0.030	--	--	0.884	66.3
(-0.430)	--	--	--	(2.658)	--	(1.629)	(-0.120)	--	--		
-4.963	--	0.509	--	--	-0.205	--	--	0.203	--	0.893	72.0
(-9.550)	--	(3.729)	--	--	(-0.699)	--	--	(1.629)	--		

Notes: The numbers in parentheses are t-statistics. R^2 is the coefficient of determination and F is the F-statistic for the regression as a whole.

long-wave instability. As is discussed below, when a short-term variability index is used, monetary sources do become important in the explanation of the difference in real exchange rate variability across countries.

Surprisingly, perhaps, enough the openness coefficient was never significant. In order to check whether this result -- which contradicts the finding by Melvin and Bernstein (1984) -- was due to the fact that an alternative measure of structural instability (i.e., the terms of trade index) had been included, a regression that excluded σ_τ, but included OP, was also run. As can be seen from Table 3 in this case the openness index remains insignificant. This indicates then, that at least for this period the degree of openness of the economy has not been associated with the extent of real exchange rate instability.[16]

III.3 Short-Term Real Exchange Rate Variability

In Table 4 the results obtained from regressions using variability indexes constructed with quarterly data for 1972-83 are presented. Data for a subset of 23 of the countries in Table 1 were used.[17] These results are quite interesting and contrast with those obtained when the long-wave variability indexes were used. The results in Table 4 show that, as expected, in the short run monetary factors play a more important role in explaining real exchange rate variability. Now, the coefficient of the index of instability of domestic credit creation turned out to he large and significantly different from zero in every regression where it was included. Also, the indexes of instability of nominal exchange rate policy are significant and positive. On the other hand, these results indicate that real factors (i.e., terms of trade variability, openness) don't play an important role in the explanation of differences in short-run real exchange rate instability across countries. Another interesting finding reported in Table 4 is that there is some evidence

Table 4: SHORT-TERM REAL EXCHANGE RATE VARIABILITY -- 1971-83

Const.	$\log\sigma_{DC}$	$\log\sigma_{DER}$	$\log\sigma_{D}$	$\log\sigma_{\tau}$	logOP	$\log\sigma_{\pi}$	logπ	$\log\sigma_{M}$	R^2	F
-4.845	1.516	0.311	--	-0.291	0.052	--	--	--	0.965	125.3
(-2.612)	(2.125)	(2.335)	--	(0.209)	(0.209)	--	--	--		
-2.975	1.016	--	1.249	0.218	--	--	--	--	0.952	125.6
(-2.394)	(2.321	--	(1.984)	(0.558)	--	--	--	--		
-4.011	1.416	--	--	0.018	-0.026	--	0.378	--	0.958	101.5
(-2.394)	(2.704)	--	--	(0.443)	(-0.102)	--	(1.906)	--		
-4.391	--	0.559	--	--	0.111	-0.330	--	--	0.893	78.5
(-7.946)	--	(3.183)	--	--	(0.316)	(-0.584)	--	--		
-0.887	--	--	--	0.811	0.066	--	--	-0.517	0.916	69.40
(-0.822)	--	--	--	(1.702)	(0.203)	--	--	(-1.808)		

Notes: See Table 3.

that a higher level of inflation will be associated with a higher degree of short-run real exchange rate instability. As in the case of Table 3, the openness coefficient was never significant, this corresponding to what DeGrauwe and Rosiers (1984) had found in their study which also used a short-term variability index.

The results presented in Table 4 have some important policy implications, since they suggest that by pursuing more stable nominal exchange rate policies countries could manage to reduce, in a significant way, the level of real exchange rate instability in the short run.

IV. Summary

In this paper the relative importance of real and monetary factors in explaining recent real exchange rate variability in developing countries have been investigated. The empirical evidence shows that in the last 15 years or so real exchange rate variability has increased significantly. However, the degree of real exchange rate variability has been quite uneven across countries, with some countries experiencing variability almost ten times higher than others.

In theory, long-run equilibrium real exchange rates depend on the behavior of a number of real variables, including the terms of trade and the degree of openness of the economy (Mussa (1984)). In the shorter run, however, real exchange rate movements will also be affected by monetary disturbances, including the instability of the nominal monetary policy. From a policy point of view it is important to determine the extent to which actual real exchange rate variability stems from monetary and real disturbances. If nominal policy-induced instability has been an important cause of real exchange rate variability, there are policy options open to reduce it.

In this paper data on a group of developing countries were used to investigate and assess the relative importance of monetary and real factors. The analysis focused both on long-wave and short-term variability. The results, contrary to previous findings, indicate that real exchange rate variability has been caused both by monetary and real disturbances, with real variables being relatively more important in the explanation of long-wave instability and nominal variables playing a more prominent role in case of short-term instability.

In terms of real disturbances the most prominent has been external terms of trade variability, which was found to have played an important role in the determination of long-run real exchange rate instability. In the shorter run, however, it was found that no real variable had been important. Regarding monetary disturbances, this study indicates that nominal exchange rate instability has been the major and more persistent source of short-term real exchange rate instability in this group of countries.

From a policy perspective these results are important. They suggest that a stable nominal exchange rate policy will help to substantially reduce real exchange rate variability. There are a number of ways to reduce the degree of instability of the nominal exchange rate, including the adoption of any variant of crawling-peg systems. On the other hand, it is well known that nominal exchange rate instability is greatly enhanced by the adoption of a flexible rate system (Frenkel and Mussa (1982)). To the extent that policymakers want to reduce real exchange rate variability, the result reported in this paper cautions them against adopting a floating rate system.

