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THE REAL EXCHANGE RATE CONUNDRUM:

THE CASE OF CENTRAL AMERICA

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LIST OF ACRONYMS

AMRER	Arithmetic mean real exchange rate
BRER	Bilateral real exchange rate
CPI	Consumer Price Index
GDP	Gross Domestic Product
GMRER	Geometric mean real exchange rate
MRER	Multilateral real exchange rate
OECD	Organization for Economic Cooperation and Development
PPP	Purchasing Power Parity
RER	Real exchange rate
RW	Random walk
WPI	Wholesale Price Index

ABSTRACT

Using data from a sample of Central American countries and Mexico, the paper demonstrates some contradictions that can occur in empirical applications of the real exchange rate. Nine measures of a Purchasing Power Parity-based real exchange rate are calculated using alternative measures of price indexes and quantity weights. The real exchange rate indexes are found to be sensitive to the prices and quantity weights chosen. In addition, alternative tests of Purchasing Power Parity can give contradictory results when the same Central American data set is used.

EXECUTIVE SUMMARY

Data from a sample of Central American countries and Mexico for the period 1962-1988 are used to compare alternative measures of real exchange rates (RER). A fundamental question is whether alternative measures of the RER indicate the same direction and magnitude of currency misalignment for a country.

Various empirical measures of a Purchasing Power Parity-based RER are calculated. They include different indexes for consumer prices, wholesale prices, and gross domestic product deflators. Bilateral indexes against the U.S. dollar and multilateral rates against the ten leading trading partners are constructed for each country. For each multilateral index both arithmetic and geometric means are calculated. Correlations among the nine RER indexes are presented.

Although correlations among indexes are fairly high, contradictions are not uncommon. For example, one index may indicate that a currency is overvalued, but a different index may indicate undervaluation for the same currency in the same year. Even more common are cases when two indexes agree about the direction of misalignment but disagree about the magnitude of misalignment as much as 20%.

Contradictions are also shown concerning the empirical validity of the Purchasing Power Parity (PPP) model. Using unit root tests (Dickey-Fuller) on data for Mexico and Costa Rica, the PPP model is rejected. However, an alternative test for whether the nominal exchange rate varies with the home-foreign inflation differential indicates strong support for PPP in the same two countries.

When RERs are used to determine currency misalignment, caution is advised. For example, it is important to know to what extent a claim that a certain currency is overvalued by X% depends on the base year chosen, or the price index or weighting scheme used. Users of RER indexes can have more confidence in the claim if the major alternative RER measures cluster around an overvaluation of X%.

1. INTRODUCTION

Disagreement about the magnitude and direction of exchange rate misalignment is not uncommon. One source of disagreement is the use of alternate definitions of the real exchange rate (RER), including a Purchasing Power Parity (PPP)-based rate, the relative prices of tradable/non-tradable goods, and the terms of trade.[1] A second source of disagreement is the existence of competing theoretical models of the RER. The weak empirical support for all existing theoretical models results in a lack of consensus about which model is most useful in analyzing currency misalignment.[2] A third source of disagreement is that there are alternate empirical representations of each theoretical model that may not be closely related to each other. In the case of PPP-based models, inflation can be measured by consumer prices, wholesale prices, or gross domestic product (GDP) deflators. In addition to alternate price indexes, there is a choice between a bilateral RER against a major trading partner or a multilateral rate against several major trading partners.

This paper attempts to clarify the relationships among RER measures by using the simplest definition and RER model to analyze different empirical measures of the same model. The PPP-based RER is applied to data for a set of Central American countries and Mexico[3] for the period 1962–88. Differences between alternative theoretical measures have been analyzed elsewhere,[4] and they will not be considered here.

A general issue investigated is how consistent the various RER measures are with each other. An extreme contradiction occurs when one measure indicates overvaluation of a currency and another measure indicates undervaluation of the same currency at the same time. A less extreme contradiction is agreement about the direction of misalignment but disagreement about the magnitude.

A result from the Central American sample is that contradictions about misalignment were not rare. Consistency of results for simple tests of PPP were also investigated, and some prominent contradictions were found.

In addition to issues of consistency, some empirical properties of price indexes and trade weights are analyzed. The relative importance of choosing between price indexes and quantity weights is also considered.

2. EMPIRICAL MEASURES OF THE REAL EXCHANGE RATE

According to PPP the RER is constant between a current year and a base year if the change in the nominal exchange rate over that period just compensates for the inflation differential between the home and partner countries. Because inflation can be measured in most countries by consumer prices, wholesale (producer) prices, or GDP deflators, three alternative measures of the RER can be constructed for each bilateral exchange rate.[5] A broader measure of a currency's value is a multilateral or real effective exchange rate, which is a weighted average exchange rate against one's major trading partners. The weights are trade shares and the averages can be computed as arithmetic means or geometric means. In addition to the three bilateral RERs, there will also be three multilateral arithmetic RERs and three multilateral geometric RERs. These nine indexes were calculated using official rates as reported in the *International Financial Statistics*.[7] Additional RERs can be constructed using black or parallel market exchange rates. They have been analyzed elsewhere[6] and will not be considered here.

The bilateral RER for country j in period t is:

$$BRER_{jt} = E_{jt} \times \frac{P_{jt}^{*}}{P_{jt}} \tag{1}$$

where E_{jt} - domestic currency per dollar

P_{jt}, P_{jt}^{*} - domestic (foreign) price level

Multilateral real exchange rates (MRER) are also calculated to represent trade with a broader set of partner countries. The arithmetic MRER is an additive trade weighted measure of the RER, whereas the geometric MRER is a multiplicative calculation of the RER. The arithmetic MRER is more sensitive to extreme observations. The arithmetic MRER for country j in period t is defined as:

$$AMRER_{jt} = \frac{\sum_{i=1}^{n} \alpha_i E_{it}^{*} P_{it}^{*}}{P_{jt}} \quad where \quad \sum_{i=1}^{n} \alpha_i = 1 \qquad 0 < \alpha_i \leq 1 \tag{2}$$

where E_{it}^{*} - domestic currency per unit of foreign currency

α_i - trade weight corresponding to partner i in computing $AMRER_{jt}$[8]

n - number of trading partners included

The geometric RER is also a trade-weighted average exchange rate; it uses the geometric mean rather than the arithmetic. The geometric MRER for country j in period t is defined as:

$$GMRER_{jt} = \frac{\sum_{i=1}^{n} (E_{it}^{*})^{\alpha_i} (P_{it})^{\alpha_i}}{P_{jt}} \tag{3}$$

3. COUNTRIES AND TRADE WEIGHTS

The nine real exchange rate indexes were calculated for Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, and Panama for the period 1962–1988. At the beginning of the period all the currencies were rigidly pegged to the U.S. dollar, but only Honduras and Panama retained fixed rates against the dollar for the entire period. During periods of fixed nominal rates, real rates varied due to differential inflation rates. The dollar was devalued in 1971, and it began floating in 1973 against OECD countries. Thus, Central American countries that remained pegged to the dollar were simultaneously floating against OECD countries. For this reason one would expect a bilateral RER with the dollar to deviate from a multilateral RER.

