REAL EXCHANGE RATE BEHAVIOR IN DEVELOPING COUNTRIES: THE CROSS COUNTRY EVIDENCE*

by

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*This is a draft of Chapter 4 of S. Edwards's Real Exchange Rates, Devaluation and Adjustment, (forthcoming, The MIT Press 1989).

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CHAPTER 4

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ABSTRACT

This paper corresponds to Chapter 4 of the forthcoming book Real Exchange Rates, Devaluation and Adjustment: Exchange Rate Policy in Developing Countries. This work investigates several aspects related to exchange rates in developing nations. Theoretical models of equilibrium and disequilibrium exchange rates are developed; the behavior of real exchange rates is investigated for a large cross section of countries; and the effectiveness of devaluation is assessed for a group of 39 developing nations.

CHAPTER 4

Real Exchange Rate Behavior in Developing Countries: The Cross Country Evidence

In spite of the prominent role that real exchange rates have attained in recent economic debates in developing countries, relatively few empirical studies have dealt in any systematic way with the subject. In this and the following chapters the findings from a detailed investigation on real exchange rate behavior in a large number of LDCs is reported. This empirical analysis is based on the theoretical models of Chapters 2 and 3. The present chapter provides a broad preliminary look at real exchange rate behavior in 33 countries between 1965 and 1985. The chapter deals with: (1) alternative measures of RERs; (2) trends and variability in real exchange rates; (3) black markets for foreign exchange and RERs behavior; and (4) time series properties of the alternative RER indexes.

In the theoretical chapters of this book the real exchange rate was defined as the relative price of tradables to nontradables: $RER = EP^*_T/P_N$. Unfortunately, it is not possible to find an exact empirical counterpart to this analytical construct.[1] For this reason, proxies for the world price of tradables (P^*_T) and the domestic price of nontradables have to be chosen. In the empirical chapters of this book P^*_T has been proxied by the wholesale price indexes (WPI) of the country's trade partners. Since WPIs contain mainly tradable goods they do provide a reasonable proxy for P^*_T (Harberger 1988). With respect to the domestic price of nontradables, we have proxied it by the country's consumer price index (CPI). Obviously, since the CPI contains some tradables, it is not the ideal measure of P_N. Still, however, the fact that consumer price indexes are heavily influenced

by nontradable goods and nontradable activities, such as retail, makes them a reasonable proxy for P_N. An additional advantage of using the CPI is that it is readily and periodically available for most countries. Thus, it is possible to make cross country comparisons.

Another important measurement problem is related to which nominal exchange rate is the most appropriate when calculating $RER = EP_T^*/P_N$. Should a bilateral rate with respect to the U.S. dollar be used? Or should a multilateral rate that considers the variability of exchange rates of a longer number of partners be used? What to do when there are multiple official nominal exchange rates? What about black or parallel markets? Given the difficulties in computing "an" index for the RER, five different indexes were constructed and their statistical properties were compared. These indexes include two bilateral RER indexes with respect to the U.S. constructed using official nominal exchange rates, two multilateral indexes also constructed with official rates and a bilateral RER index constructed using data on the nominal exchange rate in the parallel market.

4.1 Official Nominal Exchange Rates and RER Behavior in 33 Developing Countries

Multilateral Real Exchange Rates and Bilateral Exchange Rates

Multilateral real exchange rates provide a measure of the degree of competitiveness of a country relative to a group of its trade partners. It should be noted that in a world where the principal currencies are floating, multilateral real exchange rates can exhibit significant departures from bilateral real exchange rates.[2]

In the construction of the multilateral indexes of real effective exchange rate the following equation was used:

$$MRER_{jt} = \frac{\sum_{i=1}^{k} \alpha_i E_{it} P^*_{it}}{P_{jt}} \qquad (4.1)$$

where $MRER_{jt}$ is the index of the multilateral real rate in period t for country j; E_{it} is an index of the nominal rate between country i and country j in period t; $i = 1,\ldots,k$ refers to the k partner countries used in the construction of the MRER index; α_i is the weight corresponding to partner i in the computation of $MRER_{jt}$; P^*_{it} is the price index of the i partner in period t; and P_{jt} is the price index of the home country in period t. An increase in the value of this index of MRER reflects real depreciation, whereas a decline implies a real appreciation of the domestic currency.

Two indexes of multilateral real exchange rates were constructed and their behavior compared. The first index -- which corresponds to our proxy for the relative price of tradables to nontradables -- used the partner countries' WPIs as the P^*_{it}'s and the home country CPI as P_{jt}. For notation purposes this index was called MRER1. The second index -- which is related to the more traditional PPP measure of the real exchange rate -- used consumer price indexes for both partners countries and the home country. This index was called MRER2.

In the construction of both indexes the following procedure was followed: (1) The weights (α's) were trade weights constructed using data from the International Monetary Fund Directions of Trade. The actual values of these weights can be found in the Appendix to this chapter. (2) For each country the ten largest trade partners in 1975 were used for the construction of the real exchange rate indexes. (3) In all cases the nominal exchange rate indexes (E_{ij}) were constructed from data on official

nominal exchange rates obtained from International Financial Statistics (IFS). In those cases where there were multiple official exchange rates the "most common" rate as listed by the IFS, was used. This means that these indexes are capturing some of the distortions introduced by the existence of multiple rates. What they don't capture, however, is the role of non-official black or parallel markets for foreign exchange. For this reason in the next section we report results obtained when RER indexes using parallel market data are used. The need to actually construct these indexes resides on the fact that there are no long run series on multilateral real exchange rates readily available from any of the multilateral agencies. Although both the IMF and the World Bank have constructed these types of indicators, they are not currently available to the public. Morgan Guarantee publishes a multilateral real exchange rates index for a number of developing nations. Those series, however, only cover the most recent period.

Two indexes of bilateral real exchange rates with respect to the U.S. were also constructed using data on official nominal rates. These indexes were defined as:

$$BRER1 = \frac{E\ WPI^{US}}{CPI}\ , \tag{4.2}$$

and,

$$BRER2 = \frac{E\ CPI^{US}}{CPI}\ , \tag{4.3}$$

where E is the bilateral (official) nominal exchange rate with respect to the U.S. dollar; WPI^{US} and CPI^{US} are the wholesale and consumer price indexes; and CPI is, as before, the domestic country consumer price index. BRER1, then, is the bilateral counterpart of MRER1. On the other hand, BRER2 uses both the domestic country and the U.S. CPIs and has historically

been the most popular RER index in policy analyses.

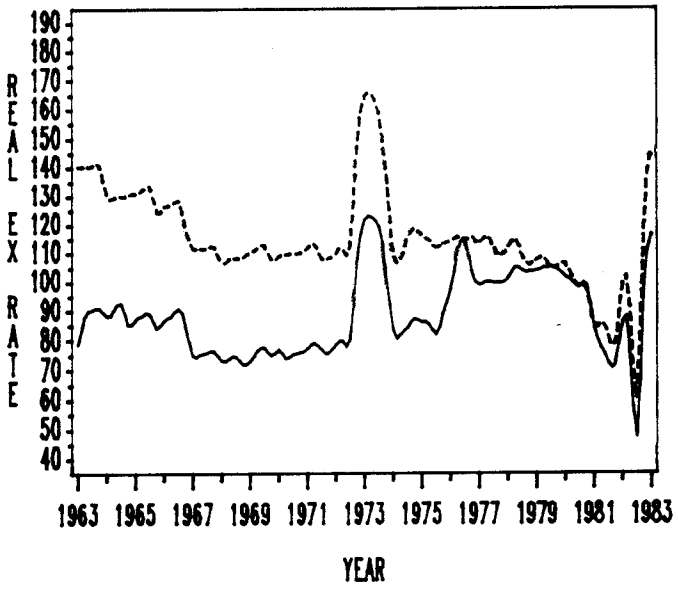
Figures 4-1 through 4-33 show the evolution of two real exchange rate indexes, the multilateral MRER1 index and the bilateral BRER1 index, for 33 developing countries.[3] As may be seen, in most cases both indexes tended to move roughly in the same direction throughout most of the period, and in particular between 1960 and 1971. After the collapse of the Bretton Woods system, in many of the countries depicted in these diagrams the multilateral and bilateral indexes started to exhibit some difference in behavior. This is especially the case during the 1980s where in many cases the bilateral and multilateral real exchange rate indexes even moved in opposite directions. This reflects the fact that in most of these countries the national nominal exchange rate policies have traditionally been pursued using the U.S. dollar as the reference currency; between 1980 and 1985, however, as the U.S. dollar appreciated steeply against the other major currencies, so did the currencies of many of these developing countries. As a result for this period the index of the real multilateral rate is below the index of the bilateral rate in most countries.[4]

In order to formally compare the behavior of the four alternative indexes of the real exchange rate constructed using official data, coefficients of correlations between the multilateral and the bilateral real exchange rate indexes were computed using quarterly data for the period that goes from the first quarter of 1965 up to the second quarter of 1985. The following regularities emerged from this analysis. First, in most countries the two alternative definitions of the bilateral real exchange rate index moved closely together during this period. In 27 out of the 33 countries considered the coefficient of correlation between log(BRER1) and log(BRER2) was above 0.9 and in all cases it exceeded 0.8. Second, the two

