Real Exchange Rate Behavior and Economic Performance in LDCs*

Joaquin A. Cottani
World Bank

Domingo F. Cavallo
Fundacion Mediterranea, Argentina

M. Shahbaz Khan
World Bank

I. Introduction

In recent years, policy discussions have included increasing references to real exchange rate (RER) stability and correct exchange rate alignment as crucial conditions to improve economic performance in less developed countries (LDCs).[1] Evidence from Latin American, Asian, and African countries is often quoted to support the view that the link between RER behavior and economic performance is strong. It is argued that while unstable RERs inhibited export growth in some of Latin America, their stability was fundamental in promoting East Asian expansion. In many African countries, on the other hand, persistently misaligned local currencies harmed the development of agriculture, reducing domestic food supply.[2] But, in spite of its importance, no empirical work has been attempted either to test the relationship between RER behavior and performance indicators at a broad multicountry level or to investigate the sources of RER variability and misalignment in LDCs.

The theoretical literature on RER determinants has been recently surveyed by Sebastian Edwards.[3] He distinguishes between equilibrium and disequilibrium RERs and between external and domestic RER determinants. Although domestic policies are often said to account for significant RER variations, empirical work has only concentrated on the effect of nominal devaluations[4] or speculative crises arising from expansionary monetary policies in a system of fixed ex-

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change rates.[5] Less is known empirically about the long-run determinants of the RER. In some cases, the link may operate from RER behavior to policy—as when exchange rate overvaluation leads to increases in tariffs or import restrictions to avoid balance of payments disequilibria.

Although policy affects performance through a lot of different mechanisms, there are many instances in which the RER is the main transmission mechanism. Policy affects the RER through changes in the domestic price level, the nominal exchange rate, or both. In turn, the link between RER behavior and economic performance is suspected to be strong for many reasons. Large swings in RERs mean greater uncertainty with respect to relative prices. The results are greater risks, shorter investment horizons, high adjustment costs as production moves back and forth from tradable to nontradable sectors, and financial instability as expectations of exchange rate changes lead to interest rate volatility. Lack of correct alignment in the RER means lower profitability in the industries in which relative prices are reduced. Very often, misalignment takes the form of domestic currency overvaluation hurting tradable activities. This affects growth performance adversely since productivity improvements tend to be concentrated in export or import-competing industries. A reversed causality is also possible. For example, higher growth would appreciate the RER if it resulted from productivity improvements in the tradables sector.[6] This effect, however, is an equilibrium movement in relative prices that does not imply misalignment.

The purpose of this article is to examine the view that RER behavior and economic performance are correlated, using empirical evidence from a cross section of LDCs. On the methodological side, we show that measuring misalignment requires an empirical analysis of RER determinants because the usual simple comparison of purchasing power parity (PPP) rates over time is not a good indicator of disequilibrium situations affecting growth. In Section II, per capita growth is run against RER variability and a PPP-based index of misalignment, showing that the results are not satisfactory in the second case. In Section III we estimate a real exchange rate model combining time series with cross-sectional data. This model is used in Section IV to compute a regression-based index of misalignment that takes into consideration the difference between "sustainable" and actual values of the policy variables used as regressors. The correlation between this new measure of misalignment and several indicators of economic performance is analyzed in Section V. Section VI presents conclusions.

II. Growth Performance and Deviations from PPP

Table 1 presents several indicators of economic performance for a group of LDCs with different growth rates over the 1960–83 period. In

TABLE 1

INDICATORS OF ECONOMIC PERFORMANCE IN 24 LDCs*

	Per Capita GDP Growth Rate	Growth Rate in the Export Sector	Net Investment as a Percentage of GDP	Incremental Capital Output Ratio	Growth Rate in Agriculture
Low-growth countries:					
Somalia	−1.0	−1.6	12.6	8.6	1.9
Zambia	−.4	.7	13.6	7.9	2.5
Jamaica	.4	1.6	16.7	12.9	−1.6
Chile	.6	6.3	11.7	7.4	1.4
Sudan	.6	.9	8.0	4.2	1.8
Peru	.8	.2	9.8	4.7	.6
Ethiopia	.9	2.9	5.5	3.3	1.8
Mali	1.0	8.3	11.0	4.8	3.3
Ivory Coast	1.4	5.5	11.6	3.0	4.1
Argentina	1.4	4.9	14.0	7.0	2.3
Bolivia	1.6	2.8	8.8	3.9	3.8
Uruguay	1.7	5.0	5.9	5.3	1.4
Group average	.8	3.1	10.7	6.0	1.9
High-growth countries:					
Philippines	2.5	5.2	16.8	4.3	4.4
Malawi	2.6	3.5	17.3	4.3	4.4
Colombia	2.8	4.3	13.6	3.9	3.6
Turkey	3.1	7.1	13.8	3.6	3.4
Dominican Republic	3.3	5.7	12.9	3.1	2.6
Mexico	3.6	6.6	15.7	3.3	1.8
Malaysia	4.3	6.8	16.4	3.3	5.8
Thailand	4.5	9.1	17.4	3.3	5.2
Brazil	4.6	8.2	19.3	3.7	2.8
Greece	4.8	9.9	18.2	4.5	3.3
Korea	6.4	21.9	17.0	2.7	2.5
Singapore	7.4	10.1	23.8	3.3	7.4
Group average	4.1	8.2	16.9	3.6	3.9