The weights (α_i)[9] for country j were based on country j's ten largest trading partners in 1980, where

$$\alpha_i = \frac{(X_i + M_i)}{\sum_{k=1}^{10} (X_k + M_k)} \qquad for\ i = 1, \ldots, 10 \tag{4}$$

where X_i - country j's exports to country i

M_i - country j's imports from country i

In some cases one or two of the largest trading partners were excluded because some of the price indexes were not reported. These omissions were not a serious problem, though, as the largest country share omitted was Honduras, which accounted for merely 4 percent of El Salvador's trade.

The U.S. is the largest trading partner for all the countries, responsible for 36 (El Salvador) to 73 percent of trade (Mexico). The fact that all countries had the same major trading partner might lead one to expect that bilateral and multilateral rates should yield similar results. In the case of Mexico, the bilateral and multilateral RERs were closely related to each other. This was not always the case, however, and alternate price indexes and trade weighting schemes often yielded widely different results.[10]

4. EMPIRICAL RESULTS FOR REAL EXCHANGE RATE INDEXES

Tables 1-7 present the nine RER indexes per country for the seven countries. The base year is 1962, and an index value greater than unity is interpreted as a real devaluation of the home country's currency relative to 1962. If the 1962 rate is interpreted as an equilibrium rate, a value less than one for a given year can be interpreted as overvaluation, and a value greater than one can be interpreted as undervaluation relative to 1962.

It is well known that applications of PPP are sensitive to the base year chosen, and the Central American data confirms this proposition. The exchange rate for a given year may appear to be overvalued relative to one base year but undervalued relative to a different base year. For example, the Mexican *peso* appeared to be overvalued in 1988 relative to a base year of 1987, and this relationship held for all six measures of the Mexican exchange rate (see Table 5). However, the Mexican *peso* appeared to be undervalued in 1988 relative to a 1962 base by all six measures.

However, even when the base year is held constant at 1962, some contradictions occur concerning the overvaluation or undervaluation of currencies for all combinations of RER indexes. In the case of Costa Rica, one bilateral index (BW = 0.98; see Table 1) shows overvaluation in 1967 relative to a 1962 base, but another bilateral index (BG = 1.06) shows undervaluation in the same year. Furthermore, this same contradiction persists through 1975. Here it results from differences in the behavior of wholesale prices and the GDP deflator.

Some contradictions also occur in Costa Rica for the two types of multilateral indexes. One multilateral arithmetic index (MGA = 0.95; see Table 1) indicates overvaluation of the Costa Rican *colon* in 1977, but another multilateral arithmetic index (MCA = 1.20) shows undervaluation of the currency the same year. This contradiction persists through 1980. A similar relationship can be found among multilateral geometric indexes. In 1979 one index (MGA = 0.97) shows overvaluation for the Costa Rican currency but another (MGG = 1.01) shows undervaluation of the currency. Given these disparities between indexes of the same type, it is not surprising to find disparities between a bilateral arithmetic index and a multilateral geometric index. Thus, an apparently well-defined RER index (PPP) for a given base year shows some contradictions concerning the direction of currency misalignment due to alternative price indexes and weighting schemes.

5. CORRELATIONS AMONG REAL EXCHANGE RATE INDEXES

It would be informative to find a pattern of either consistently high or consistently low correlation coefficients among the RER indexes. At one extreme, if they were perfectly positively correlated and used the same base year, all the RERs would contain similar information. At the opposite extreme, consistently low correlations would indicate substantial differences among RERs. Choosing among RERs would be important, and some criteria would be needed to determine the most useful index. Unfortunately, the data did not generate a consistent simple pattern of correlations, and there is no unambiguous criterion for determining whether two indexes are approximately equivalent. Correlation coefficients among the nine RER series are shown for each country in Tables 8-14.

For two of the seven countries (Honduras and Panama) certain pairs of real exchange rate indexes were negatively correlated.[11] Usually the negative correlations involved different types of indexes, either a bilateral index with a multilateral index or multilateral arithmetic with a multilateral geometric index. In the case of Honduras (Table 11) the bilateral consumer and multilateral arithmetic consumer indexes are negatively correlated even though the two bilateral indexes (0.83) and the two multilateral arithmetic indexes (0.99) are highly correlated with each other. In the case of Panama (Table 14), pairs of bilateral indexes (BC—BW and BG—BW) are negatively correlated with each other.

Even when real exchange rate indexes are correlated as highly as +0.50, different RERs can have quite different implications about equilibrium exchange rates. In the case of bilateral indexes for Costa Rica (Table 8) the consumer and wholesale price indexes are correlated +0.52. In 1988, when the actual nominal rate was 75.81 *colones* per dollar, the equilibrium nominal rate implied by the wholesale index was 72.74 *colones*, but the equilibrium rate implied by the consumer price index was 39.77 *colones* per dollar. Thus, the wholesale index implied that the actual index was 1.04 times the equilibrium rate, but the consumer index implied that the actual rate was 1.91 times the equilibrium rate. Costa Rican policymakers would not have found it very informative in 1988 to have been told that the exchange rate was either approximately equal to its equilibrium value or nearly twice its equilibrium value.

In an earlier study Edwards concluded that the choice between bilateral and multilateral indexes is more important than the choice among price indexes.[12] This proposition can be formalized as a hypothesis that the correlation coefficient between any two bilateral indexes is greater than the correlation coefficient between one bilateral index and the corresponding (using the same price index) multilateral index. All possible pairs of appropriate correlation coefficients (50) were compared and just over 50 percent of the time the hypothesis was contradicted. Based on this sample it is difficult to deny that the choice of price index is as important as the choice between bilateral and multilateral indexes.

One reason for the above result is that wholesale prices have different properties from consumer prices and GDP deflators.[13] Wholesale prices include more prices of traded goods

than CPIs or GDP deflators. A formal statement of this relationship is that the correlation between comparable indexes using consumer prices and GDP deflators is greater than the correlation between either one of them and the comparable wholesale index. All possible comparisons (20) were made from the correlation coefficients in Tables 8-14 and in 90 percent of the cases the hypothesis was supported. Thus, RERs using consumer prices and GDP deflators were more closely related to each other than either one was to RERs using wholesale prices. The distinctiveness of wholesale prices showed up in another comparison. Most of the negative correlation coefficients among RERs involved wholesale prices.

6. VOLATILITY OF THE REAL EXCHANGE RATE

The effect of RER volatility on exports and real income has been considered by Edwards (1989) and Cottani, Cavallo, and Kahn (1990).[14] Variances and coefficients of variation (variance divided by mean) were calculated for the nine RER series for each country; they appear in Table 15.

$$\textit{Let } VAR(BRER)_{jt} = \sigma_j^2 \textit{ for all } t \textit{ and } j\textit{; then} \tag{5}$$

$$Var(AMRER_{jt}) = Var\left(\sum_{i=1}^{n} \alpha_i BRER_i\right) = \sum_{i=1}^{n} \alpha_i^2 \sigma_i^2 \quad \textit{if the BRERs are independent} \tag{6}$$

Independence seems a reasonable assumption, as the U.S. is the largest trading partner for each country analyzed.[15] Thus it is easy to show that the sign of VAR $(BRER)_{jt}$ - VAR $(AMRER)_{jt}$ is ambiguous.