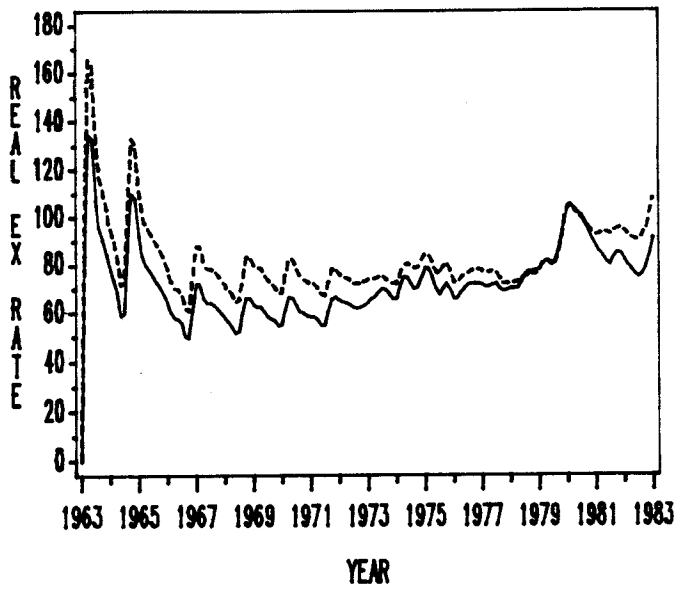
FIGURE 4.1

MULTILATERAL AND BILATERAL REAL EXCHANGE RATE

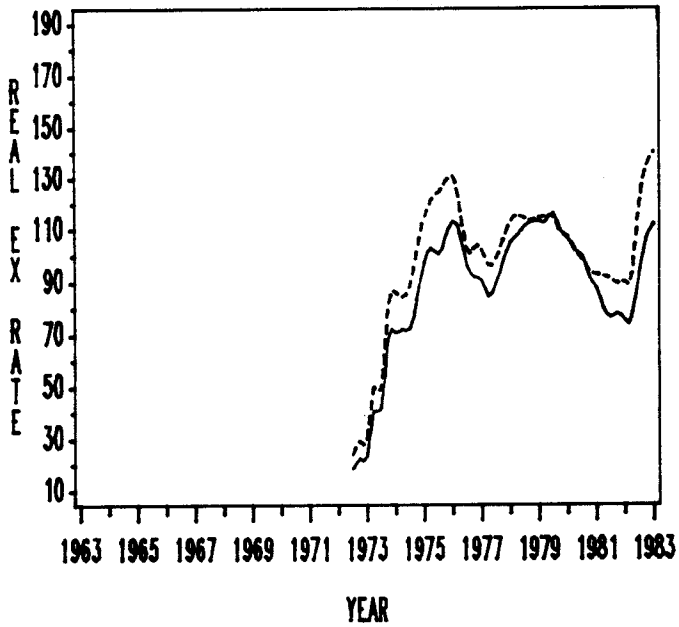
BOLIVIA



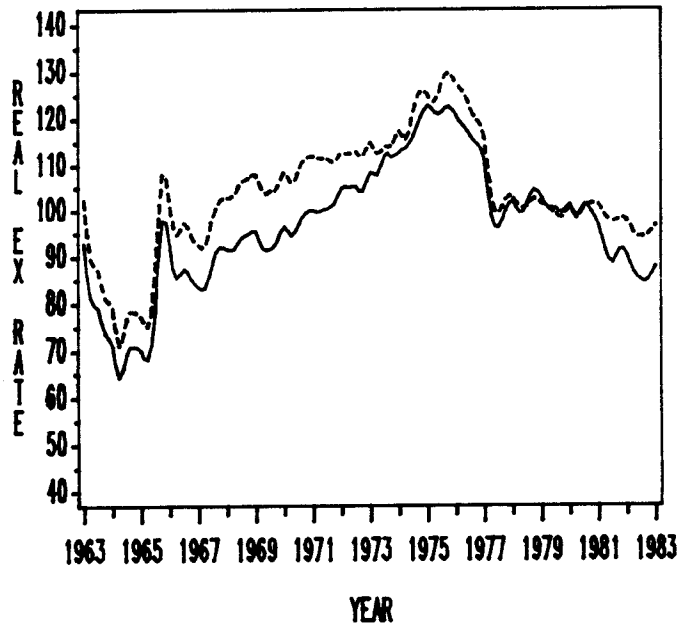
BRAZIL



CHILE



COLOMBIA



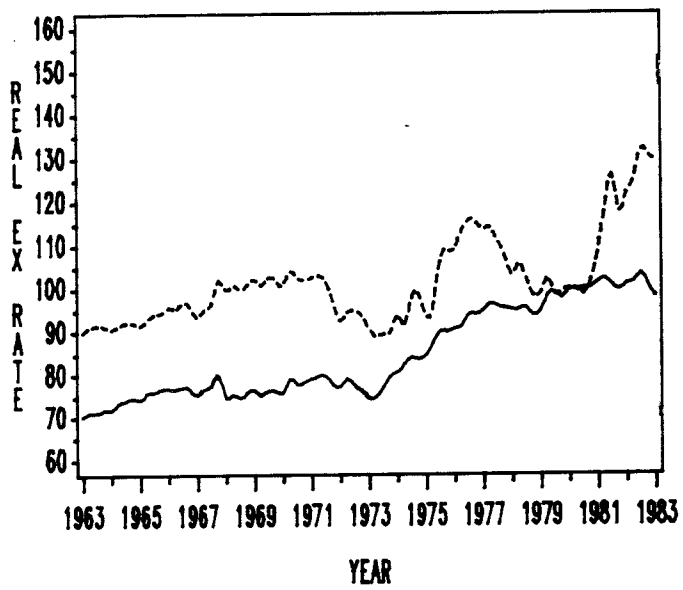
MULTILATERAL _____ BILATERAL _ _ _ _ _ _ _

SOURCE: CONSTRUCTED FROM RAW DATA OBTAINED FROM THE I.F.S.

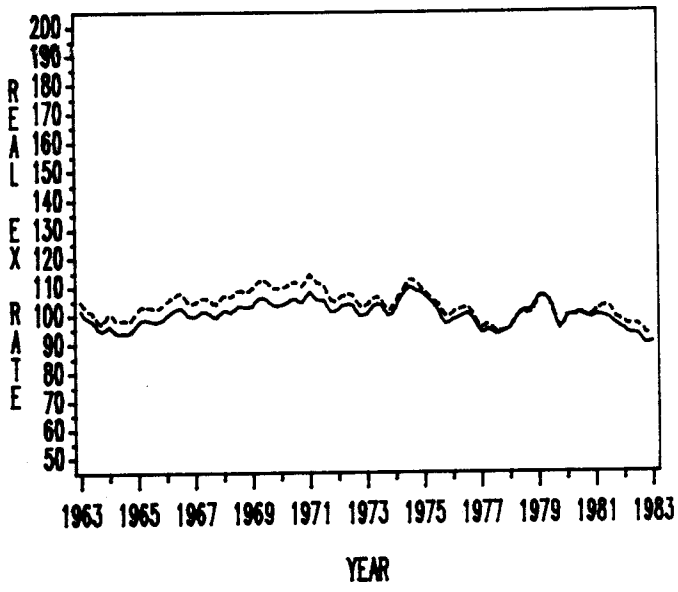
FIGURE 4.2

MULTILATERAL AND BILATERAL REAL EXCHANGE RATE

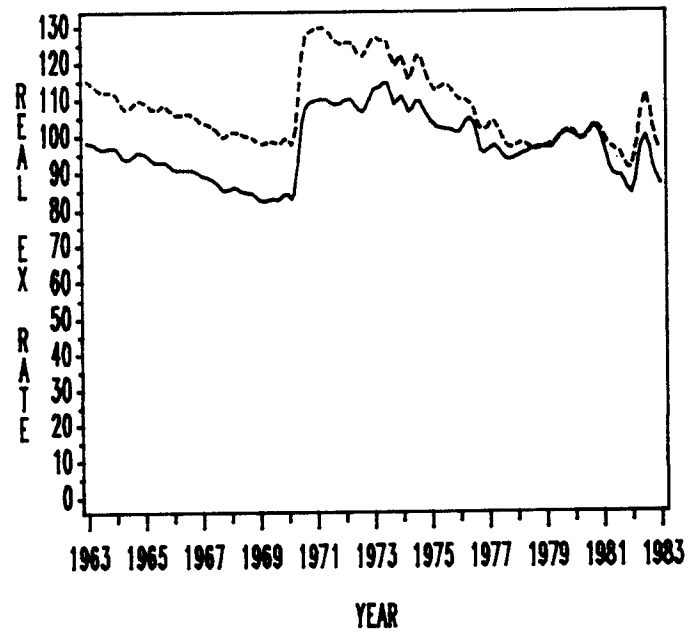
CYPRUS



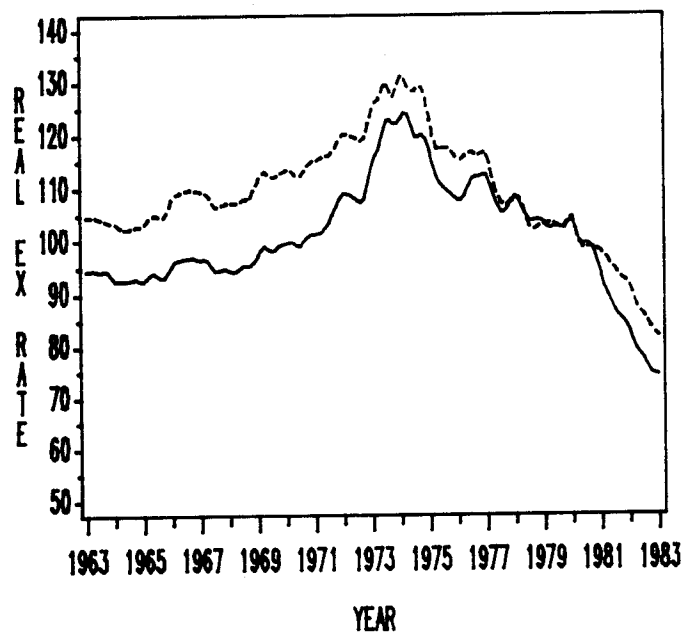
DOMINICAN REP.



ECUADOR



EL SALVADOR



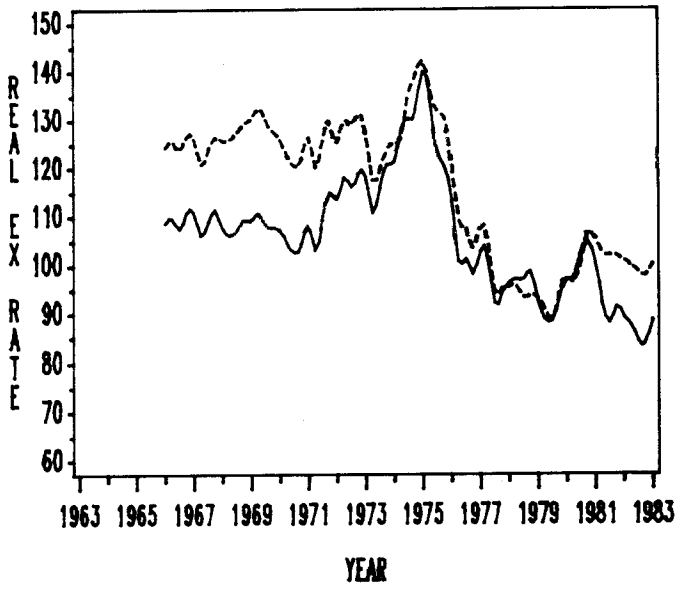
MULTILATERAL _____ BILATERAL _ _ _ _ _ _ _

SOURCE: CONSTRUCTED FROM RAW DATA OBTAINED FROM THE I.F.S.

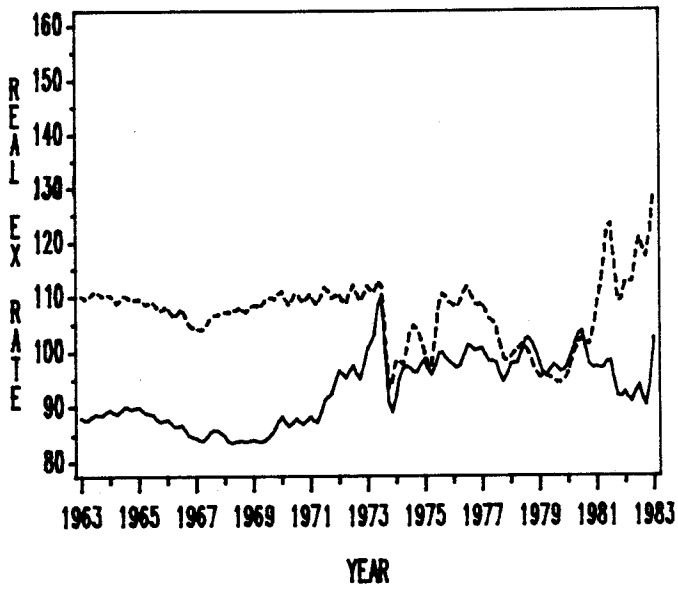
FIGURE 4.3

MULTILATERAL AND BILATERAL REAL EXCHANGE RATE

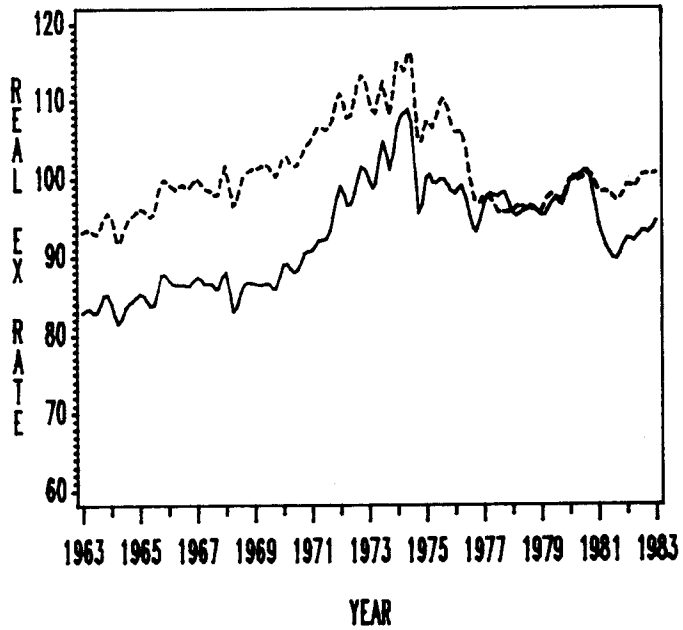
ETHIOPIA



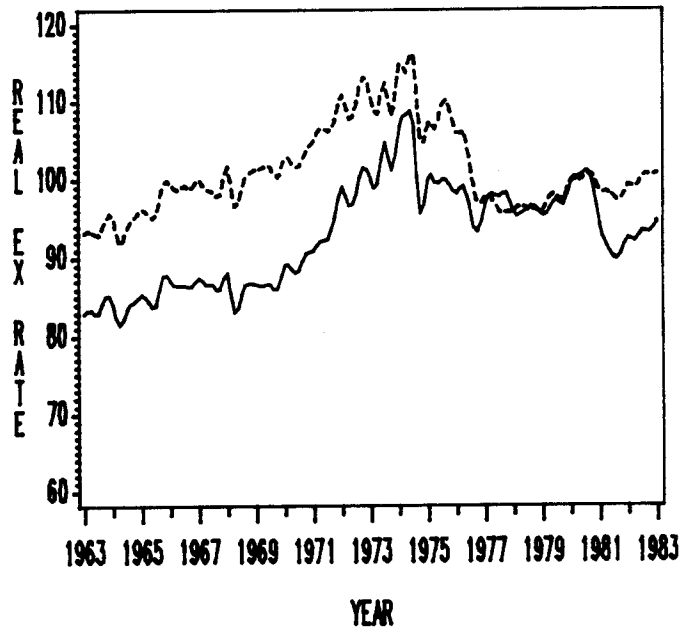
GREECE



GUATEMALA



GUYANA



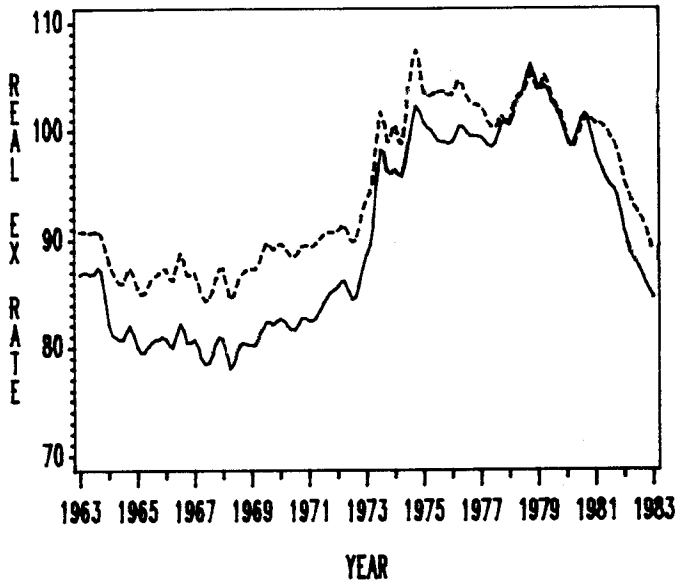
MULTILATERAL _____ BILATERAL _ _ _ _ _ _ _