* All figures are for the time period 1960–83 and represent period averages. Growth rates are calculated by fitting exponential lines to the data.

table 2, two indicators of RER behavior, instability and misalignment, are shown for the same countries. RER instability is often referred to as erratic deviations around some average level; misalignment usually has been measured with reference to an "equilibrium" year. To compute these indicators, all that is needed is a time series of real exchange rates for each country and some criterion about how to choose the years when the RER was considered to be in equilibrium. Two statistics built from RER series are reported.[7] The coefficient of variation of the RER around its mean for the sample period is the measure of instability.[8] In order to have a PPP measure of misalignment, parity deviations were computed using the mean of the 3 years with the highest RER values as a reference. These deviations were then averaged over the whole sample period.[9]

TABLE 2

SUMMARY STATISTICS OF REAL EXCHANGE RATE SERIES (1960–83)*

	Deflator Used†	Coefficient of Variation of the RER Index (%)	Reference Years‡	PPP Measure or RER Misalignment (%)§
Somalia	CPI	24	1960, 1961, 1962	23
Zambia	CPI	13	1960, 1961, 1963	18
Jamaica	DEF	11	1979, 1980, 1981	18
Chile	DEF	17	1975, 1976, 1983	32
Sudan	CPI	17	1960, 1961, 1968	16
Peru	DEF	16	1960, 1961, 1978	20
Ethiopia	CPI	21	1960, 1973, 1974	29
Mali	DEF	16	1960, 1961, 1983	18
Ivory Coast	CPI	15	1960, 1962, 1971	13
Argentina	CPI	23	1960, 1975, 1982	24
Bolivia	DEF	19	1960, 1961, 1973	20
Uruguay	CPI	26	1960, 1965, 1966	36
Philippines	CPI	17	1970, 1971, 1983	33
Malawi	DEF	8	1981, 1982, 1983	14
Colombia	CPI	12	1974, 1975, 1976	23
Turkey	CPI	18	1961, 1982, 1983	40
Dominican Republic	DEF	5	1961, 1974, 1981	7
Mexico	CPI	11	1977, 1982, 1983	23
Malaysia	DEF	7	1971, 1981, 1982	12
Thailand	CPI	3	1960, 1971, 1972	6
Brazil	DEF	15	1960, 1961, 1962	21
Greece	DEF	9	1960, 1961, 1983	14
Korea	CPI	13	1965, 1966, 1975	30
Singapore	DEF	6	1969, 1970, 1971	6

* Bilateral rate with respect to U.S. dollar.

† CPI = consumer price index, DEF = GDP deflator. The selection was done on the basis of data reliability.

‡ Years in which the RER index was at its maximum.

§ The difference between the average of the maximum values and the period average of the RER index.

To examine if these simple indicators of instability and misalignment are related to growth performance, two cross-section regressions were run with per capita GDP growth as the explained variable. The results suggest that there is a strong negative correlation between per capita GDP growth and the measure of RER instability at the multicountry level corresponding to our sample of countries. This can be seen in figure 1 where per capita GDP growth is plotted against $CV(e)$, the coefficient of variation of the RER around its mean. The equation is reported above the regression line. The coefficient linking the two variables is statistically very significant and the R^2 is .36. The plot of per capita growth on the PPP measure of misalignment is not shown. In this case, the R^2 of the regression was only .06 and, although negative, the regression coefficient was insignificant.