The sign is likely to be positive unless at least one σ_i^2 is very large relative to a σ_j^2. As $\alpha_j \rightarrow 1$, the Var (RER) $\approx$ Var (AMRER), and hence the indifference between multilateral and bilateral real exchange rates. In the special case when $\sigma_j^2 = \sigma^2$ for all j, then Var(BRER) exceeds Var(AMRER). Consequently, if all the BRER have similar variances then the BRER are likely to be more volatile than the MRER.

A first order Taylor series expansion is used to approximate the variance of the GMRER.

$$Var(GMRER) - Var(AMRER) = \sum_{i=1}^{n} \left[\{(BRER_i^{\alpha_i})(\log BRER_i)\}^2 - \alpha_i^2 \right] \sigma_i^2 \tag{7}$$

If $BRER_i \approx 1$[16] for all i and t--i.e., PPP holds almost exactly--then Log $BRER_i \approx 0$, which implies Var (GMRER) < Var (AMRER). Consequently the BRERs for a number of countries must substantially exceed unity for a long period of time in order for Var (GMRER) > Var (AMRER). These conditions were seldom satisfied. While the mean of the GMRER is less than or equal to that of the AMRER, the Var (GMRER) need not be less than that of the AMRER, but it usually is.

The coefficient of variation (CV) is defined as

$$CV = 100 \times \frac{\textit{Standard Deviation}}{\textit{Mean}} \tag{8}$$

and is used to analyze the volatility of RER's. The CVs are calculated over the same periods of time as the variances were examined.

One cannot determine on *a priori* grounds which RER measure will have the minimum variance or least coefficient of variation. Some biases in RER can occur if one of the trading partners has a large variance in a variable used to calculate BRER. This typically arises for countries which have large real devaluations in exchange rates such as Nicaragua and Mexico. If such countries are included in a MRER then they dominate the variance of the MRER regardless of the trade share. The GMRER is preferable to the AMRER in such cases since it places less emphasis on these extreme events. Another remedy is to exclude these countries from the MRER calculations if their trade share is minimal in order to avoid biases.

The period 1962–88 can be divided into three sub-periods: 1962-1972, with fixed exchange rates; 1973-80, transition to floating; and 1981-88, mostly managed floating rates. The coefficients of variation for nearly all indexes and countries showed the greatest volatility of RERs in the 1981-88 sub-period. This same result has been found for the OECD countries, and it is the period of greatest variation in nominal exchange rates. For both the entire period and the last period the coefficients of variation for the multilateral arithmetic indexes showed the greatest volatility. CVs using wholesale prices showed less volatility than those using consumer prices or GDP deflators.

A result with strong empirical support is that the multilateral arithmetic index results in greater volatility than either the multilateral geometric index or the bilateral index. This result was found for all countries and all (32) possible comparisons.

7. ALTERNATIVE TESTS OF PURCHASING POWER PARITY

The nine measures of the real exchange rate analyzed above are all based on Purchasing Power Parity. It is instructive to consider the empirical validity of PPP for the sample of Central American countries.[17] Two standard tests for PPP will be employed, and the results will be compared to determine whether the tests provide consistent relationships for these countries. One approach is a unit root test to determine whether the RER follows a random walk (RW). If the RER follows an RW, temporary deviations from PPP are not corrected in the long-run and PPP is rejected. Hakkio[18] provides sufficient conditions for the RER to follow an RW. Results of unit root tests are shown in Table 15. An alternative test follows Edwards[19] in testing for short-run and long-run deviations from PPP.

The Dickey-Fuller[20] unit root procedure is used to test for an RW. The three measures of the RER based on the three indexes were tested for unit roots. The BRER had the most unit roots, totalling 17, whereas the GMRER had 13 and AMRER only 9. Thus PPP may follow an RW with the BRER but not necessarily with MRER. In the case of Panama unit roots were found for all three bilateral RERs, but they were not found for any of the six multilateral measures. Thus the results are sensitive to the measure of RER, but no clear pattern emerged with respect to the price index used.

Edwards' paper on Peru provides an alternative framework for analyzing short run (SR) and long run (LR) deviations from PPP. The nominal exchange rate (E_{jt}) is expressed in terms of the inflation differential and the lagged exchange rate. The equation to be estimated is[21]

$$\ln E_{jt} = \alpha_0\alpha_3 + \alpha_1\alpha_3 (\ln P_{jt} - \ln P_{jt}^{*}) + (1 - \alpha_3) \ln E_{jt-1} + U_t \qquad (9)$$

The LR elasticity is α_1 and, under the hypothesis that PPP holds in the LR, it should not differ from unity. The SR elasticity of the exchange rate with respect to the price index differentials is $\alpha_1\alpha_3$, and it should be less than unity if there are SR deviations from PPP. Honduras and Panama had fixed nominal exchange rates, so the test cannot be applied to them.

The LR elasticity was not significantly different from unity except for Nicaragua--i.e., PPP holds in the LR for all countries and price indexes. There were SR deviations for El Salvador and Nicaragua but not for Costa Rica, Guatemala, or Mexico for all price indexes. The SR elasticities based on GDP deflators were the smallest. The SR elasticities were sensitive to the price index used and could move from below unity for GDP but could be greater than two if the CPI was used, as was the case for Costa Rica. The LR elasticities were less sensitive. The adjustment coefficient (α_3) was sensitive to the use of the price index for Costa Rica and Mexico but not for Guatemala and El Salvador. For Costa Rica and Mexico the GDP deflators indicate that the adjustment from PPP deviations is slow (i.e., less than unity), whereas the CPI and WPI indicate rapid adjustment.

The wholesale price index provided stronger support for PPP in the sense that the long-run elasticity coefficient (α_1) is closer to unity when wholesale prices are used for all countries.[22] The same point can be seen in the Tables of RER indexes where the indexes using wholesale prices show the smallest deviations from unity.

A major contradiction between the results of the two tests can be seen in the cases of Costa Rica and Mexico. The unit root tests show virtually no empirical support for PPP, whereas the Edwards' test shows overwhelming support for PPP. For Costa Rica unit roots were found for eight of the nine RER series, indicating rejection of PPP. However, in Edwards' test the elasticity of the nominal exchange rate with respect to the relative price levels did not significantly differ from unity in the short-run or the long-run for any of the three price indexes. The same strong contradiction occurred for Mexico. Unit roots were found for all six RER series, indicating that the Mexican RER followed an RW from 1962-88. However, an estimate of the elasticity of the nominal exchange rate with respect to national price levels for the same period shows that it did not significantly differ from unity in the short-run or the long-run.