SOURCE: CONSTRUCTED FROM RAW DATA OBTAINED FROM THE I.F.S.

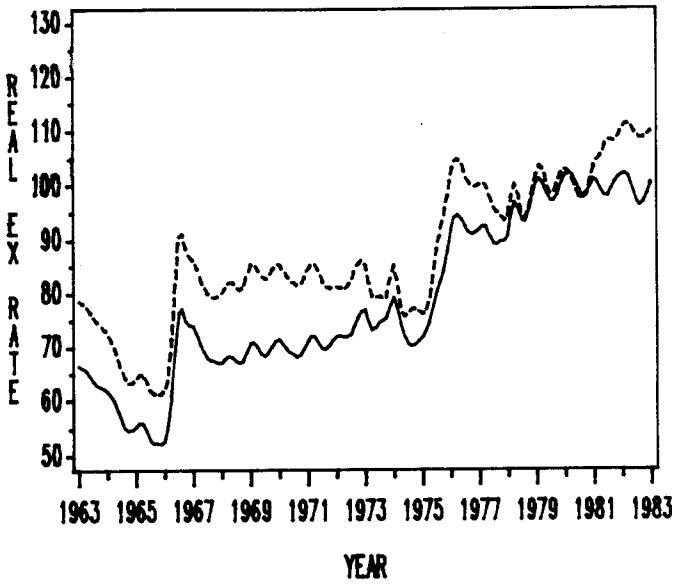
FIGURE 4.4

MULTILATERAL AND BILATERAL REAL EXCHANGE RATE

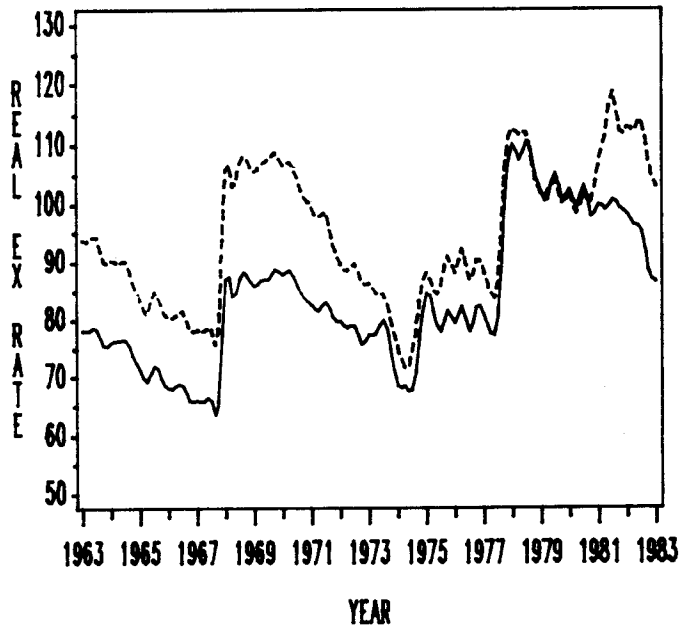
HONDURAS



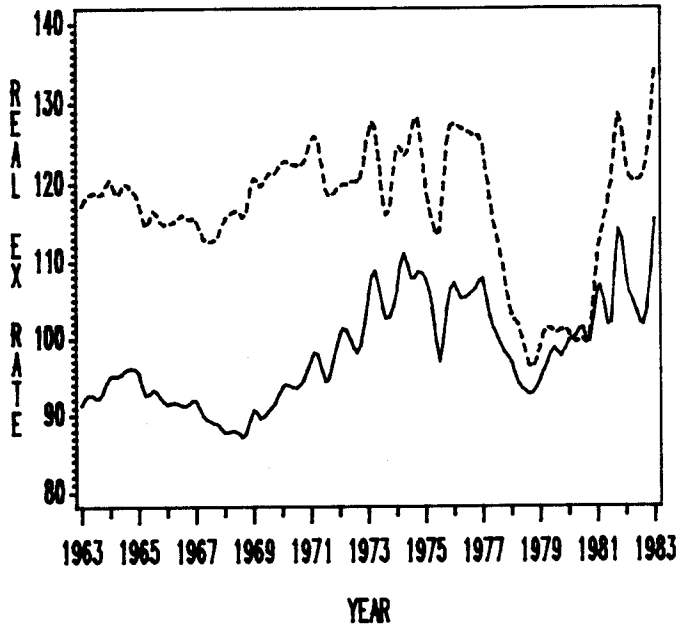
INDIA



ISRAEL



KENYA



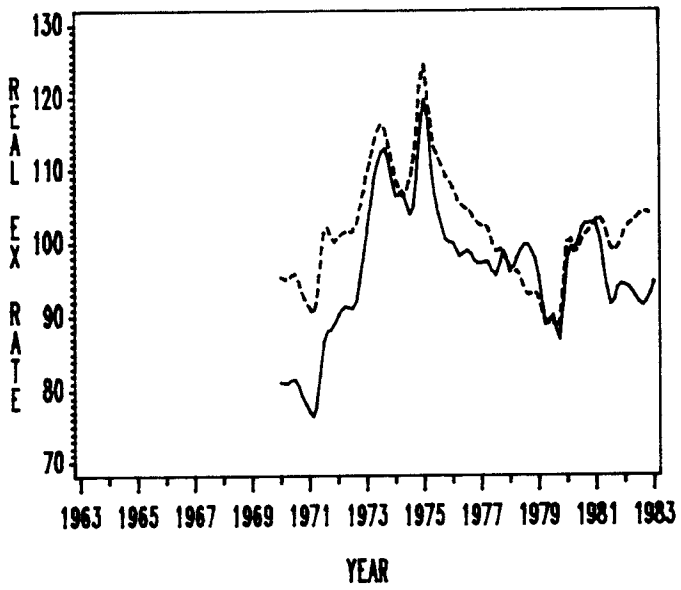
MULTILATERAL _____ BILATERAL _ _ _ _ _ _ _

SOURCE: CONSTRUCTED FROM RAW DATA OBTAINED FROM THE I.F.S.

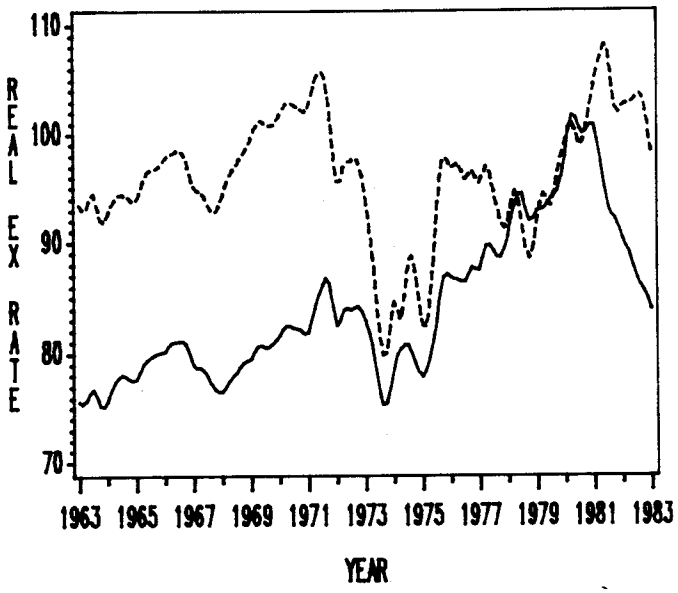
FIGURE 4.5

MULTILATERAL AND BILATERAL REAL EXCHANGE RATE

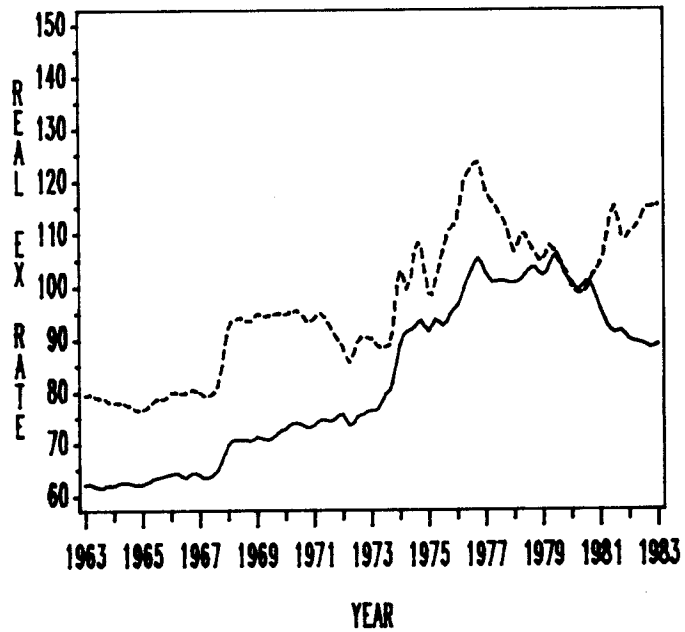
KOREA



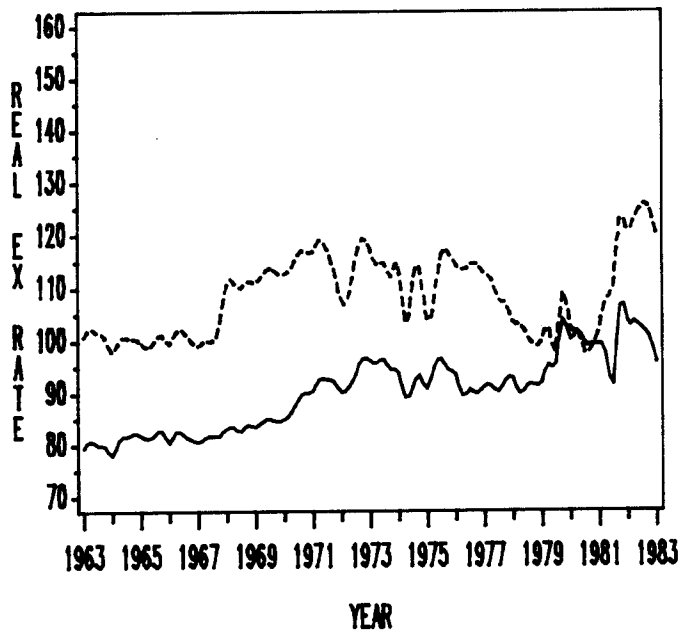
MALAYSIA



MALTA



MAURITIUS



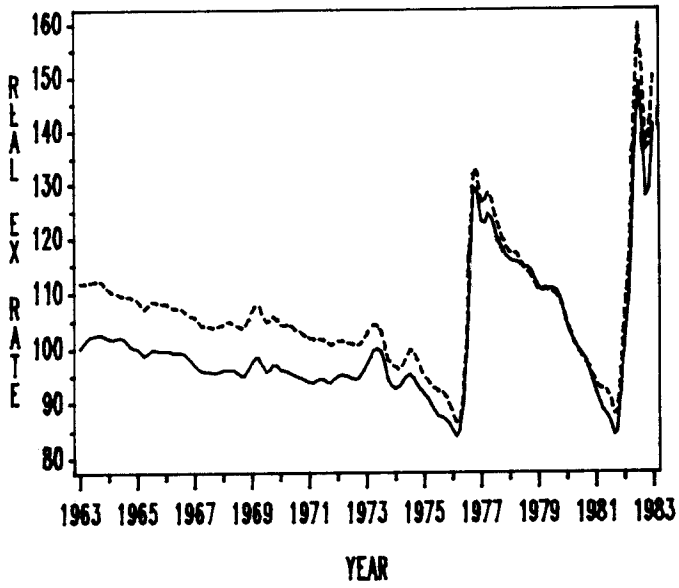
MULTILATERAL _____ BILATERAL _ _ _ _ _ _ _

SOURCE: CONSTRUCTED FROM RAW DATA OBTAINED FROM THE I.F.S.