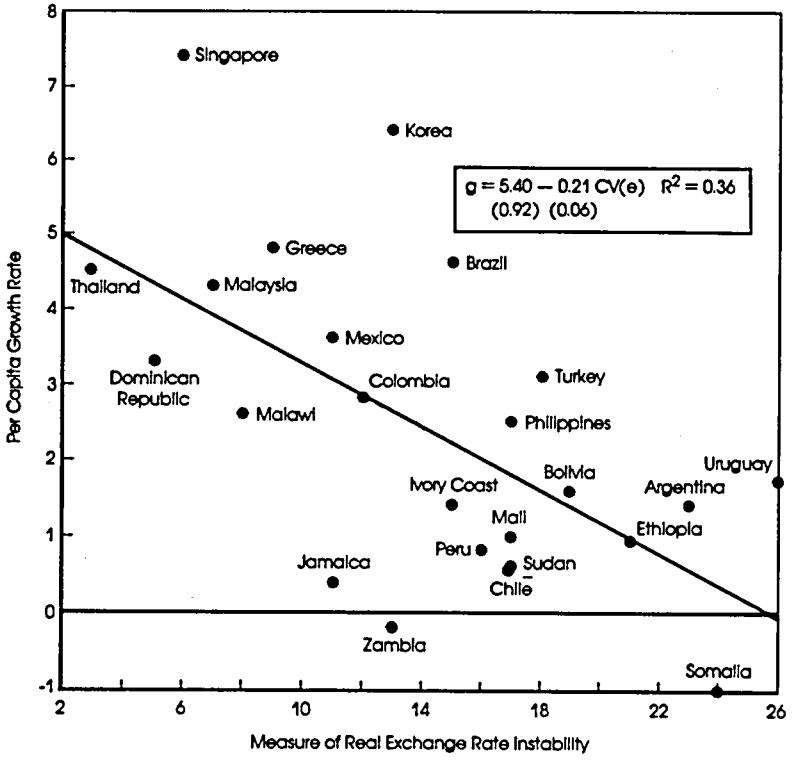

FIG. 1.—Correlation between real exchange rate instability and per capita growth rate.

As noted before, a high correlation between RER behavior and growth may result from the following conditions: (*a*) the RER is a link between policy and performance (but not necessarily the only link); thus, policies that stabilize the RER around a realistic level may enhance growth through this mechanism; (*b*) both growth and the RER are affected by policy in a way that increases the correlation between the two variables without necessarily implying causality in one direction or another; in other words, policies that create a stable environment and promote a more efficient utilization of scarce resources also tend to result in stable and well-aligned RERs. Notice that, while the first condition means that the RER is an immediate determinant of growth performance, the second condition suggests that RER behavior is an indicator of policies that have wider implications on performance than those directly attributable to the RER. One possible reason for the apparent lack of correlation between growth performance and RER deviations from PPP is that changes in RER levels over time need not indicate RER misalignment. On the contrary, those changes may be necessary to accommodate external or internal shocks that modify

equilibrium RERs. To look more closely at the possibility of misalignment, it is necessary to be more specific about RER determinants.

III. Estimating Real Exchange Rate Response to Changes in RER's Determinants

Edwards has singled out the following determinants of equilibrium RERs as "the most important in analytical and policy discussions":[10] (*a*) international terms of trade; (*b*) international transfers or aid; (*c*) world real interest rates; (*d*) trade policies; (*e*) exchange and capital controls; (*f*) the composition of government expenditure; and (*g*) technological progress. Under plausible conditions, the signs of the effects of alternative shocks on the equilibrium RER are as indicated in table 3. On the other hand, deviations from equilibrium usually take place as a result of monetary disturbances such as financing large fiscal deficits through increases in domestic credit while fixing the nominal exchange rate. Conversely, a nominal devaluation accompanied by monetary and fiscal restraint can effectively eliminate macroeconomically induced misalignment. To estimate the relationship between the RER and its determinants, the following regression was run using a combination of time series and cross-sectional data:

$$\log(e_t) = b_0 + b_1 \log(P_x^*/P_q^*)_t + b_2 \log[Y/(X + Q)]_t + b_3 k_t + b_4 \hat{d}_t + b_5 t, \quad (1)$$

where:

e_t = the RER;

$(P_x^*/P_q^*)_t$ = international terms of trade;

$[Y/(X + Q)]_t$ = the ratio of income over the sum of exports plus imports;

k_t = net capital inflows as a proportion of GDP;

$\hat{d}_t$ = domestic credit creation in excess of devaluation, foreign inflation, and real GDP growth;

t = time.

There is an obvious reason to include the terms of trade as an explanatory variable in equation (1). Foreign price shocks have accounted for large fluctuations in RERs, especially in the 1970s. The 1973 increase in oil prices, for example, resulted in massive real devaluations in oil importing nations while significantly appreciating oil exporters' currencies. In some cases, favorable shocks were responsible for squeezing profitability in other tradable industries (the often cited "Dutch disease" phenomenon).