The two tests appear to be dealing with the same basic question. Does the real exchange rate follow an RW as determined by a unit root test? Does the elasticity of the nominal exchange rate with respect to the inflation differential differ from unity? As seen in the cases of Costa Rica and Mexico, it is possible to pass one of the tests and fail the other test using data from the same time period. However, Hakkio has shown that the unit root tests tend to be biased toward indicating that a unit root is present when it is not.[23]

8. CONCLUSION

One should exercise great caution in interpreting changes in observed RERs. It has been demonstrated that for a sample of Central American countries the direction and magnitude of exchange rate misalignment can vary with the price indexes and quantity weighting schemes used to construct an RER. Paradoxically, the same currency can appear to be both overvalued and undervalued at the same time. It was also shown that the empirical validity of the underlying PPP model can depend on the kind of test that is employed. In particular, one test may indicate strong support for PPP, whereas another test may provide no support at all for the hypothesis for the same countries and time periods.

The proper interpretation of these results is caution rather than nihilism. We have pointed out the contradictory cases, but they do not occur all the time or even most of the time. Real exchange rates may provide useful information, but users should be wary of the possibility that a certain result may depend entirely on a particular price index or quantity weighting scheme. Both economic analysts and policymakers should insist on information about the robustness of RERs to alternative price and quantity measures. Similarly, the validity of an exchange rate model cannot be determined by any single test, and knowledge of the results of alternative tests would be informative.

In addition to the general results concerning consistency, some specific empirical regularities were observed. Consumer price indexes and GDP deflators were found to be more closely related to each other than either one was to the wholesale price index. The fact that wholesale price indexes contain a larger percentage of traded goods prices may account for both this relationship and the stronger support for PPP obtained when RERs contain wholesale prices. Multilateral RERs based on arithmetic means show greater volatility than bilateral RERs or multilateral RERs based on geometric means. Finally, the choice among price indexes was found to be at least as important as the choice among trade weights for the Central American sample.

NOTES

1. See Sebastian Edwards, Real Exchange Rates, Devaluation and Adjustment, 1989.

2. See Richard Meese, "Currency Fluctuations in the Post-Bretton Woods Era," 1990.

3. A time series for Belize was not available for the same time period. Mexico was included because it is an important trading partner of the other countries, it is located in the same region, and it followed a similar exchange rate policy.

4. Joaquin Cottani, Domingo Cavallo, and M. Shahbaz Khan, "Real Exchange Rate Behavior and Economic Performance in LDCs," (1990).

5. All three price indexes have been used in the empirical literature, but rarely are the results for all three measures reported and compared.

6. See Sebastian Edwards, n.1, and Edwards, "Real Exchange Rates in Developing Countries: Concepts and Measurement," (1990). RERs using black market rates have been calculated for Costa Rica, and they are reported in Thomas Grennes, "Analysis of the Real Exchange Rate in Costa Rica," (1990).

7. Missing observations were estimated for Guatemala WPI 1987-8, Honduras GDP 1988, Panama GDP 1988 WPI 1962-65, Nicaragua GDP 1988.

8. Michael Connolly, "Optimum Currency Pegs for Latin America," (1983), discusses optimal choices for α. Also see William Branson and Louka T. Katseli-Papaefstatiou, "Income Instability, Terms of Trade, and the Choice of Exchange Rate Regime," (1980).

9. The 10 largest trading partners accounted for well over 90 percent of the trade for all countries examined. The base year selected was 1980 and like Adrian Wood "Global Trends in Real Exchange Rates: 1960-84," (1991), our results are not sensitive to fixed weights.

10. For example for Mexico, the weight for the U.S. in the bilateral index is 1.0. It is 0.73 in both multilateral indexes, but the mean relative to the ten trading partners is calculated arithmetically for one index and geometrically for the other. Thus, the weighing schemes differ for the two multilateral indexes even though the weights for each trading partner are the same.

11. The source of the negative correlation can be seen by inspecting Columns (1) and (2) in Table 7. For example, BW fell for four consecutive years beginning in 1979, whereas BC increased or remained constant during the same period.

12. See Edwards n.6: "These findings indicate that for most countries, and within a particular type of index--bilateral or multilateral--the selection of the price indexes used in the construction of the RER measure is not a major practical problem," p. 79.

13. The distinctiveness of wholesale prices in the calculation of PPP has been claimed by various people over many years. See for example, Gottfried Haberler, A Survey of International Trade Theory (1961) on the controversy, concerning Churchill's use of wholesale prices in adjusting the British exchange rate in 1924-25. A recent claim that wholesale prices are different (and better for PPP) appears in Ronald J. McKinnon, "Monetary and Exchange Rate Policies for International Finance Stability: A Proposal," (1988).

14. See Edwards n.4 and Cottani et al. n.3. A list of papers relating instability of export earnings appears in Kwabena Gyimah-Brempong, "Export Instability and Economic Growth in Sub-Saharan Africa," (1991). Economic Development and Cultural Change 39 (July 1991):815-828.15.

15. Independence of bilateral rates means for example that Cov (Panama RER, Honduras RER) = O.

16. If $BRER_i = 1$ then $\sigma_i^2 = 0$.

17. For a general discussion of theoretical and empirical issues related to PPP see Lawrence Officer, Purchasing Power Parity and the Exchange Rate: Theory, Evidence, and Relevance (1982).

18. See Craig Hakkio, "A Re-examination of Purchasing Power Parity: A MultiCountry, Multi-Period Study," (1984).

19. See Sebastian Edwards, "Floating Exchange Rates in Less Developed Countries: A Monetary Analysis of the Peruvian Experience, 1950-54," (1983).

20. See David Dickey and Wayne A. Fuller, "Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root," (1981).

21. Fair's two stage least squares method was implemented to account for serial correlation and lagged endogenous variables. See Ray Fair, "The Estimation of Simultaneous Equation Models with Lagged Endogenous Variables and First Order Serially Correlated Errors," (1970).

22. Edwards' paper on Peru used wholesale prices exclusively (p. 77).

23. See Hakkio (1984).

TABLES

Table 1. Real Exchange Rate Indexes : 1962 - 88

Costa Rica

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	BC	BW	BG	MCA	MWA	MGA	MCG	MWG	MGG
1962	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1963	0.98	0.97	0.99	0.99	0.98	1.00	0.99	0.98	1.00
1964	0.96	0.95	0.99	0.97	0.97	1.00	0.97	0.97	0.99
1965	0.99	0.98	1.03	1.01	1.00	1.03	1.00	0.99	1.02
1966	1.02	1.01	1.05	1.03	1.02	1.05	1.02	1.01	1.03
1967	1.03	0.98	1.06	1.05	0.99	1.05	1.03	0.98	1.04
1968	1.03	0.96	1.09	1.04	0.96	1.07	1.03	0.95	1.05
1969	1.06	0.95	1.10	1.06	0.94	1.06	1.04	0.94	1.05
1970	1.07	0.93	1.08	1.06	0.93	1.05	1.05	0.92	1.04
1971	1.09	0.90	1.11	1.08	0.90	1.09	1.07	0.90	1.08
1972	1.07	0.89	1.10	1.08	0.88	1.08	1.10	0.91	1.10
1973	0.99	0.87	1.02	1.02	0.87	1.04	1.07	0.91	1.08
1974	1.01	0.88	1.07	1.07	0.90	1.14	1.11	0.94	1.18
1975	1.01	0.86	1.03	1.10	0.86	1.08	1.13	0.90	1.13
1976	1.04	0.82	0.94	1.14	0.86	1.01	1.17	0.89	1.04
1977	1.06	0.81	0.85	1.20	0.90	0.95	1.21	0.91	0.97
1978	1.08	0.81	0.85	1.23	0.88	0.96	1.29	0.91	1.00
1979	1.10	0.79	0.85	1.26	0.84	0.97	1.31	0.88	1.01
1980	1.05	0.73	0.78	1.21	0.79	0.92	1.25	0.81	0.94
1981	2.15	1.22	1.53	2.44	1.31	1.78	2.44	1.30	1.75
1982	2.07	1.02	1.52	2.44	1.16	1.85	2.24	1.05	1.65
1983	1.77	0.90	1.38	2.36	1.17	1.91	1.91	0.92	1.48
1984	1.78	0.93	1.30	2.67	1.40	2.04	1.86	0.93	1.36
1985	1.82	0.95	1.26	3.22	1.74	2.35	1.93	0.98	1.33
1986	1.84	0.94	1.21	4.10	2.30	2.78	1.93	0.97	1.26
1987	1.83	0.98	1.27	7.01	4.30	4.88	2.01	1.05	1.38
1988	1.90	1.04	1.31	12.78	7.97	8.05	2.15	1.14	1.47