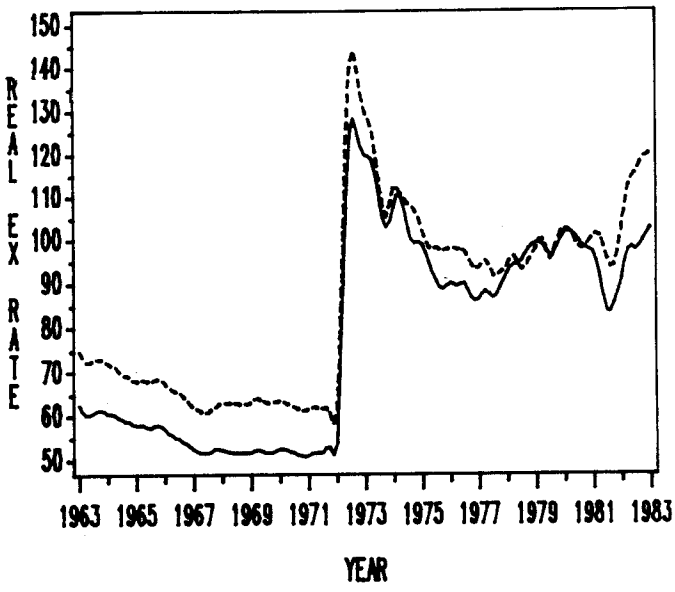
FIGURE 4.6

MULTILATERAL AND BILATERAL REAL EXCHANGE RATE

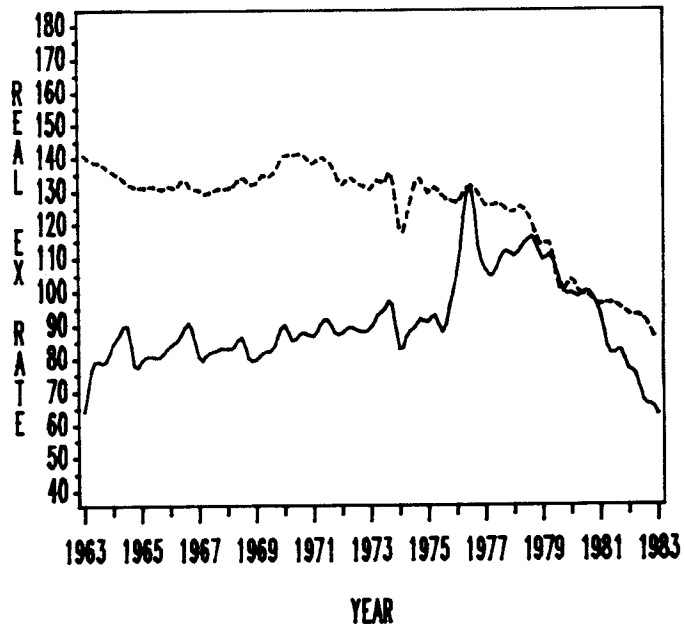
MEXICO



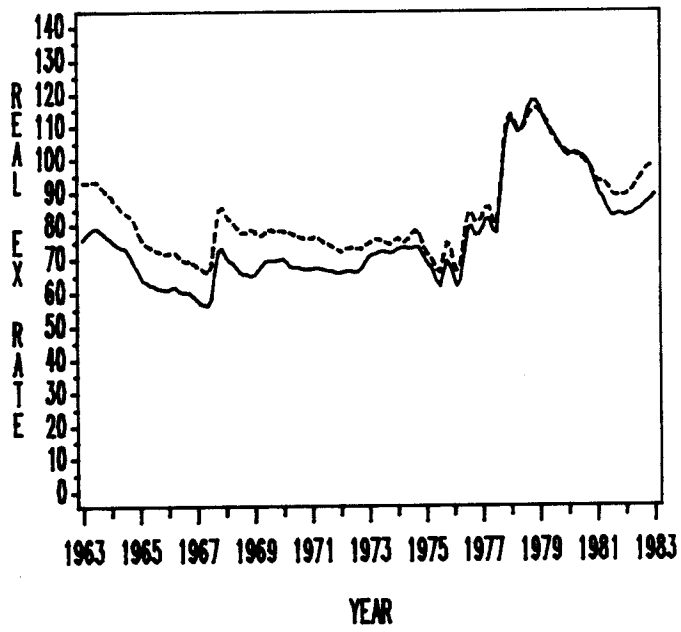
PAKISTAN



PARAGUAY



PERU



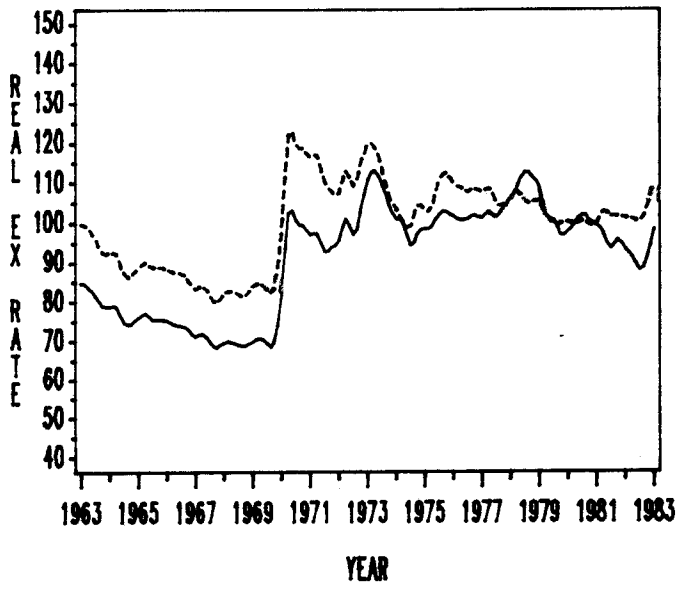
MULTILATERAL _____ BILATERAL _ _ _ _ _ _ _

SOURCE: CONSTRUCTED FROM RAW DATA OBTAINED FROM THE I.F.S.

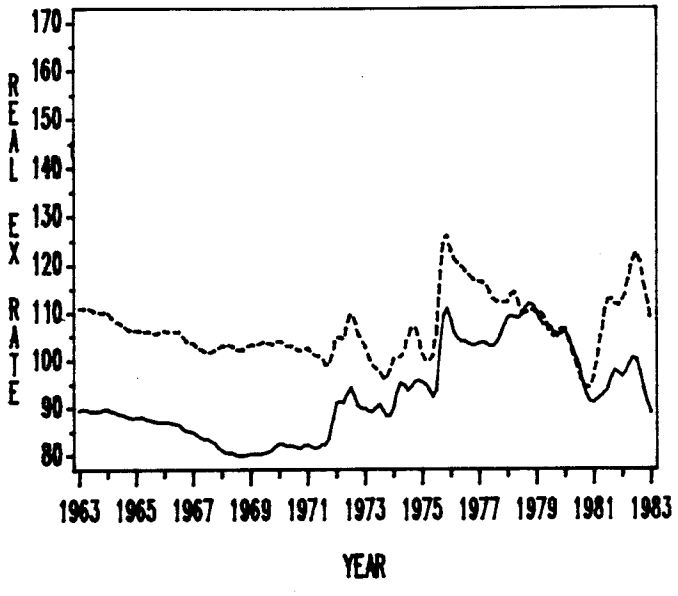
FIGURE 4.7

MULTILATERAL AND BILATERAL REAL EXCHANGE RATE

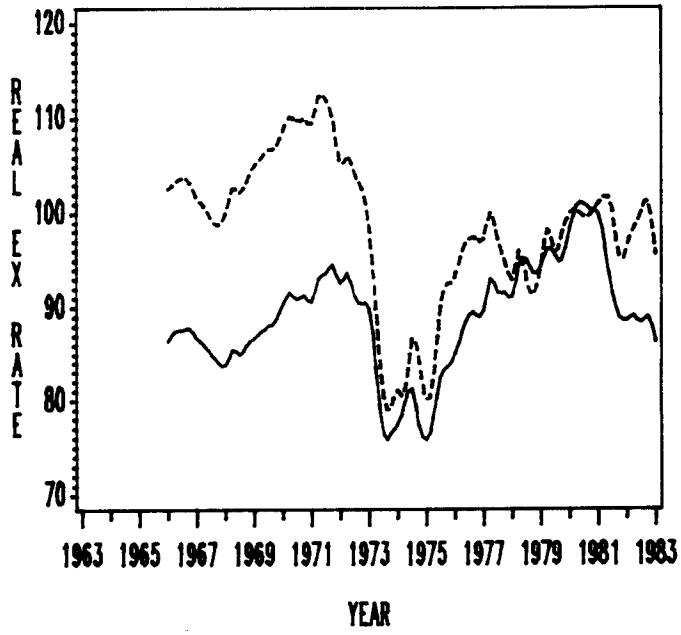
PHILIPPINES



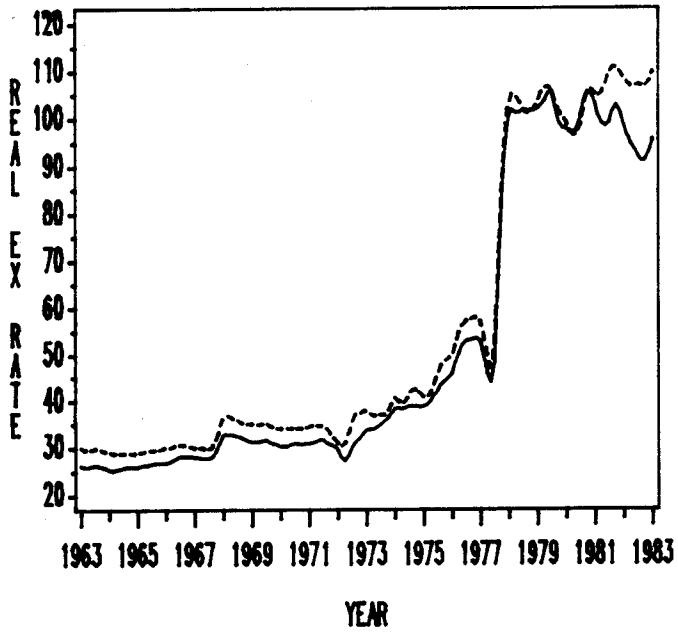
SOUTH AFRICA



SINGAPORE



SRI LANKA



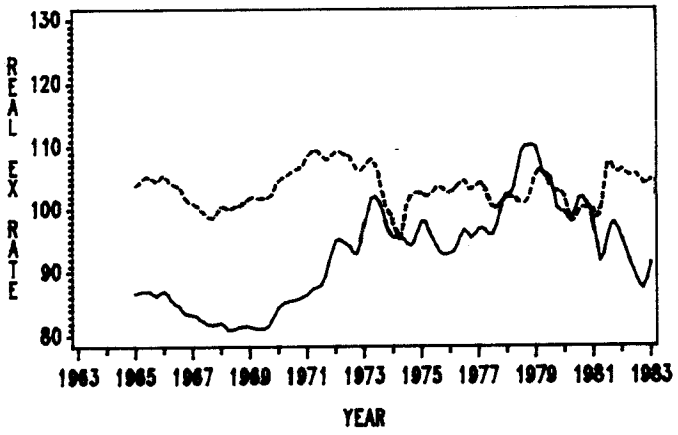
MULTILATERAL _____ BILATERAL _ _ _ _ _ _ _

SOURCE: CONSTRUCTED FROM RAW DATA OBTAINED FROM THE I.F.S.