The other explanatory variables in equation (1) need further clarification. The expression $[Y/(X + Q)]_t$ is an indicator of trade policy restrictions such as tariffs and quotas. An import quota, for ex-

TABLE 3

RER Comparative Statics

Type of Shock	Effect on RER
Decrease in foreign terms of trade	+
Increase in foreign aid	−
Increase in world real interest rate	+
Higher tariffs	−
Increase in quantitative restrictions	−
Higher export taxes	+
Higher export subsidies	−
Liberalization of the capital account	−
Government finances a larger share of deficit through foreign borrowing	−
Public spending increases demand for nontradables	−
Productivity improves in the tradable sector	−

ample, reduces openness (increases $[Y/(X + Q)]_t$) and usually leads to an appreciated RER.[11] Although changes in outwardness are often dominated by protection, one cannot overlook the fact that trade is the result not just of trade policies but also of many other variables affecting exports and imports, including the RER itself. Unfortunately, good indicators of trade policy do not exist, making it impossible to overcome this problem in a simple way.

Net capital flows are defined as net increases in foreign borrowing, transfers, and aid, minus net factor payments. Thus, an increase in k_t may be due to (*a*) an autonomous increase in grants; (*b*) a reduction in the world real interest rate; (*c*) the removal of domestic capital controls; (*d*) an increase in public borrowing to finance the fiscal deficit; and (*e*) an exogenous increase in voluntary lending by foreign creditors. An increase in k_t tends to appreciate the RER by increasing spending in all goods including nontradables.

Changes in equilibrium RERs may also result from technological factors. According to B. Balassa, productivity improvements in rapidly growing economies tend to be concentrated in tradable sectors and usually account for a fall in RERs.[12] It thus seems relevant to include a time variable to capture the residual trend in the RER; by comparing the estimated coefficients across countries, one can check for evidence of the Balassa effect.

Finally, excess credit expansion, $\hat{d}_t$, correlates inversely to the RER. To understand this, assume that all RER equilibrium fundamentals are constant, nominal devaluation is given, and the government expands money supply by increasing domestic credit at a certain rate. For the RER to be constant, domestic inflation must equal foreign inflation plus devaluation. This, in turn, requires monetary growth not

to exceed a certain limit beyond which the RER would appreciate. Assuming, for simplicity, a unitary income elasticity of money and a constant velocity, the following condition must hold:

$$\hat{M} = \hat{E} + \hat{P}^* + \hat{y}, \tag{2}$$

where $\hat{M}$ is money growth, $\hat{E}$ is nominal devaluation, $\hat{P}^*$ is foreign inflation, and $\hat{y}$ is real GDP growth. Monetary expansion, however, is the result not only of domestic credit creation but also of reserves accumulation, that is,

$$\hat{M} = \dot{D}/M + \dot{R}/M, \tag{3}$$

where D represents domestic credit, R reserves, and a dot above a variable indicates a time derivative. Since changes in foreign reserves cannot be negative in steady state, the consistency condition becomes:

$$\hat{d} \leq 0, \hat{d} = \dot{D}/M - \hat{E} - \hat{P}^* - \hat{y}. \tag{4}$$

In most LDCs, governments control the nominal exchange rate using different rules, for examle, fixed or pre-fixed parities, adjustable pegs, crawling pegs, etc. On the other hand, they expand domestic credit to finance fiscal deficits or increase lending to the private sector. In the long run, a high and positive $\hat{d}$ is inconsistent with a constant RER and generally leads to a fall in reserves and a speculative attack against the domestic currency. Until a devaluation occurs, however, a path of real appreciation resulting from expansionary monetary policies may be observed.

Econometric results are presented in table 4. The countries are grouped according to the value of the estimated coefficients. The groups under each estimate were achieved by pooling the data for all countries, allowing each country to have a different set of coefficients by including both intercept and slope dummies in the regression, and then estimating the coefficients using a backward elimination procedure. In this way, we were able to achieve higher confidence in our estimates as well as a manageable set of country coefficients based on statistical criteria.[13] Given the computational complexity of our pooling method, only ordinary least squares (OLS) estimates can be reported although, in principle, instrumental variables (IV) would have been a more appropriate method of estimation. While this may cast some doubts on the consistency of our results, no evidence was found in previous nonpooled regressions for the individual countries suggesting that OLS and IV coefficients were significantly different from a statistical point of view.