BC - Bilateral, using CPI
BW - Bilateral, using WPI
BG - Bilateral, using GDP deflator
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MWA - Multilateral arithmetic, using WPI
MGA - Multilateral arithmetic, using GDP deflator
MCG - Multilateral geometric, using CPI
MWG - Multilateral geometric, using WPI
MGG - Multilateral geometric, using GDP deflator

Table 2. Real Exchange Rate Indexes : 1962 - 88

El Salvador

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	BC	BW	BG	MCA	MWA	MGA	MCG	MWG	MGG
1962	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1963	1.00	0.98	0.99	1.00	0.99	1.00	1.00	0.99	1.00
1964	0.99	0.92	1.00	0.98	0.94	0.99	0.96	0.91	0.96
1965	1.00	0.96	1.01	0.99	0.96	0.98	0.97	0.94	0.96
1966	1.05	0.99	1.06	1.03	0.98	1.02	1.00	0.95	0.99
1967	1.06	0.98	1.09	1.03	0.97	1.04	1.00	0.95	1.01
1968	1.08	1.01	1.15	1.04	1.01	1.08	1.01	0.98	1.05
1969	1.14	1.06	1.20	1.08	1.04	1.11	1.05	1.02	1.08
1970	1.17	1.01	1.21	1.10	1.00	1.12	1.07	0.98	1.10
1971	1.22	1.10	1.28	1.14	1.09	1.17	1.11	1.07	1.15
1972	1.24	1.09	1.32	1.16	1.06	1.21	1.15	1.06	1.20
1973	1.23	1.01	1.28	1.20	0.99	1.22	1.21	1.01	1.23
1974	1.17	0.96	1.26	1.16	0.96	1.28	1.16	0.96	1.28
1975	1.07	1.03	1.28	1.09	1.05	1.31	1.08	1.04	1.30
1976	1.06	0.80	1.11	1.09	0.83	1.16	1.08	0.82	1.15
1977	1.01	0.58	1.00	1.06	0.62	1.08	1.06	0.61	1.08
1978	0.96	0.78	1.07	1.01	0.82	1.15	1.02	0.83	1.17
1979	0.93	0.81	1.02	0.98	0.85	1.12	0.99	0.86	1.14
1980	0.90	0.80	0.98	0.94	0.85	1.11	0.95	0.85	1.12
1981	0.87	0.80	1.02	0.90	0.88	1.16	0.85	0.79	1.06
1982	0.82	0.75	0.99	0.92	0.97	1.22	0.79	0.74	1.01
1983	0.75	0.71	0.91	0.88	0.99	1.17	0.73	0.71	0.93
1984	0.70	0.69	0.84	0.82	0.98	1.13	0.63	0.65	0.82
1985	0.59	0.60	0.72	0.74	0.94	1.03	0.55	0.60	0.72
1986	0.92	0.88	1.08	1.01	1.29	1.39	0.77	0.84	0.98
1987	0.76	0.86	0.96	0.92	1.40	1.32	0.64	0.83	0.86
1988	0.66	0.75	0.85	0.85	1.28	1.27	0.57	0.71	0.78

BC - Bilateral, using CPI
BW - Bilateral, using WPI
BG - Bilateral, using GDP deflator
MCA - Multilateral arithmetic, using CPI
MWA - Multilateral arithmetic, using WPI
MGA - Multilateral arithmetic, using GDP deflator
MCG - Multilateral geometric, using CPI
MWG - Multilateral geometric, using WPI
MGG - Multilateral geometric, using GDP deflator

Table 3. Real Exchange Rate Indexes : 1962 - 88

Guatemala

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	BC	BW	BG	MCA	MWA	MGA	MCG	MWG	MGG
1962	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1963	1.01	1.00	1.01	1.02	1.02	1.02	1.02	1.02	1.02
1964	1.02	0.97	1.04	1.04	0.99	1.05	1.03	0.98	1.04
1965	1.05	1.01	1.09	1.07	1.03	1.09	1.06	1.02	1.08
1966	1.08	1.05	1.14	1.10	1.06	1.13	1.08	1.05	1.12
1967	1.10	1.05	1.16	1.12	1.06	1.16	1.10	1.05	1.14
1968	1.13	1.03	1.20	1.14	1.05	1.19	1.13	1.04	1.17
1969	1.16	1.03	1.24	1.16	1.04	1.21	1.15	1.03	1.20
1970	1.20	1.05	1.25	1.20	1.06	1.23	1.19	1.05	1.22
1971	1.26	1.06	1.34	1.26	1.07	1.32	1.26	1.07	1.32
1972	1.29	1.11	1.42	1.32	1.13	1.42	1.33	1.15	1.44
1973	1.21	1.10	1.32	1.27	1.13	1.37	1.31	1.17	1.42
1974	1.15	1.07	1.24	1.25	1.11	1.36	1.26	1.13	1.38
1975	1.11	1.04	1.21	1.24	1.08	1.34	1.25	1.09	1.35
1976	1.06	0.98	1.15	1.22	1.08	1.33	1.21	1.07	1.33
1977	1.01	0.92	1.06	1.19	1.09	1.28	1.16	1.04	1.24
1978	1.00	0.96	1.07	1.20	1.09	1.31	1.19	1.08	1.30
1979	1.00	0.98	1.08	1.20	1.11	1.35	1.19	1.08	1.33
1980	1.02	0.96	1.07	1.24	1.10	1.40	1.22	1.06	1.34
1981	1.01	0.94	1.08	1.24	1.12	1.43	1.11	0.96	1.25
1982	1.07	1.02	1.07	1.47	1.50	1.61	1.15	1.04	1.20
1983	1.06	1.02	1.07	1.69	1.79	1.85	1.16	1.06	1.20
1984	1.07	0.99	1.06	1.91	1.96	2.11	1.13	1.00	1.17
1985	0.93	0.80	0.92	1.95	1.89	2.16	1.00	0.82	1.03
1986	1.73	1.36	1.68	4.72	4.35	5.02	1.89	1.44	1.90
1987	1.60	1.24	1.51	7.16	6.59	7.07	1.79	1.32	1.73
1988	1.62	1.30	1.46	12.43	11.65	10.54	1.87	1.43	1.71