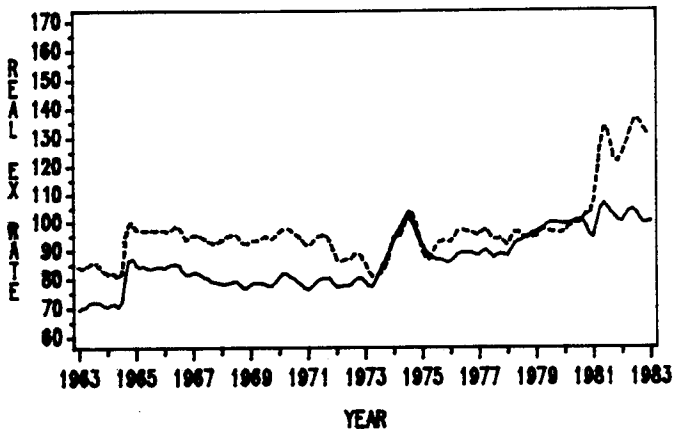
FIGURE 4.8

MULTILATERAL AND BILATERAL REAL EXCHANGE RATE

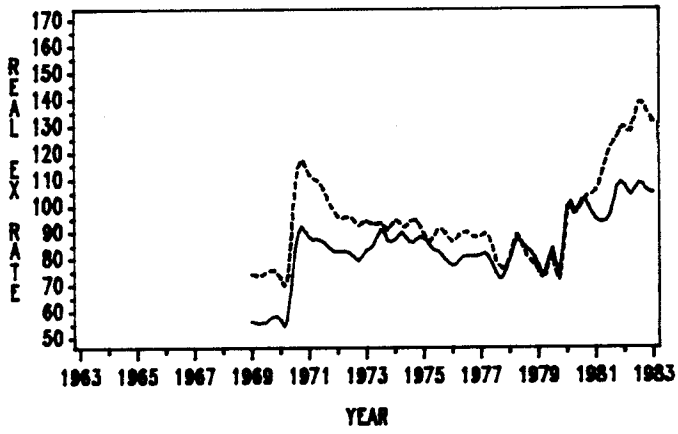
THAILAND



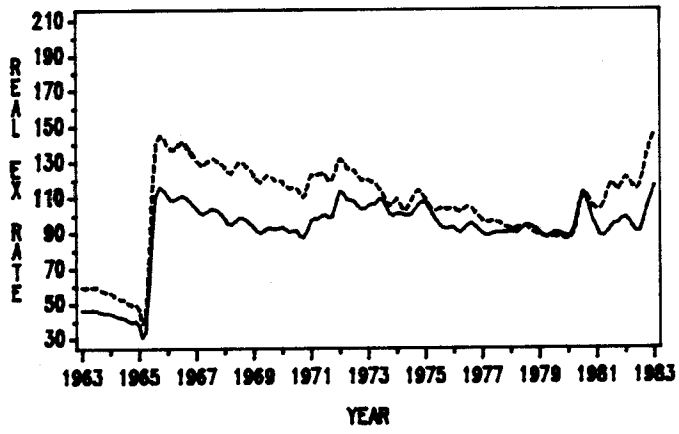
TUNISIA



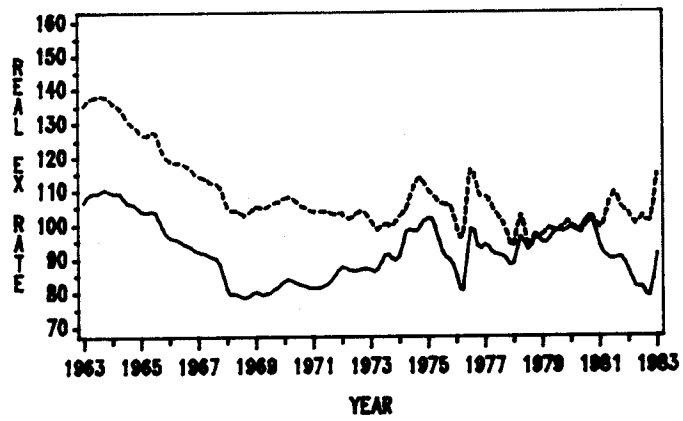
TURKEY



YUGOSLAVIA



ZAMBIA



MULTILATERAL _____ BILATERAL _ _ _ _ _ _ _

SOURCE: CONSTRUCTED FROM RAW DATA OBTAINED FROM THE I.F.S.

indexes of trade weighted multilateral RER also moved closely together. In 30 out of the 33 countries the coefficient of correlation between the logs of MRER1 and MRER2 exceeded 0.9. And third, the behavior of the bilateral and multilateral RER indexes has been quite different in many of these countries. In 16 cases the coefficient of correlation between log MRER and log BRER was below 0.5 and in two countries it was even negative.

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. The results also show that the bilateral and multilateral real exchange rate indexes move in different, and even opposite, directions. This means that when evaluating policy-related situations it is necessary to use or construct a broad multilateral index of real exchange rate. A failure to do this, can result in misleading and incorrect inferences regarding the evolution of a country's degree of competitiveness.[5]

Some authors -- and in particular the IMF -- have recommended using wages at home and abroad to construct indexes of real exchange rates or competitiveness. In order to compare these wage-based real exchange rate indexes to the more traditional ones, data on manufacturing wages for 13 out of the 33 countries were collected and wage-rate-based bilateral (with respect to the U.S. dollar) real exchange rate indexes were constructed.[6] Coefficients of correlation were then computed between this bilateral rate and some of the more traditional indexes of bilateral real exchange rates. The results showed that there has been a wide divergence between these indexes. For example, in 10 of 13 cases the correlation coefficient between BRER2 and the wage-based real exchange rate index was below 0.7, and in 6 of

the cases it was lower than 0.5. In a way this result is not too surprising, since it is well known that wage rate figures are not very reliable for these small countries; also the indexes used were actual wages, not corrected by productivity changes (see IFS April 1984, p. 63).

Trends and Variability

The real exchange rate indexes depicted in Figures 4-1 through 4-33 have two important characteristics. First they show that in most countries the real exchange rate has been fairly variable. Second, in spite of the observed variability, in several of these countries it appears that these indexes have not had significant long term trends during the whole long period under consideration. For the shorter, more recent periods, however, negative trends can be detected in a number of cases.

Tables 4.1 through 4.3 contain data on the main statistical properties of the multilateral real exchange rate index MRER1 for the 33 countries considered in this chapter. These indicators have been calculated for three alternative periods of time: 1965-85, 1965-71 and 1972-85. The years 1965-71 correspond to the last years of the Bretton Woods period, where a majority of countries were pegged to the U.S. dollar. The last period, 1972-85, corresponds to the post-Bretton Woods era, a period during which most advanced countries have followed a dirty (or managed) floating nominal exchange rates system and most of the developing nations have maintained some kind of peg. The more important findings that emerge from these tables can be summarized as follows: First, as the diagrams suggested, real exchange rates have been quite volatile in many of these countries, with the extent of this variability being quite different across countries. For example, while in Zambia the difference between the maximum and minimum values of the index for the complete 1965-85 period surpasses 130 points, it

TABLE 4.1

Basic Statistical Properties of Multilateral Real Exchange Rate Index MRER1 (Quarterly Data 1965-1985)

	Mean	St. Dev.	C.V.	Max	Min
Bolivia	86.78	15.93	18.35	122.92	47.17
Brazil	75.83	17.02	22.44	115.23	50.02
Chile	93.47	26.44	28.29	147.66	18.67
Colombia	99.08	11.76	11.87	124.12	68.26
Cyprus	88.04	10.61	12.05	103.40	74.33
Dominican Republic	101.17	14.46	14.29	175.51	59.95
Ecuador	96.63	8.96	9.27	114.38	79.60
El Salvador	96.24	17.42	18.10	123.94	51.07
Ethiopia	102.51	15.22	14.84	140.18	64.27
Greece	94.45	6.45	6.96	112.29	83.65
Guatemala	92.22	7.38	8.00	108.46	67.93
Guyana	82.03	14.17	17.27	105.08	62.40
Honduras	89.00	9.58	10.76	106.10	74.58
India	82.92	15.00	18.09	105.30	52.45
Israel	85.64	11.91	13.90	110.68	65.72
Kenya	100.31	7.89	7.86	118.96	87.60
Korea	96.75	8.51	8.80	119.72	77.12
Malaysia	84.68	6.43	7.59	101.72	75.49
Malta	85.02	13.65	16.05	106.03	62.31
Mauritius	93.02	8.10	8.00	-	-
Mexico	103.42	13.66	13.21	148.95	85.06
Pakistan	82.83	22.80	27.53	125.48	51.09
Paraguay	88.72	14.64	16.50	131.60	56.82
Peru	79.69	17.14	21.51	117.96	56.39
Philippines	94.00	13.74	14.62	123.87	68.40
Singapore	88.56	5.60	6.32	100.99	75.84
South Africa	93.60	10.10	10.79	116.21	80.08
Sri Lanka	58.36	30.62	52.46	105.63	26.22
Thailand	92.43	7.52	8.14	110.21	80.99
Tunisia	90.46	10.11	11.18	107.50	76.41
Turkey	89.03	15.88	17.83	123.08	55.68
Yugoslavia	100.42	15.77	15.70	133.93	35.65
Zambia	92.86	15.31	16.48	213.73	78.96

Source: See text.

TABLE 4.2

Basic Statistical Properties of Multilateral Real Exchange Rate Index MRER1 (Quarterly Data 1965-1971)

	Mean	St. Dev.	C.V.	Max	Min
Bolivia	78.95	5.79	7.33	90.62	72.05
Brazil	62.73	9.05	14.43	92.37	50.02
Colombia	90.93	8.39	9.23	101.59	68.26
Cyprus	76.98	1.58	2.05	80.26	74.34
Dominican Republic	102.35	2.82	2.75	108.43	97.67
Ecuador	92.17	7.36	10.15	110.19	82.69
El Salvador	97.31	3.37	3.46	106.49	92.30
Ethiopia	108.06	2.82	2.60	115.09	102.51
Greece	86.66	2.34	2.70	92.53	83.65
Guatemala	87.48	2.63	3.00	94.02	83.13
Guyana	68.64	4.32	6.30	75.59	62.46
Honduras	81.11	1.61	1.98	85.14	78.03
India	66.90	6.77	10.12	76.53	52.45
Israel	78.10	9.12	11.68	88.88	65.72
Kenya	91.94	2.85	3.10	97.83	87.60
Korea	81.57	3.98	4.87	88.29	77.12
Malaysia	80.43	2.43	3.02	86.18	76.48
Malta	68.81	4.49	6.53	74.88	62.31
Mauritius	84.61	3.79	4.48	92.65	80.91
Mexico	96.82	2.00	2.06	100.04	51.09
Pakistan	53.31	2.32	4.35	58.12	-
Paraguay	84.53	3.63	4.29	91.40	56.82
Peru	64.95	4.20	6.47	72.29	56.39
Philippines	78.78	11.65	14.79	102.45	68.40
Singapore	88.28	3.04	3.45	94.47	83.89
South Africa	83.37	2.65	3.18	88.03	80.08
Sri Lanka	29.82	2.11	7.10	32.91	26.22
Thailand	84.45	2.67	3.16	91.09	80.99
Tunisia	80.74	2.68	3.32	85.23	76.41
Turkey	71.88	15.78	21.95	92.35	55.68
Yugoslavia	94.77	17.87	18.85	115.91	35.65
Zambia	87.72	8.25	9.41	104.05	78.96

Source: See text.