The results of table 4 are of interest for various reasons. First, the

TABLE 4

COEFFICIENT ESTIMATES FROM THE POOLED MODEL

Terms of Trade (b_1)	$\frac{\text{Income}}{\text{Exports + Imports}}$ (b_2)	$\frac{\text{Capital Flows}}{\text{Income}}$ (b_3)	Rate of Excess Domestic Credit (b_4)	Trend (b_5)
b_1 = −4.7 (1.84):	b_2 = −1.11 (.10):	b_3 = −3.07 (.25):	b_4 = −.31 (.16):	b_5 = −.03 (.001):
Singapore	Argentina	Colombia	Greece	Argentina
b_1 = −.68 (.09):	Colombia	Mexico	b_4 = −.09 (.01):	Bolivia
Korea	b_2 = −.65 (.03):	b_3 = −1.37 (.12):	Argentina	Ethiopia
Malaysia	Chile	Argentina	Brazil	Korea
b_1 = −.44 (.04):	Ivory Coast	Brazil	Ivory Coast	Mali
Colombia	Ethiopia	Chile	Colombia	Somalia
Jamaica	Jamaica	Ivory Coast	Dominican Republic	Turkey
Mexico	Mali	Ethiopia	Ethiopia	Uruguay
b_1 = −.16 (.03):	Malawi	Greece	Jamaica	b_5 = −.02 (.001):
Brazil	Peru	Korea	Korea	Ivory Coast
Ivory Coast	Philippines	Mali	Mali	Sudan
Dominican Republic	Sudan	Malawi	Malawi	b_5 = −.01 (.001):
Ethiopia	Turkey	Peru	Malaysia	Brazil
Mali	Uruguay	Philippines	Peru	Chile
Peru	b_2 = −.21 (.03):	Sudan	Philippines	Jamaica
Philippines	Bolivia	Turkey	Singapore	Malawi
Somalia	Dominican Republic	Uruguay	Somalia	Singapore
Sudan	Korea	b_3 = .03 (.06):	Thailand	Zambia
Turkey	Mexico	Bolivia	Turkey	b_5 = −.001 (.003):
b_1 = −.07 (.02):	Malaysia	Dominican Republic	Uruguay	Philippines
Thailand	Singapore	Jamaica	b_4 = −.001 (.003):	b_5 = .004 (.001):
Zambia	Somalia	Malaysia	Bolivia	Colombia
b_1 = .08 (.06):	Zambia	Singapore	Chile	Dominican Republic
Chile	b_2 = .05 (.06):	Somalia	Sudan	Malaysia
b_1 = .25 (.19):	Brazil	Thailand	Zambia	Mexico
Argentina	Greece	Zambia	b_4 = .11 (.31):	Thailand
Bolivia	b_2 = .29 (.04):		Mexico	b_5 = .01 (.001):
Greece	Thailand			Greece
Malawi				Peru
Uruguay				

SOURCE.—Model results (see text for details).

NOTE.—The value of b_1 represents the estimate for each group that follows; standard errors are in parentheses.

signs of the estimated coefficients are mostly according to theoretical expectations. In instances where this is not the case, the estimates with incorrect signs are insignificant even though a large number of observations were available for the estimation. This is especially true for the coefficients b_1 and b_3 related to the terms of trade and capital inflows variables, respectively. Second, RERs in high-export and high-growth countries are more responsive to changes in the terms of trade than in low-export, low-growth countries. This result may be deemed in line with Balassa and D. McCarthy's finding that export-oriented economies have adjusted more effectively to external shocks than closed economies,[14] since b_1 can be interpreted as an indicator of macroeconomic adjustment (real depreciation) in response to adverse terms of trade. In the case of the income over trade variable, we note that a majority of the countries (10 out of 15) with a coefficient value near the upper end of the scale are from the low growth group, whereas the high growth group tends to cluster at the other end. Thus, lower rates of real depreciation are needed as a result of trade liberalization in high-growth countries suggesting that exports and imports are more elastic to relative prices than in low-growth countries. Finally, the estimated trend coefficients are also of interest because, although most of the countries (12 out of 17) that show an appreciating trend over time are low-growth countries—an apparent contradiction with the Balassa effect discussed earlier—some of the more export-oriented and rapidly growing economies, like Korea, Brazil, and Singapore, actually belong in this category too.

IV. Searching for a Better Measure of Misalignment

The model in the previous section makes it possible to distinguish among several sources of RER variations. Two of these sources, foreign terms of trade and differential productivity changes accounting for the residual trend, are exogenous nonpolicy variables. The remaining three, namely, excess domestic credit creation, net capital inflows, and the income over trade ratio, are affected by domestic policies in a way that may create "policy-induced misalignment."

As indicated earlier, domestic credit expansion in excess of the sum of devaluation, GDP growth, and foreign inflation generally results in domestic currency overvaluation and a loss of foreign reserves.[15] Clearly, the RER cannot be in equilibrium if reserves are not being accumulated at the desired rate. A typical situation of disequilibrium arises when the government sustains a large fiscal deficit by resorting to the inflation tax and, simultaneously, attempts to control the nominal exchange rate (or the rate of crawl) to prevent an inflation-devaluation spiral.[16] A measure of RER misalignment resulting from macroeconomic policies is given by $b_4\hat{d}_t$ when $\hat{d}_t > 0$, where b_4 is

the estimated semielasticity of the RER with respect to excess domestic credit creation. Implicitly, we are assuming that, for the RER to be in equilibrium, $\hat{d}_t$ must be less than or equal to zero.