BC - Bilateral, using CPI
BW - Bilateral, using WPI
BG - Bilateral, using GDP deflator
MCA - Multilateral arithmetic, using CPI
MWA - Multilateral arithmetic, using WPI
MGA - Multilateral arithmetic, using GDP deflator
MCG - Multilateral geometric, using CPI
MWG - Multilateral geometric, using WPI
MGG - Multilateral geometric, using GDP deflator

Table 4. Real Exchange Rate Indexes : 1962 - 88

Honduras

	(1)	(2)	(3)	(4)	(5)	(6)
	BC	BG	MCA	MGA	MCG	MGG
1962	1.00	1.00	1.00	1.00	1.00	1.00
1963	0.98	0.99	0.99	1.00	0.99	1.00
1964	0.95	0.95	0.96	0.96	0.95	0.95
1965	0.94	0.97	0.95	0.97	0.95	0.95
1966	0.95	0.99	0.96	0.98	0.96	0.97
1967	0.95	0.97	0.97	0.97	0.96	0.95
1968	0.98	1.01	0.99	1.00	0.99	0.98
1969	1.02	1.03	1.02	1.01	1.02	1.00
1970	1.05	1.06	1.05	1.05	1.05	1.04
1971	1.07	1.10	1.08	1.09	1.09	1.09
1972	1.07	1.10	1.08	1.10	1.13	1.12
1973	1.07	1.11	1.12	1.13	1.20	1.18
1974	1.06	1.08	1.12	1.15	1.18	1.19
1975	1.06	1.08	1.15	1.16	1.20	1.19
1976	1.08	1.06	1.18	1.15	1.24	1.18
1977	1.06	1.01	1.18	1.11	1.24	1.15
1978	1.07	1.03	1.20	1.14	1.30	1.22
1979	1.07	1.02	1.18	1.14	1.27	1.21
1980	1.02	0.98	1.12	1.11	1.17	1.17
1981	1.03	1.00	1.12	1.12	1.12	1.13
1982	1.01	1.01	1.13	1.18	1.07	1.10
1983	0.96	1.00	1.14	1.23	1.03	1.09
1984	0.96	0.99	1.17	1.29	0.98	1.05
1985	0.96	0.98	1.26	1.37	0.98	1.04
1986	0.93	0.96	1.35	1.48	0.99	1.03
1987	0.95	0.97	1.80	1.93	1.01	1.06
1988	0.94	0.99	2.53	2.60	1.01	1.10

BC - Bilateral, using CPI
BG - Bilateral, using GDP deflator
MCA - Multilateral arithmetic, using CPI
MGA - Multilateral arithmetic, using GDP deflator
MCG - Multilateral geometric, using CPI
MGG - Multilateral geometric, using GDP deflator

Table 5. Real Exchange Rate Indexes : 1962 - 88

Mexico

	(1)	(2)	(3)	(4)	(5)	(6)
	BC	BW	MCA	MWA	MCG	MWG
1962	1.00	1.00	1.00	1.00	1.00	1.00
1963	1.01	0.99	1.02	1.00	1.02	1.00
1964	1.00	0.95	1.01	0.98	1.01	0.98
1965	0.98	0.95	1.01	0.99	1.01	0.99
1966	0.97	0.97	1.00	1.02	1.00	1.01
1967	0.97	0.95	1.00	0.99	1.00	0.98
1968	0.98	0.95	1.02	1.01	1.01	0.99
1969	1.00	0.96	1.04	1.03	1.03	1.01
1970	1.01	0.95	1.05	1.02	1.04	0.99
1971	1.00	0.94	1.04	1.01	1.04	0.99
1972	0.98	0.95	1.04	1.04	1.05	1.03
1973	0.93	0.93	1.00	1.01	1.03	1.03
1974	0.84	0.91	0.91	0.96	0.93	0.98
1975	0.79	0.89	0.88	0.92	0.90	0.95
1976	0.72	0.76	0.81	0.79	0.82	0.80
1977	1.08	1.04	1.25	1.08	1.25	1.09
1978	1.00	0.98	1.16	1.00	1.18	1.03
1979	0.94	0.93	1.10	0.93	1.12	0.97
1980	0.85	0.86	0.99	0.84	1.00	0.86
1981	0.78	0.80	0.91	0.77	0.83	0.77
1982	1.20	1.21	1.41	1.16	1.20	1.13
1983	1.31	1.26	1.57	1.21	1.26	1.16
1984	1.16	1.06	1.39	1.02	1.07	0.96
1985	1.16	1.05	1.41	1.02	1.04	0.95
1986	1.51	1.29	1.87	1.26	1.42	1.23
1987	1.52	1.26	1.89	1.23	1.43	1.24
1988	1.22	1.04	1.50	1.01	1.11	1.03

BC - Bilateral, using CPI
BW - Bilateral, using WPI
MCA - Multilateral arithmetic, using CPI
MWA - Multilateral arithmetic, using WPI
MCG - Multilateral geometric, using CPI
MWG - Multilateral geometric, using WPI

Table 6. Real Exchange Rate Indexes : 1962 - 88

Nicargua

	(1)	(2)	(3)
	BG	MGA	MGG
1962	1.00	1.00	1.00
1963	0.99	0.99	0.99
1964	0.98	0.97	0.95
1965	0.98	0.96	0.94
1966	0.99	0.96	0.93
1967	0.99	0.95	0.93
1968	1.02	0.96	0.94
1969	1.04	0.97	0.95
1970	1.08	1.01	0.98
1971	1.10	1.03	1.00
1972	1.12	1.05	1.04
1973	1.16	1.13	1.14
1974	1.22	1.27	1.25
1975	1.29	1.36	1.33
1976	1.32	1.42	1.38
1977	1.36	1.51	1.48
1978	1.41	1.57	1.56
1979	1.80	2.05	2.04
1980	2.10	2.49	2.45
1981	2.20	2.63	2.23
1982	2.26	3.15	2.24
1983	2.28	3.40	2.27
1984	2.29	3.60	2.17
1985	6.17	10.53	5.94
1986	15.20	25.93	14.28
1987	15.75	28.94	14.58
1988	17.92	36.18	16.90

BG - Bilateral, using GDP deflator
MGA - Multilateral arithmetic, using GDP deflator
MGG - Multilateral geometric, using GDP deflator