TABLE 4.3

Basic Statistical Properties of Multilateral Real Exchange Rate Index MRER1 (Quarterly Data 1972-1985)

	Mean	St. Dev.	C.V.	Max	Min
Bolivia	91.00	17.99	19.76	122.92	47.17
Brazil	82.38	16.30	19.79	115.23	61.85
Chile	93.47	26.44	28.29	147.66	18.67
Colombia	103.15	11.12	10.78	124.12	84.71
Cyprus	93.57	8.68	9.27	103.40	74.73
Dominican Republic	100.57	17.68	17.58	175.51	59.95
Ecuador	98.86	7.93	8.03	114.38	79.60
El Salvador	95.71	21.25	22.20	123.94	51.07
Ethiopia	100.09	17.65	17.63	140.18	64.27
Greece	98.35	4.03	4.10	112.29	90.38
Guatemala	94.60	7.85	8.30	108.46	67.93
Guyana	89.38	12.15	13.59	105.08	63.03
Honduras	92.94	9.47	10.79	106.10	74.58
India	90.93	11.01	12.10	105.30	70.44
Israel	89.42	11.39	12.74	110.68	67.91
Kenya	104.49	6.04	5.78	118.96	92.83
Korea	98.92	6.54	6.61	119.72	87.02
Malaysia	86.80	6.76	7.79	101.72	75.49
Malta	93.12	8.40	9.02	106.02	73.43
Mauritius	97.23	6.17	6.34	111.62	89.15
Mexico	106.72	15.70	14.72	148.95	85.06
Pakistan	97.59	10.81	11.07	125.48	54.81
Paraguay	90.81	17.43	19.19	131.60	56.82
Peru	87.07	16.40	18.83	117.96	61.64
Philippines	101.61	6.43	6.33	123.87	87.99
Singapore	88.68	6.41	7.23	100.99	75.84
South Africa	98.91	8.26	8.35	116.21	84.50
Sri Lanka	72.64	28.11	38.70	105.63	27.41
Thailand	96.42	5.77	5.98	110.21	84.85
Tunisia	95.32	8.87	9.30	107.50	77.51
Turkey	92.70	13.39	14.45	123.08	73.11
Yugoslavia	103.25	13.94	13.50	133.93	87.76
Zambia	95.43	17.32	18.15	213.73	79.12

Source: See text.

was only 25 points in Singapore. The differential in real exchange rate variability across countries can be better illustrated by looking at the ratio of the highest to the lowest coefficients of variation. For the complete period under consideration (1965-85) this ratio is above 8! A second fact that emerges from Tables 4.1, 4.2, and 4.3 refers to the increased real exchange rate variability through time. A comparison of the coefficients of variation for 1965-71 and 1972-85 (Tables 4.2 and 4.3) reveals that in all but 4 countries (Ecuador, Philippines, Turkey and Yugoslavia), the multilateral real exchange rate has been significantly more volatile during the post-Bretton Woods era. This reflects, among other things, the fact that during the post-1972 period exchange rates across industrial countries have experienced significant increases in variability, affecting the stability of real exchange rates in those smaller countries that either peg to one of the large industrial countries or use one of the major currencies as a point of reference when conducting (nominal) exchange rate policy (see Edwards 1988b).

From a preliminary analysis of the RER diagrams, it is possible to classify these countries into four broad groups. The rules for classifying them are only approximate and take into account the behavior of the real effective exchange rate throughout the period. A first group can be labeled "two-regime countries" and includes Sri Lanka, Pakistan, Chile, Philippines, Yugoslavia and Peru. In these countries two distinct periods -- each relatively stable -- can be distinguished. The two periods are separated either by an abrupt real depreciation or an abrupt real appreciation. A second group of countries has been grouped under the label of "inverted-U countries" and includes Colombia, Dominican Republic, El Salvador, Guatemala, Guyana and Honduras. In all of these countries a steady real

multilateral depreciation was observed until a certain date -- usually late 1970s -- and a fairly steep real appreciation has been detected since. Not surprisingly a number of these countries have pegged, or managed their currency against the U.S. dollar; as the U.S dollar appreciated in the first part of the 1980s so did these countries real exchange rates. A third group is comprised of those countries whose RERs have exhibited clear long term trends: Cyprus, India, Malta, Mauritius, Tunisia and Turkey have a definitively strong positive trend (i.e., the RER has depreciated through time), while Bolivia, Ecuador, Ethiopia, Paraguay and Zambia have exhibited a negative (real appreciation) long run trend. The final group includes all other countries, whose RERs don't show a strong long term trend. However, in spite of the absence of long term trend, in some of these cases, as in Kenya and Mexico, there have been some fairly abrupt jumps in RERs usually as a result of major nominal devaluations. The degree of RER instability across these countries has also been fairly different, with Kenya, for example, being quite stable, while Mexico has exhibited a fair amount of instability.

Table 4.4 contains estimates of the trend coefficients for the multilateral real exchange rate index MRER1. Linear trends regressions were estimated for four time periods: 1965-1985, 1965-1971, 1972-1985 and the more recent period 1978-1985. For most countries the absolute value of the estimated coefficients for the whole period are small, although in most cases they are significant. A comparison of the number of negative signs of the trend coefficients in the earlier Bretton Woods era and the more recent period shows that during 1965-71 in only 8 out of the 33 countries the trend coefficient was small but negative, indicating a weak tendency towards appreciation. However, during 1978-85 in 23 out of 33 countries the trend coefficient was negative, and in some cases like Ecuador, Paraguay and

TABLE 4.4

Estimated Trend Coefficients for Multilateral

Real Exchange Rate Indexes (MRER1)

	Trend 1965-85	Trend 1965-71	Trend 1972-85	Trend 1978-85
Bolivia	0.001 (1.112)	-0.006 (-4.656)	-0.005 (-2.797)	-0.021 (-4.373)
Brazil	0.006 (9.454)	-0.008 (-2.702)	0.009 (10.216)	0.011 (3.758)
Chile	0.017 (4.639)	0.009 (6.521)	0.017 (4.639)	-0.005 (-1.297)
Colombia	0.001 (1.797)	0.003 (7.491)	-0.006 (-8.998)	-0.007 (-6.253)
Cyprus	0.005 (23.766)	0.001 (3.001)	0.006 (16.164)	0.003 (6.092)
Dominican Republic	-0.002 (-5.678)	0.004 (2.085)	-0.005 (-6.242)	-0.013 (-6.382)
Ecuador	0.001 (1.455)	0.004 (9.160)	-0.004 (-8.607)	-0.002 (-1.413)
El Salvador	-0.002 (-3.491)	0.003 (8.460)	-0.011 (-12.624)	-0.022 (-18.900)
Ethiopia	-0.003 (-6.182)	-0.000 (-1.112)	-0.009 (-10.208)	-0.005 (-3.322)
Greece	0.002 (8.370)	0.000 (0.755)	-0.000 (-1.105)	-0.002 (-1.622)
Guatemala	0.002 (5.390)	0.003 (5.460)	-0.002 (-5.644)	-0.003 (-2.479)
Guyana	0.005 (6.389)	0.007 (13.481)	-0.003 (-2.214)	-0.020 (-9.588)
Honduras	0.002 (5.431)	0.002 (4.679)	-0.002 (-2.169)	-0.013 (-14.271)
India	0.008 (20.414)	0.008 (4.014)	0.008 (12.364)	0.001 (1.090)

Table 4.4 (cont.)

	Trend 1965-85	Trend 1965-71	Trend 1972-85	Trend 1978-85
Israel	0.004 (7.101)	0.012 (4.781)	0.007 (5.504)	-0.010 (-8.813)
Kenya	0.002 (8.411)	0.001 (1.859)	0.001 (0.866)	0.009 (8.686)
Korea	0.001 (1.623)	0.009 (1.259)	-0.002 (-3.155)	-0.001 (-0.686)
Malaysia	0.002 (7.433)	0.002 (4.452)	0.002 (3.309)	-0.006 (-4.815)
Malta	0.006 (14.428)	0.008 (16.603)	0.003 (3.150)	-0.007 (-8.638)
Mauritius	0.003 (15.864)	0.005 (9.241)	0.002 (5.100)	0.005 (3.773)
Mexico	0.003 (5.138)	-0.002 (-8.459)	0.006 (4.442)	0.007 (1.775)
Pakistan	0.010 (10.065)	-0.004 (-6.518)	-0.001 (-0.557)	0.001 (0.656)
Paraguay	0.000 (-0.364)	0.003 (3.650)	-0.007 (-3.784)	-0.029 (-12.787)
Peru	0.007 (11.257)	0.005 (3.564)	0.008 (5.656)	-0.012 (-6.604)
Philippines	0.005 (8.293)	0.010 (3.955)	-0.001 (-2.349)	-0.006 (-3.833)
Singapore	0.001 (2.905)	0.004 (5.926)	0.003 (3.471)	-0.004 (-3.323)
South Africa	0.003 (6.550)	-0.003 (-5.584)	-0.000 (-0.073)	-0.010 (-9.582)
Sri Lanka	0.022 (20.052)	0.007 (6.493)	0.032 (14.958)	-0.005 (-4.562)
Thailand	0.002 (6.077)	0.000 (0.482)	-0.001 (-2.021)	-0.010 (-12.150)
Tunisia	0.004 (13.829)	-0.003 (5.453)	0.005 (11.090)	0.005 (6.582)

Table 4.4 (cont.)

	Trend 1965-85	Trend 1965-71	Trend 1972-85	Trend 1978-85
Turkey	0.007 (8.288)	0.053 (5.441)	0.006 (6.518)	0.016 (8.233)
Yugoslavia	0.002 (2.277)	0.009 (1.461)	0.001 (0.995)	0.123 (5.777)
Zambia	0.000 (0.949)	-0.009 (-7.495)	-0.000 (-0.235)	-0.006 (-3.214)

Note: The numbers in parentheses are t-statistics

Bolivia, fairly large. Undoubtedly, this tendency towards real appreciation in a much vaster number of countries has been largely determined by the behavior of the U.S. dollar in the first half of the 1980s. Since most of these countries used the U.S. dollar as the reference currency when formulating their nominal exchange rate policies, the real appreciation of the dollar with respect to other major industrial currencies necessarily resulted in a real appreciation of these small countries' currencies. This effect is clearer when the small country has a fixed nominal rate with respect to the U.S. dollar -- as is the case of most of the "inverted-U" countries in our sample -- Guatemala, Honduras, and the Dominican Republic, for example. It should be emphasized, however, that without looking at other variable it is not possible to infer from the trend regressions that these countries' currencies were at any particular moment in time misaligned.

4.2 Parallel Markets and RER Behavior: The Cross Country Evidence

The RER indexes used in the analysis of Section 4.1 were constructed using data on official nominal exchange rates.[7] However, as pointed out in Chapters 1 and 3, in many developing countries at different points in time there have been quite significant parallel (or black) markets for foreign exchange. The coverage and importance of these parallel market varies from country to country and period to period. In some cases they are quite thin, and are mainly used by those nationals that want to spend their vacations abroad and are only allowed a limited quota of foreign exchange at the official rates. In other cases, the coverage of the parallel market is very broad and the parallel market exchange rate is the relevant marginal rate for most transactions. The degree of legality of these parallel markets

also varies from case to case. While in some cases they are quasi-legal and accepted by the authorities as a minor nuisance, in others they are strongly repressed with the authorities severely persecuting those that engage in black market transactions.

By the very nature of these markets -- illegal or quasi-illegal -- it is not possible to have accurate data on their volume of transactions and of their relative importance. However, there are relatively reliable data on parallel market quotations and parallel market premia. Generally speaking, the parallel market premium will become higher as exchange controls become more pervasive and generalized and as fewer and fewer transactions are allowed through the official market. In fact, under conditions of generalized exchange controls and rationing the RER indexes computed using official rates will become more and more irrelevant for a number of transactions and in particular for imports. In this study data on parallel market quotations were collected for 28 out of the 33 countries in Section 4.1 (see Table 4.5).[8] These quotations refer to the nominal exchange rate with respect to the U.S. dollar, and were used to construct series on parallel market premia and on parallel market bilateral (with respect to the U.S.) real exchange rate indexes.