Net capital inflows as a proportion of GDP need not be zero in equilibrium. In fact, if F is the "desired" stock of foreign debt in proportion to GDP, a sustainable value for k_t would be $k_t = (\hat{y}^e - r^*)F$, where $\hat{y}^e$ is expected GDP growth and r^* is the world real interest rate. If, during some years, the net inflow of foreign capital exceeds this value, the RER will fall below its sustainable long-run equilibrium level. Whether we refer to this situation as "disequilibrium" or as "a gap between long- and short-run equilibrium levels" is immaterial as long as our definition of sustainable or long-run equilibrium is consistent with the idea of an intertemporal budget constraint faced by countries and individuals, in which "the current account in present and future periods is balanced on average."[17] In order to measure the misalignment caused by unsustainable capital movements, the following computation was tried. First, we calculated 3-year moving averages of GDP growth and foreign inflation, where the latter is an average of the rates of change in the foreign prices of each country's exports and imports. These moving averages were assumed to represent expected values of real income growth and international inflation, respectively. The real interest rate was then calculated by subtracting expected foreign inflation from the nominal cost of credit paid on average by each country.[18] In the years where the expected real cost of credit was lower than the rate of growth, the observed values of k_t (whether positive or negative) were regarded as sustainable. Only in the cases where the real cost of credit exceeded expected growth, positive net inflows were regarded as excessive, and a net value of zero was assumed to be the sustainable level. Thus, RER misalignment is measured by $b_3(k_t)$ when $t = j$ and zero otherwise, where b_3 is the semielasticity of the RER with respect to the net inflow of foreign capital and j represents the year in which excessive foreign borrowing is considered to have taken place (see table 5).

Finally, regarding the effect of trade policies, we computed

$$b_2 \log\{[Y/(X + Q)]_t / \min[Y/(X + Q)]\}, \tag{5}$$

where min $[Y/(X + Q)]$ is the mean of the three lowest values of $Y/(X + Q)_t$—that is, those corresponding to the years in which the degree of openness was highest.[19] This is but a simple way of taking into account J. Williamson's remark that the fundamental or long-run equilibrium exchange rate is attained "given that the country is pursuing international balance as best it can and not restricting trade for balance of payments reasons."[20]

TABLE 5

REGRESSION-BASED MEASURE OF RER MISALIGNMENT (1960–83)

	MIS(e)	Years in Which Countries Seem to Have Overborrowed
Somalia	9	1983
Zambia	3	1982
Jamaica	23	1969, 1982, 1983
Chile	21	1962, 1972, 1973, 1977–81
Sudan	10	1960, 1961, 1982, 1983
Peru	14	1982
Ethiopia	5	1960–62, 1982, 1983
Mali	19	1967, 1968, 1982, 1983
Ivory Coast	8	...
Argentina	22	1979
Bolivia	2	...
Uruguay	15	...
Philippines	5	1960–62, 1964
Malawi	15	1968–70
Colombia	13	1981, 1982
Turkey	22	1970, 1982, 1983
Dominican Republic	5	1966, 1967, 1978, 1983
Mexico	5	...
Malaysia	−7	...
Thailand	.6	1982, 1983
Brazil	.3	...
Greece	5	1969, 1981–83
Korea	−7	1960–63, 1983
Singapore	7	1966, 1982, 1983

SOURCE.—Model results (see text for details).

Adding up the three sources of misalignment for a given year yields:

$$\exp(-b_2\log\{[Y/(X+M)]_t/\min[Y/(X+M)]\} - b_3 k_t|_{t=j} - b_4\hat{d}_t). \quad (6)$$

When the mean of these values is computed for each country over the sample period, we get an overall indicator of RER misalignment, MIS(e), as reported in table 5.[21] Although a great deal of arbitrariness still enters into its calculation, this indicator represents an improvement over the crude PPP measure of misalignment that we had before.[22]

V. Economic Performance, Real Exchange Rate Instability, and Policy-induced Misalignment

Figure 2 shows the correlation between per capita growth and the new measure of misalignment using individual countries as observations. In this case, the slope of the regression line is highly significant, and the R^2 is higher than when the PPP-based indicator is used as regressor