Table 7. Real Exchange Rate Indexes : 1962 - 88

Panama

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	BC	BW	BG	MCA	MGA	MCG	MGG
1962	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1963	1.01	0.99	0.99	1.02	1.00	1.02	1.00
1964	1.00	0.97	0.98	1.01	0.99	1.00	0.98
1965	1.01	0.98	1.00	1.03	1.00	1.02	0.99
1966	1.04	0.98	1.02	1.06	1.02	1.04	1.00
1967	1.05	0.98	1.02	1.07	1.03	1.05	1.01
1968	1.08	0.99	1.07	1.09	1.06	1.07	1.04
1969	1.12	1.01	1.11	1.12	1.09	1.10	1.08
1970	1.15	1.01	1.16	1.14	1.14	1.11	1.12
1971	1.17	0.99	1.19	1.16	1.16	1.13	1.14
1972	1.15	0.95	1.19	1.15	1.17	1.14	1.16
1973	1.14	0.98	1.17	1.16	1.16	1.16	1.17
1974	1.09	0.89	1.14	1.12	1.20	1.11	1.19
1975	1.12	0.85	1.15	1.18	1.21	1.15	1.19
1976	1.14	0.83	1.17	1.21	1.25	1.17	1.22
1977	1.17	0.82	1.19	1.25	1.31	1.22	1.28
1978	1.20	0.84	1.18	1.29	1.30	1.28	1.29
1979	1.24	0.83	1.18	1.32	1.32	1.31	1.30
1980	1.24	0.82	1.17	1.33	1.35	1.32	1.32
1981	1.27	0.81	1.22	1.38	1.43	1.30	1.32
1982	1.30	0.77	1.24	1.48	1.54	1.31	1.31
1983	1.31	0.81	1.27	1.60	1.65	1.35	1.34
1984	1.34	0.82	1.26	1.67	1.72	1.32	1.28
1985	1.38	0.82	1.27	1.78	1.84	1.36	1.29
1986	1.40	0.94	1.28	1.91	1.96	1.43	1.35
1987	1.44	0.96	1.30	2.08	2.13	1.44	1.34
1988	1.50	1.07	1.33	2.41	2.47	1.52	1.38

BC - Bilateral, using CPI
BW - Bilateral, using WPI
BG - Bilateral, using GDP deflator
MCA - Multilateral arithmetic, using CPI
MGA - Multilateral arithmetic, using GDP deflator
MCG - Multilateral geometric, using CPI
MGG - Multilateral geometric, using GDP deflator

Note - no multilateral rates using WPI were calculated since a major trading partner does not report WPI data.

Table 8. Correlation Coefficients Among Real Exchange Rates: 1962-1988, Costa Rica

	BC	BW	BG	MCA	MWA	MGA	MCG	MWG	MGG
BC	1	.52	.87	.72	.53	.72	.99	.60	.93
BW		1	.74	.37	.40	.44	.46	.96	.65
BG			1	.55	.42	.60	.82	.72	.96
MCA				1	.96	.99	.72	.49	.59
MWA					1	.97	.52	.49	.43
MGA						1	.70	.53	.62
MCG							1	.57	.92
MWG								1	.68
MGG									1

Source: Calculated from RERs in Tables 1-7.

Notation:

BC = bilateral CPI
BW = bilateral WPI
BG = bilateral GDP
MCA = multilateral arithmetic CPI
MWA = multilateral arithmetic WPI
MGA = multilateral arithmetic GDP
MCG = multilateral geometric CPI
MWG = multilateral geometric WPI
MGG = multilateral geometric GDP

Table 9. Correlation Coefficients Among Real Exchange Rates: 1962-1988, El Salvador

	BC	BW	BG	MCA	MWA	MGA	MCG	MWG	MGG
BC	1	.79	.92	.86	.75	.88	.95	.83	.81
BW		1	.79	.82	.87	.86	.65	.98	.50
BG			1	.68	.58	.73	.85	.81	.86
MCA				1	.96	.99	.82	.83	.49
MWA					1	.96	.66	.86	.33
MGA						1	.83	.87	.55
MCG							1	.74	.88
MWG								1	.61
MGG									1

Source: Calculated from RERs in Tables 1-7.

Notation:

BC = bilateral CPI
BW = bilateral WPI
BG = bilateral GDP
MCA = multilateral arithmetic CPI
MWA = multilateral arithmetic WPI
MGA = multilateral arithmetic GDP
MCG = multilateral geometric CPI
MWG = multilateral geometric WPI
MGG = multilateral geometric GDP

Table 10. Correlation Coefficients Among Real Exchange Rates: 1962-1988, Guatemala

	BC	BW	BG	MCA	MWA	MGA	MCG	MWG	MGG
BC	1	.95	.95	.77	.76	.80	.95	.92	.88
BW		1	.92	.71	.70	.72	.89	.95	.83
BG			1	.59	.57	.62	.89	.88	.88
MCA				1	.99	.99	.83	.76	.69
MWA					1	.99	.82	.75	.67
MGA						1	.82	.78	.73
MCG							1	.95	.96
MWG								1	.92
MGG									1

Source: Calculated from RERs in Tables 1-7.

Notation:

BC = bilateral CPI
BW = bilateral WPI
BC = bilateral GDP
MCA = multilateral arithmetic CPI
MWA = multilateral arithmetic WPI
MGA = multilateral arithmetic GDP
MCG = multilateral geometric CPI
MWG = multilateral geometric WPI
MGG = multilateral geometric GDP

Table 11. Correlation Coefficients Among Real Exchange Rates: 1962-1988, Honduras

	BC	BG	MCA	MGA	MCG	MGG
BC	1	.83	-.25	-.32	.88	.76
BG		1	-.14	-.18	.59	.56
MCA			1	.99	-.02	-.21
MGA				1	-.10	.15
MCG					1	.93
MGG						1

Source: Calculated from RERs in Tables 1-7.

Notation:

BC = bilateral CPI
BW = bilateral WPI
BG = bilateral GDP
MCA = multilateral arithmetic CPI
MWA = multilateral arithmetic WPI
MGA = multilateral arithmetic GDP
MCG = multilateral geometric CPI
MWG = multilateral geometric WPI
MGG = multilateral geometric GDP

Table 12. Correlation Coefficients Among Real Exchange Rates: 1962-1988, Mexico

	BC	BW	MCA	MWA	MCG	MWG
BC	1	.96	.97	.90	.97	.87
BW		1	.92	.95	.91	.91
MCA			1	.81	.99	.78
MWA				1	.83	.97
MCG					1	.82
MWG						1

Source: Calculated from RERs in Tables 1-7.

Notation:

BC = bilateral CPI
BW = bilateral WPI
BG = bilateral GDP
MCA = multilateral arithmetic CPI
MWA = multilateral arithmetic WPI
MGA = multilateral arithmetic GDP
MCG = multilateral geometric CPI
MWG = multilateral geometric WPI
MGG = multilateral geometric GDP

Table 13. Correlation Coefficients Among Real Exchange Rates: 1962-1988, Nicaragua

	BG	MGA	MGG
BG	1	.99	.99
MGA		1	.99
MGG			1

Source: Calculated from RERs in Tables 1-7.

Notation:

BC = bilateral CPI
BW = bilateral WPI
BG = bilateral GDP
MCA = multilateral arithmetic CPI
MWA = multilateral arithmetic WPI
MGA = multilateral arithmetic GDP
MCG = multilateral geometric CPI
MWG = multilateral geometric WPI
MGG = multilateral geometric GDP

Table 14. Correlation Coefficients Among Real Exchange Rates: 1962-1988, Panama

	BC	BW	BG	MCA	MGA	MCG	MGG
BC	1	-.31	.94	.95	.95	.98	.90
BW		1	-.39	-.12	-.16	-.40	-.59
BG			1	.82	.85	.92	.93
MCA				1	.99	.92	.78
MGA					1	.93	.80
MCG						1	.95
MGG							1

Source: Calculated from RERs in Tables 1-7.