Figures 4-34 through 4-53 depict the behavior of the parallel market premium for the 28 countries that have data. As can be seen the premia have varied significantly across countries and periods.[9] The cases of Bolivia, Chile, and Pakistan are particularly interesting, showing how the premium can not only become extremely acute, but also exhibit dramatic jumps. As is discussed in great detail in Chapter 6 in a vast number of cases the parallel market premium behaves very closely to what our model of Chapter 3 predicts, increasing very rapidly in the period immediately preceding a

TABLE 4.5

Basic Statistical Properties of Black Market Premium*

(Quarterly Data: 1965-1983)

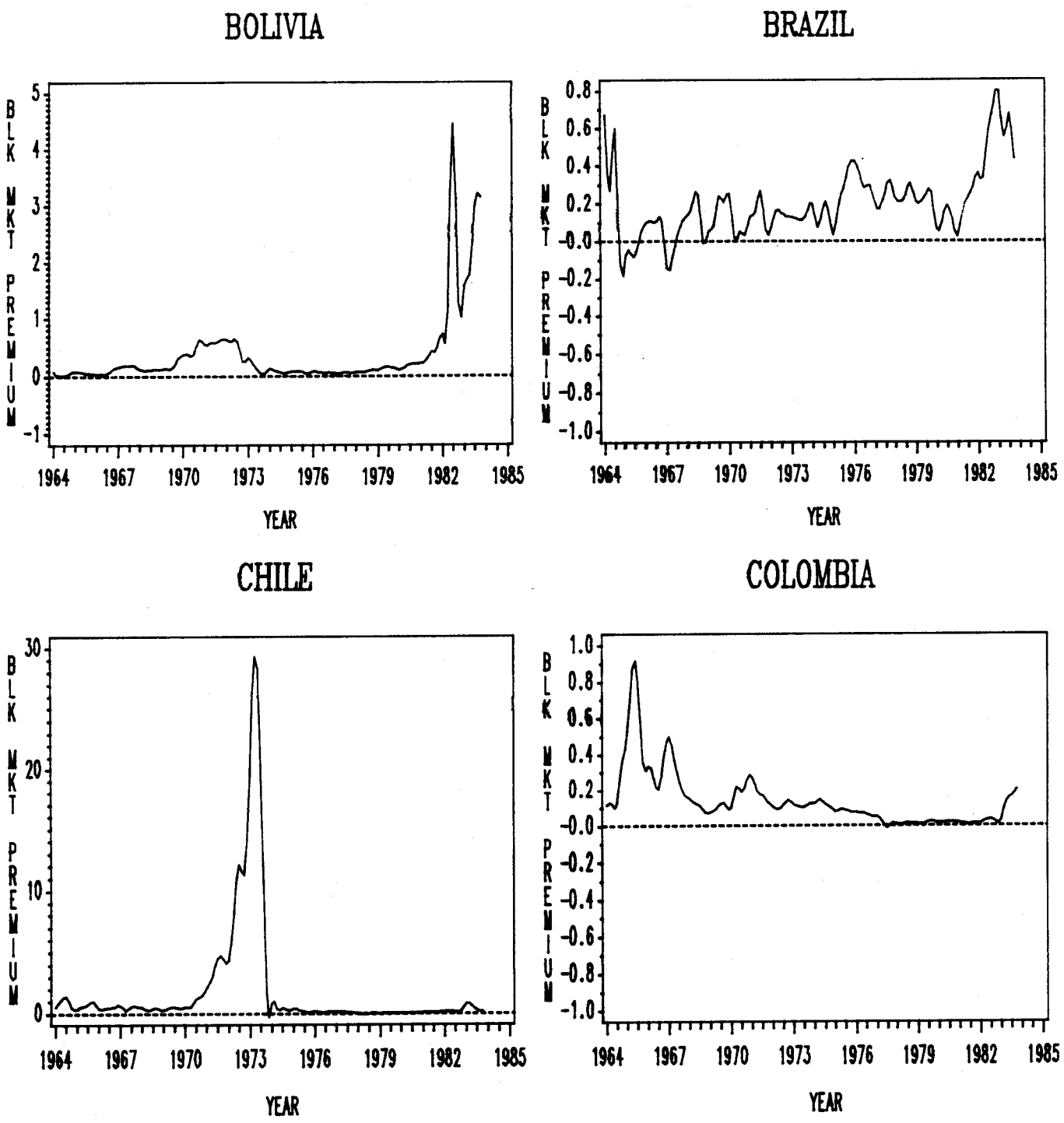
	Mean	St. Dev.	C.V.	Max	Min
Bolivia	40.40	73.30	181.41	444.96	4.58
Brazil	19.35	17.53	90.62	79.95	-15.00
Chile	190.50	498.85	261.85	2934.18	1.87
Colombia	13.47	16.29	120.99	87.40	-1.27
Cyprus	4.23	5.63	133.24	29.79	-2.82
Dominican Republic	30.79	14.78	48.00	78.33	-9.66
Ecuador	19.93	24.75	124.13	119.18	0.06
El Salvador	36.62	36.04	98.40	146.66	4.66
Ethiopia	56.15	43.24	77.01	175.84	1.77
Greece	5.08	3.14	61.95	16.43	1.49
India	34.40	26.07	75.80	124.00	6.10
Israel	16.12	18.13	112.33	72.27	-10.66
Kenya	22.12	13.62	61.59	65.89	1.11
Korea	9.76	11.31	115.95	60.70	-5.23
Malaysia	0.71	0.99	138.93	3.61	-1.40
Mexico	5.24	13.75	262.15	86.39	-0.10
Pakistan	54.52	42.28	77.55	171.95	2.58
Paraguay	27.29	40.97	150.10	224.07	5.29
Peru	26.77	28.52	106.52	82.60	-0.27
Philippines	8.70	8.96	102.95	55.85	0.17
Singapore	0.28	0.67	237.97	2.59	-0.80
South Africa	11.97	10.01	83.61	49.88	-19.73
Sri Lanka	89.80	58.96	65.65	220.25	1.70
Thailand	0.09	1.85	187.90	6.37	-5.19
Tunisia	17.37	18.02	103.74	80.31	-7.14
Turkey	21.98	19.13	87.02	74.12	-4.82
Yugoslavia	8.40	7.07	84.15	26.02	-6.41
Zambia	93.19	50.54	54.23	201.66	29.08

Source: Based on raw data obtained from various issues of Pick's Currency Yearbook and World Currency Yearbook.

*In some countries the time period is slightly shorter, due to data limitations.

FIGURE 4.9

BLACK MARKET PREMIUM

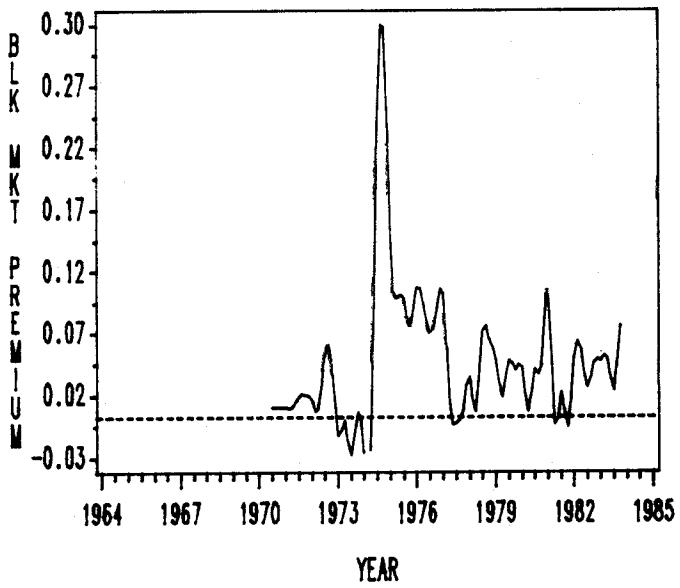


SOURCE: CONSTRUCTED FROM RAW DATA OBTAINED FROM PICKS CURRENCY YEARBOOK

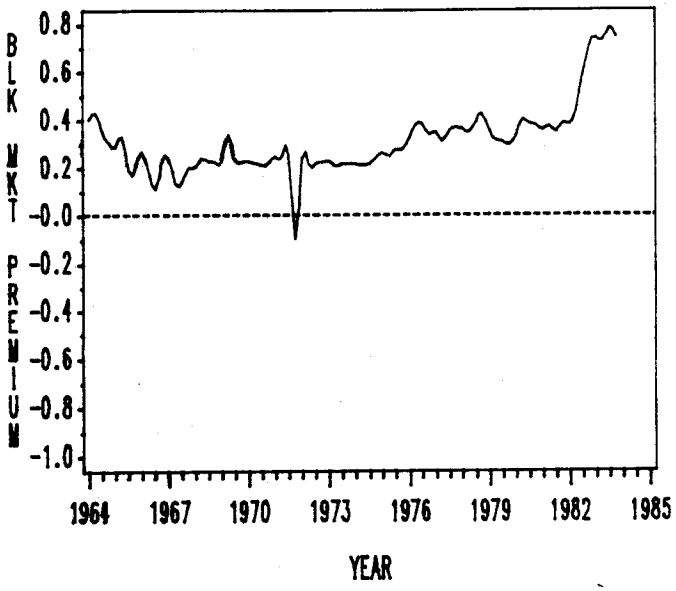
FIGURE 4.10

BLACK MARKET PREMIUM

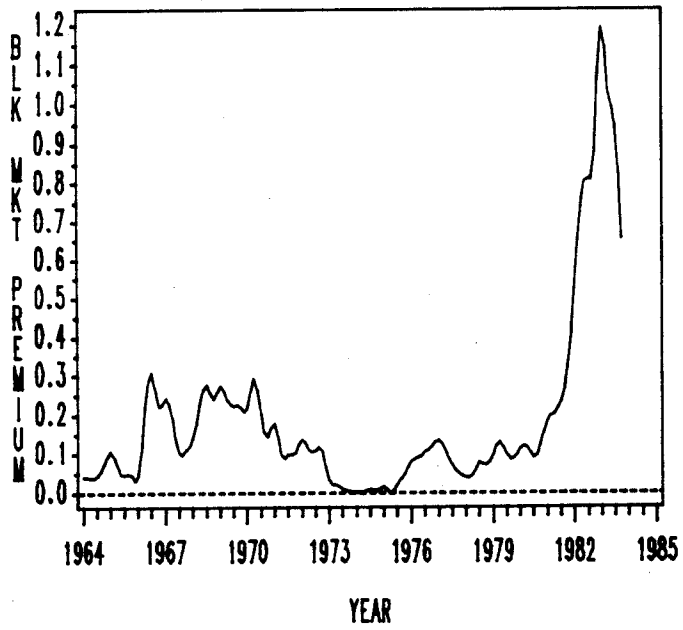
CYPRUS



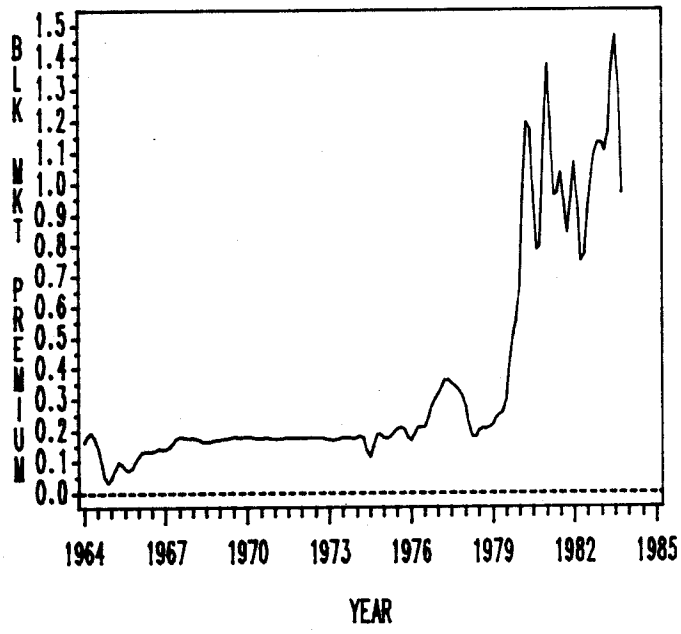
DOMINICAN REP.