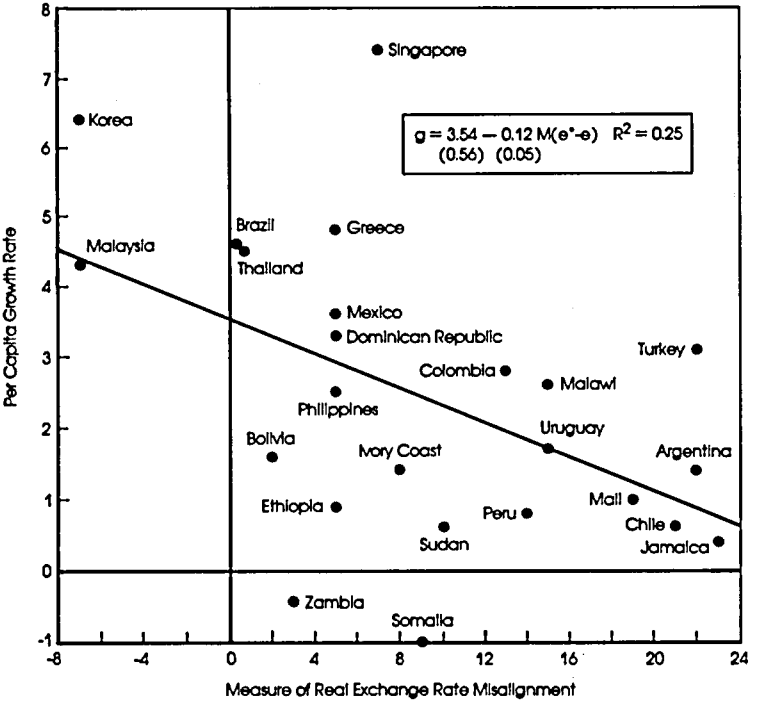

FIG. 2.—Correlation between real exchange rate misalignment and per capita growth.

(see Sec. II). Although this does not imply a causal relationship or a model, the result is interesting because it suggests that improving the measure of misalignment may yield results more consistent with theoretical expectations.

From our previous equations, both instability and misalignment of the RER are correlated with per capita GDP growth across countries. A regression using both indicators is shown below (statistics in parentheses are standard errors):

$$g = \underset{(.87)}{5.51} - \underset{(.06)}{0.17}\,\mathrm{CV(e)} - \underset{(.04)}{0.08}\,\mathrm{MIS(e)}, \text{ adjusted } R^2 = .39. \quad (7)$$

Here, the two slopes are statistically different from zero and the adjusted R^2 is higher than in the two individual regressions, suggesting that instability and misalignment are two empirically distinct variables regarding their relation to growth.[23] The nexus between RER behavior and growth can be explored a little further by using other indicators of economic performance in the regressions. Thus, in table 6, we show the results of four additional sets of cross-section equations where the

TABLE 6

CROSS-SECTION REGRESSIONS OF ECONOMIC PERFORMANCE INDICATORS ON INDICES OF RER INSTABILITY AND MISALIGNMENT

Dependent Variable	Intercept	RER Instability	RER Misalignment	R^2	Adjusted R^2
Per capita growth rate	5.40	−.21	...	.36	.33
	(.92)	(.06)			
	3.54	...	−.12	.25	.21
	(.56)		(.05)		
	5.51	−.17	−.08	.44	.39
	(.87)	(.06)	(.04)		
Export growth rate	9.37	−.26	...	.11	.07
	(2.38)	(.15)			
	7.56	...	−.21	.15	.12
	(1.30)		(.11)		
	9.61	−.17	−.17	.20	.12
	(2.32)	(.16)	(.11)		
Net rate of investment	20.56	−.47	...	.44	.41
	(1.78)	(.11)			
	14.93	...	−.13	.06	.02
	(1.28)		(.10)		
	20.56	−.47	−.002	.44	.38
	(1.82)	(.13)	(.09)		
ICOR	3.42	.10	...	.07	.02
	(1.24)	(.08)			
	3.56	...	.14	.28	.24
	(.61)		(.05)		
	3.23	.03	.14	.28	.21
	(1.11)	(.08)	(.05)		
Agriculture growth	4.86	−.13	...	.20	.16
	(.89)	(.06)			
	3.76	...	−.09	.19	.15
	(.50)		(.04)		
	4.94	−.10	−.07	.28	.21
	(.86)	(.06)	(.04)		

NOTE.—Standard errors in parentheses.

dependent variables are average export growth, agriculture growth, net investment, and the incremental capital-output ratio (ICOR).

It is interesting that RER instability seems to outweigh misalignment in the explanation of net investment, while the opposite happens in the case of the ICOR—only CV(e) is significant in the first equation while only MIS(e) is significant in the latter. This is consistent with economic intuition since one expects investment levels to be primarily affected by relative price uncertainty and investment productivity to be more strongly correlated to relative price distortions, of which RER misalignment is an average indicator.

The results for agriculture and export performance are less clear-

cut but convey a similar message. Their rates of growth are negatively correlated with the two indicators of RER behavior taken separately, but the *t*-statistics are lower when instability and misalignment are included together in the regression, probably due to colinearity between the regressors. Moreover, the coefficients are higher in the export equations than in the per capita growth equations, which is consistent with a theory of export-led growth.