Notation:

BC = bilateral CPI
BW = bilateral WPI
BG = bilateral GDP
MCA = multilateral arithmetic CPI
MWA = multilateral arithmetic WPI
MGA = multilateral arithmetic GDP
MCG = multilateral geometric CPI
MWG = multilateral geometric WPI
MGG = multilateral geometric GDP

Table 15.[1] Coefficients of Variation for Real Exchange Rates, 1962-88

	CR	EL	GU	HON	MEX	NIC	PAN
BC[2]	31.75	18.36	17.39	4.95	18.45		7.45
BG	17.27	14.15	15.24	4.90	13.13	150.00	8.62
BW	10.75	16.85	10.58				8.79
MCA	80.00	80.00	38.02	41.94	38.71		26.32
MGA	51.55	52.23	39.22	41.94		238.21	28.77
MWA	60.24	66.04	42.74		41.67		
MCG	33.09	19.15	19.49	10.28	21.24		12.50
MGG	18.25	13.46	17.18	8.41	9.90	145.02	10.92
MWG	9.47	16.09	12.03				

Source: Calculated from RERs in Tables 1-7.

[1]Countries are costa Rica (CR), El Salvador (EL), Guatemala (GU), Honduras (HON), Mexico (Mexico), Nicaragua (NIC), and Panama (PAN).

[2]The first three exchange rates are bilateral, the middle three are multilateral arithmetic, and the last three are multilateral geometric. C, G, W refer to consumer, GDP deflators, and wholesale prices.

Table 16. Coefficients for Unit Root Tests[1]

	CR[2]	ELS	GUAT	HON	MEX	NIC	PAN
BC[3]	1.014	.986	1.014	.998	.998	NA	1.017
BG	1.001	.991	1.006	.999	NA	1.192	1.011
BW	.995	.983	1.006	NA	.993	NA	1.002
MAC	1.005	.993	NUR	1.069	1.005	NUR	NUR
MAG	NUR	1.006	NUR	1.072	NA	NA	NUR
MAW	.993	1.006	NUR	NA	.993	NA	NUR
MGC	1.023	.983	1.021	1.000	1.004	NUR	NUR
MGW	1.010	.990	1.012	1.003	NA	NA	NUR
MGG	1.007	.983	1.009	NA	.993	NA	NUR

[1]Tests performed at 5 percent level of significance.

[2]Countries are Costa Rica (CR) El Salvador (ELS), Guatemala (GUAT), Honduras (HON), Mexico (MEX), Nicaragua (NIC), and Panama (PAN).

[3]The first three exchange rates are bilateral, the middle three are multilateral arithmetic, and the last three are multilateral geometric. C, G, W refer to consumer, GDP deflator, and wholesale prices.

[4]NUR indicates no unit root.

Table 17. Purchasing Power Parity in the Long-Run and the Short-Run

	SR Elasticity (α_1)			LR Elasticity (α_1)			Adjustment Coefficient (α_3)		
	CPI	WPI	GDP	CP	WPI	GDP	CPI	WPI	GDP
Costa Rica	2.031	1.084	0.986	1.364	1.024	1.141	1.489	1.059	.864
	(0.370)	(0.131)	(0.203)	(.507)	(.256)	(.489)			
Guatemala	1.158	1.165	.936	1.698	1.319	1.383	.682	0.883	.677
	(0.211)	(0.130)	(0.180)	(.665)	(.306)	(.269)			
El Salvador	0.381*	0.369*	0.487*	.585	0.836	.779	.651	0.441	.625
	(0.093)	(0.102)	(0.106)	(.331)	(.493)	(.316)			
Nicaragua	-	NA	-0.477*	-	NA	11.093*	-	NA	-.043
			(0.306)			(20.537)*			
Mexico	1.1021	1.293	0.797	1.088	1.020	1.174	1.015	1.268	.679
	(.153)	(.117)	(.134)	(.482)	(.196)	(.445)			

*Significantly less than unity at 5 percent level.

Numbers in brackets are standard errors. Long run standard errors were approximated by Taylor Series.

REFERENCES

Branson, William, and Louka T. Katseli-Papaefstation. "Income Stability, Terms of Trade, and the Choice of Exchange Rate Regime." Journal of Development Economics no. 7 (1980), pp. 49-69.

Connolly, Michael. "Optimum Currency Pegs for Latin America." Journal of Money Credit and Banking 15 (February 1983), pp. 56-72.

Cottani, Joaquin, Domingo Cavallo and M. Shahbaz Khan. "Real Exchange Rate Behavior and Economic Performance in LDCs." Economic Development and Cultural Change (1990), pp. 60-76.

Edwards, Sebastian. "Floating Exchange Rates in Less Developed Countries: A Monetary Analysis of the Peruvian Experience, 1950-54." Journal of Money, Credit, and Banking 15 (February 1983), pp. 73-81.

Edwards, Sebastian. Real Exchange Rates, Devaluation and Adjustment. Cambridge, MA: MIT Press, 1989.

Edwards, Sebastian. "Real Exchange Rates on Developing Countries: Concepts and Measurement." in Thomas Grennes, ed. International Financial Markets and Agricultural Trade. Boulder, CO: Western Press, 1990.

Fair, Ray. "The Estimation of Simultaneous Equation Models with Lagged Endogenous Variables and First Order Serially Correlated Errors". Econometrica 38, May 1970, pp. 507-16.

Thomas Grennes. "Analysis of the Real Exchange Rate in Costa Rica." Agricultural Policy Analysis Project, Phase II (APAP II) Collaborative Research Report No. 316. Department of Economics and Business, North Carolina State University, Raleigh, July 1990.

Gyimah-Brempong, Kwabena. "Export Instability and Economic Growth in Sub-Saharan Africa". Economic Development and Cultural Change 39, July 1991, pp. 815-28.

Haberler, Gottfried. A Survey of International Trade Theory, Revised Edition. Special Papers in International Economics. No. 1, July 1961. International Finance Section. Princeton University.

Hakkio, Craig. "A Re-examination of Purchasing Power Parity: A Multi-country Multi-Period Study." Journal of International Economics 17, November 1984, pp. 265-77.

McKinnon, Ronald. "Monetary and Exchange Rate Policies for International Finance Stability: A Proposal." Journal of Economic Perspectives 2, Winter 1988, pp. 83-103.

Meese, Richard. "Currency Fluctuations in the Post-Bretton Woods Era." Journal of Economic Perspectives 4, Winter 1990, pp. 117-34.

O. Lawrence. Purchasing Power Parity and the Exchange Rate: Theory, Evidence, and Relevance. Greenwich, CT: JAI Press, 1982.

Wood, Adrian. "Global Trends in Real Exchange Rates: 1960-84." World Development 19, 1991, pp. 317-32.