FOOTNOTES

[1]Some authors have recently pointed out that "explaining the large persistent real exchange rate movements...[is] at the center of policy debate" (Dornbusch, 1984, p. 63). It has been argued that "excessive" real exchange rate variability has negative welfare effects. It reduces the level of international trade, affects investment decisions and, in general, hampers growth possibilities. On the welfare effects of real exchange rate instability see, for example, Coes (1982) and Willet (1986). On the increase of real exchange rate variability in the recent years, see Helleiner (1981), IMF (1984). It should be noted that in IMF (1984) it is argued that this increased instability has had little or no effects on international trade.

[2]It should be noted that the degree of significance is marginal. Also, a problem with these results, as well as from those of the studies discussed before, is that the variables used in the regression analysis explain a fairly small proportion of the cross-country differences in real exchange rate variability.

[3]In theory, in the short run, real exchange rate behavior will depend both on monetary and real factors. See, for example, Mussa (1984, especially section 1.6, pp. 37-43).

[4]It is important to realize that some authors have used the terms of trade and the real exchange rate interchangeably. These two variables, however, will not be equivalent in models with importables, exportables and nontradable goods. See Williamson (1983) and Katseli (1984). In fact, Katseli (1984) shows that the time series properties of the terms of trade and the real exchange rate have been significantly different for a group of countries.

[5]See, for example, Helleiner (1981), IMF (1984), Cumby and Obstfeld (1984).

[6]Krueger (1983) has emphasized the importance of looking both at short-term and long-term instability indexes. Melvin and Bernstein (1984) used yearly data only; Yuravlivker (1982) used quarterly data only. DeGrauwe, Janssens and Lelianart (1984), DeGrauwe and Rosiers (1984) and Stockman (1983) used monthly data only. DeGrauwe, Janssens and Lelianert (1984), DeGrauwe and Rosiers (1984) and Melvin and Bernstein (1984) have also used cross-country data in their studies. Stockman (1982), on the other hand, used a variance components method on pooled cross-section, time series data. An alternative method for looking at real exchange variability is to estimate a model of real exchange rate determination using time series and then test for heteroscedasticity. If heteroscedasticity is present an Engel's (1983) ARCH procedure can be used to compute the conditional real exchange rate variance.

[7]See, for example, Mussa (1984).

[8]Aizenman (1984), for example, has postulated that real exchange rate variability is a linear function of the variances of the underlying shocks, both real and monetary, affecting the economy. See also Mussa (1984), Frenkel and Mussa (1985) and Korteweg (1980).

[9]Some of the more descriptive studies have also considered the variability of the real effective exchange rate (Korteweg (1980), Helleiner (1981)).

[10]Unfortunately data on real effective exchange rates are not readily available for the developing countries. The series published by Morgan Guarantee, for example don't go far enough back in time.

[11]The equilibrium level of the real exchange rate in general will differ across countries. Consequently, even assuming that the actual and equilibrium real exchange rates will coincide, on average, for each country, there is no

reason to expect that all countries will have the same mean. Williamson (1983) also used coefficients of variation to compute nominal exchange rate variability. Stockman (1982) used the variance; the IMF (1984) used period-to-period changes; Katseli (1984) and Melvin and Bernstein used standard deviations; and DeGrauwe, Janssens and Helinaert (1984) used mean absolute changes.

[12]Some authors have sometimes confused the real exchange rate and the terms of trade. It is important to stress that in a setup with exportables, importables and nontradables, both from empirical and analytical perspectives, these are two different variables. Analytically, the terms of trade are defined as the relative price of exportables to importables, while the real exchange rate is the relative price of tradables to nontradables. See, for example, the discussion in Katseli (1984).

[13]Of course, a problem with using a measure of growth variability is that it is not clear to what extent it is a genuine exogenous variable.

[14]Notice that in the construction of the indexes of instability of the nominal exchange rate policy the rate of devaluation was used; whereas the variability index for the real effective exchange rate was constructed using levels data.

[15]Note, however, that only a handful of coefficients turned out to be significant. This -- not uncommon in empirical works dealing with LDCs -- indicates that only a few variables have in fact been important in the determination of real exchange rate instability in these countries. Several aspects of these results are worth noting.

[16]Regressions were also run using data for period 1960-71. The results obtained were somewhat different from those reported in Table 3. First, there was only weak support for the hypothesis that terms of trade instability

played a role in the explanation of real exchange rate instability during this early period. Second, and more important, there is no evidence that during this period real exchange rate instability was affected by monetary policy disturbances. Also, these results indicate that during this earlier period real exchange rate variability was greatly affected by the instability of nominal exchange rate policy. This means that countries that had a more variable rate of nominal devaluation also had a more unstable real exchange rate.

[17]A relatively small number of countries have quarterly data on the relvant variables. The countries included in these regressions are: Bolivia, Brazil, Colombia, Cyprue, Dominican Republic, Ecuador, El Salvador, Ethiopia, Greece, Guyana, Honduras, India, Israel, Korea, Malaysia, Pakistan, Paraguay, Peru, South Africa, Thailand, Turkey, Western Samoa and Chile.

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