VI. Conclusions

Our empirical results show that a strong negative correlation across countries exists between performance indicators and two measures of RER behavior, instability and misalignment. In the case of misalignment, this is clear only after some empirical refinement is introduced in its estimation, since simple deviations from PPP do not provide a good account of disequilibrium situations affecting growth. We also show that, while RER instability is mainly correlated to net investment, misalignment is mainly correlated to the ICOR. However, these results do not imply that real exchange rate behavior is the main determinant of growth performance. As an exogenous variable, the RER reflects shocks (including domestic policies) that have wider implications on performance than those directly attributable to the RER.

Notes

* An earlier version of this article was written as background material for *World Development Report 1986* (Washington, D.C.: World Bank, 1986). However, the views herein are not necessarily shared by the World Bank or its affiliated institutions. We are grateful to Saul Lizondo, Sebastian Edwards, and two anonymous referees for stimulating comments. Errors and omissions are our sole responsibility.

1. See, e.g., Ann Krueger, *Exchange Rate Determination* (Cambridge: Cambridge University Press, 1983); John Williamson, *The Exchange Rate System,* Policy Analysis in International Economics, no. 5 (Washington, D.C.: Institute for International Economics, 1983); and Sebastian Edwards, *Exchange Rate Misalignment in Developing Countries,* World Bank Occasional Paper no. 2, n.s. (Baltimore and London: Johns Hopkins University Press, 1988).

2. See World Bank, *Towards Sustained Development in Sub-Saharan Africa* (New York: Oxford University Press, 1984).

3. Edwards, *Exchange Rate Misalignment in Developing Countries.*

4. See, e.g., Sebastian Edwards, *Real Exchange Rates, Devaluation and Adjustment* (Cambridge, Mass.: MIT Press, 1987).

5. See ibid.; and John Bilson, "Leading Indicators of Currency Devaluations" (University of Chicago, Department of Economics, Chicago, 1979, mimeograph).

6. See Bela Balassa, "The Purchasing Parity Doctrine: A Reappraisal," *Journal of Political Economy* 72 (December 1964): 584–96.

7. Bilateral RERs were used throughout. These were calculated using the price of the U.S. dollar in terms of domestic currency as the nominal exchange rate, the wholesale price index (WPI) of the United States as the foreign price

index, and the consumer price index (CPI) or the GDP deflator as the domestic price index. Unfortunately, due to data limitations, it was not possible to obtain multilateral or effective RERs. This must be taken as a caveat when interpreting our results since, for some countries and years, bilateral and effective RERs may be quite different.

8. An alternative measure of instability, the coefficient of variation of the RER value adjusted for trend, was also tried with virtually no change in the results.

9. By choosing the three highest values of the RER as a reference, we choose devaluation years that may or may not be "equilibrium years." However, since devaluations usually take place at times of balance of payments crisis or when the external sector is visibly out of equilibrium, it is not unreasonable to assume that the RER is closer to equilibrium when a devaluation occurs than otherwise.

10. Edwards, *Exchange Rate Misalignment in Developing Countries*, pp. 5–9.

11. For a full discussion of the effect of trade policies on the RER using an intertemporal equilibrium model, see Edwards, *Real Exchange Rates, Devaluation and Adjustment.*

12. Balassa.

13. Details about the estimation technique and the data used in the model are given in an econometric appendix available from the authors on request.

14. Bela Balassa and Desmond McCarthy, "Adjustment Policies in Developing Countries, 1979–83," World Bank Staff Working Papers, no. 675 (Washington, D.C.: World Bank, 1984).

15. Unless, of course, domestic credit supply increases pari passu with money demand.

16. Argentina in the late 1970s is a clear example of this.

17. J. Frenkel and M. Mussa, "Asset Markets, Exchange Rates and the Balance of Trade," in *Handbook in International Economics*, ed. R. Jones and P. Kenen (Amsterdam: North-Holland, 1985), vol. 2.

18. Figures were provided by the World Bank's Economic Projection Department in November 1985.

19. The values of $[Y/(X + M)]_t$ were corrected by the trend when the latter was downward.

20. Williamson (n. 1 above).

21. In calculating the misalignment indices, we restricted all coefficient values without the correct sign to zero.

22. Implicit in our estimation is the assumption that RER undervaluation is less common or less harmful to economic performance than overvaluation. Although, in theory, deviations from equilibrium, either positive or negative, may be harmful, a limit to undervaluation generally exists given by real wage rigidity.

23. In principle, it is possible to conceive of situations characterized by high instability and no misalignment and vice versa. The experiences of Latin America and Africa illustrate this difference, with instability having been more pervasive in Latin America than in Africa, and misalignment having been more pervasive in Africa than in Latin America.