ECUADOR



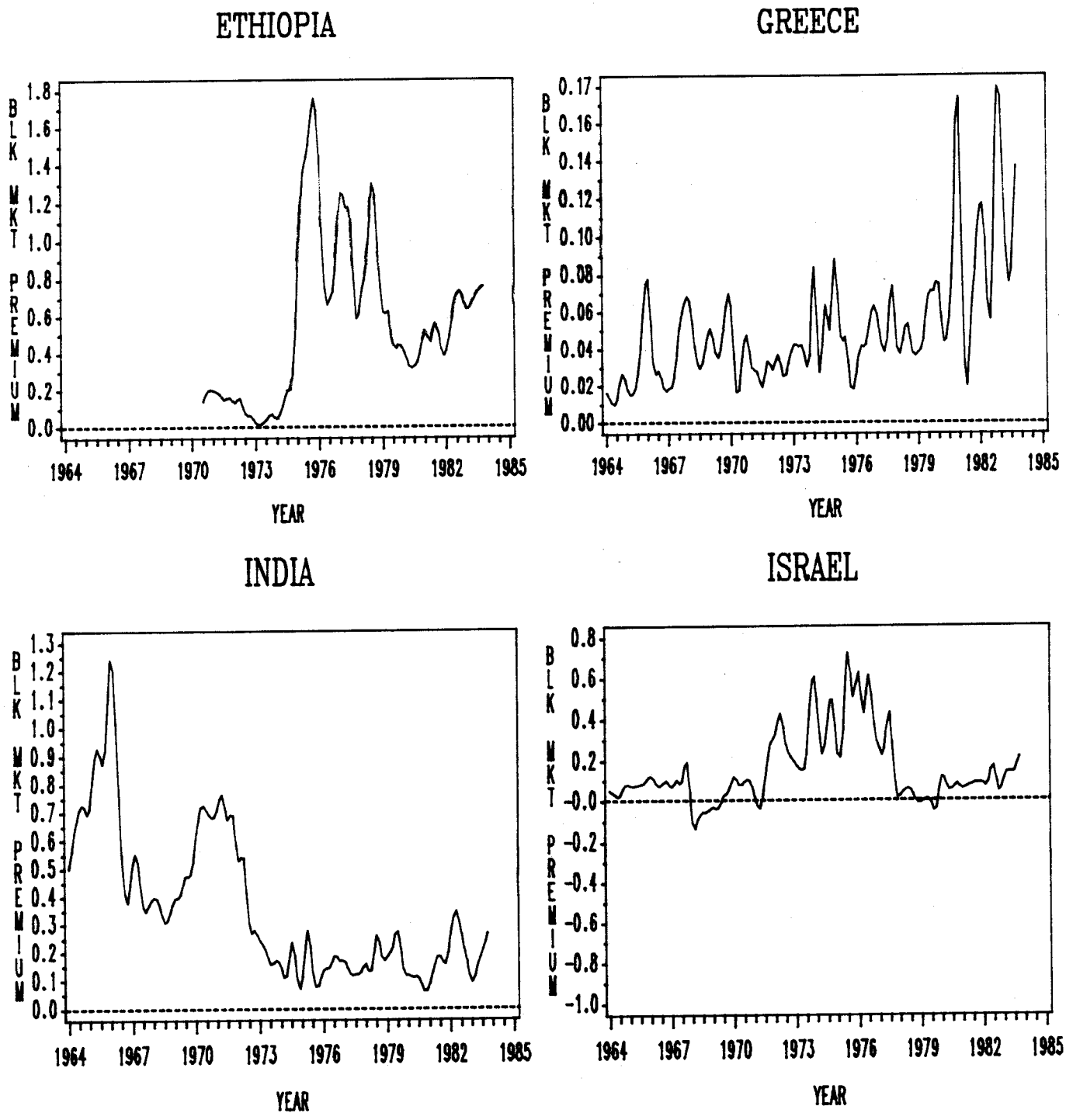
EL SALVADOR



SOURCE: CONSTRUCTED FROM RAW DATA OBTAINED FROM PICKS CURRENCY YEARBOOK

FIGURE 4.11

BLACK MARKET PREMIUM

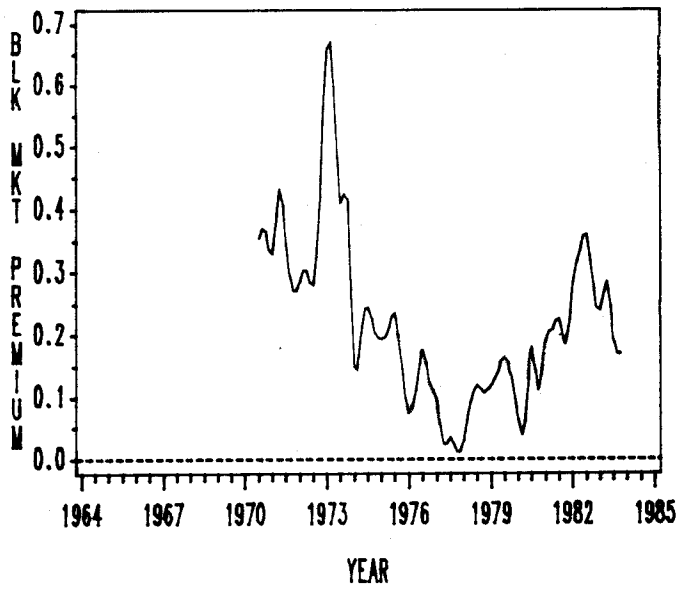


SOURCE: CONSTRUCTED FROM RAW DATA OBTAINED FROM PICKS CURRENCY YEARBOOK

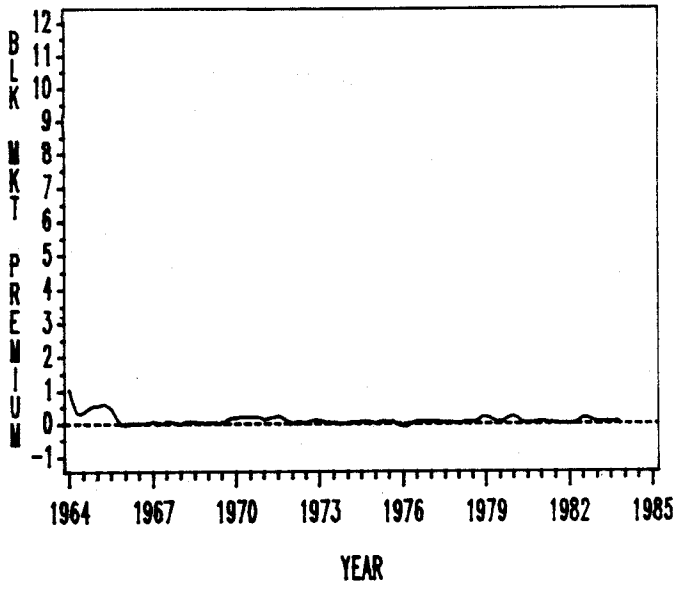
FIGURE 4.12

BLACK MARKET PREMIUM

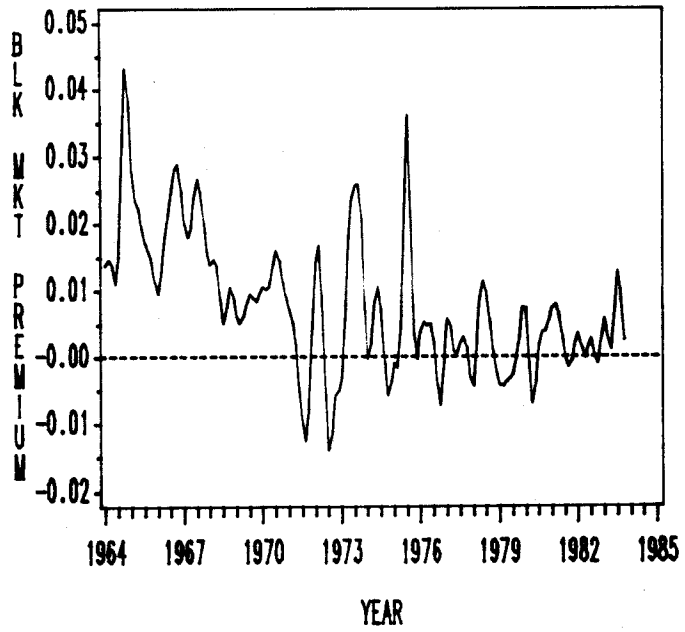
KENYA



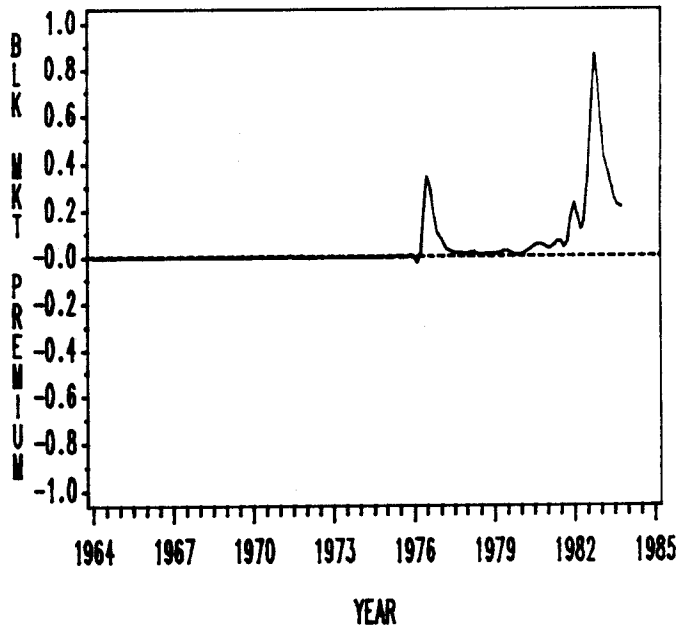
KOREA



MALAYSIA



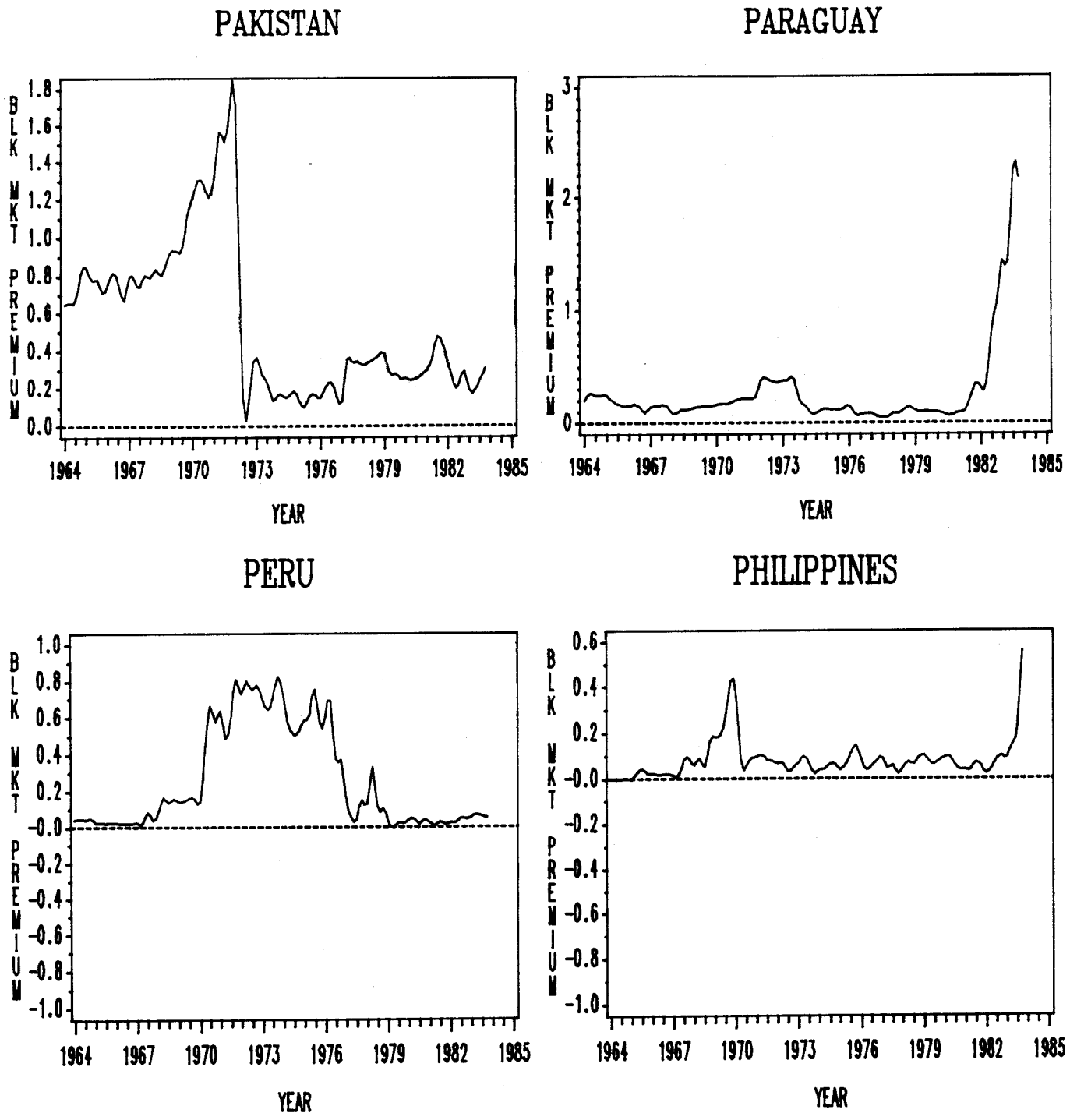
MEXICO



SOURCE: CONSTRUCTED FROM RAW DATA OBTAINED FROM PICKS CURRENCY YEARBOOK

FIGURE 4.13

BLACK MARKET PREMIUM

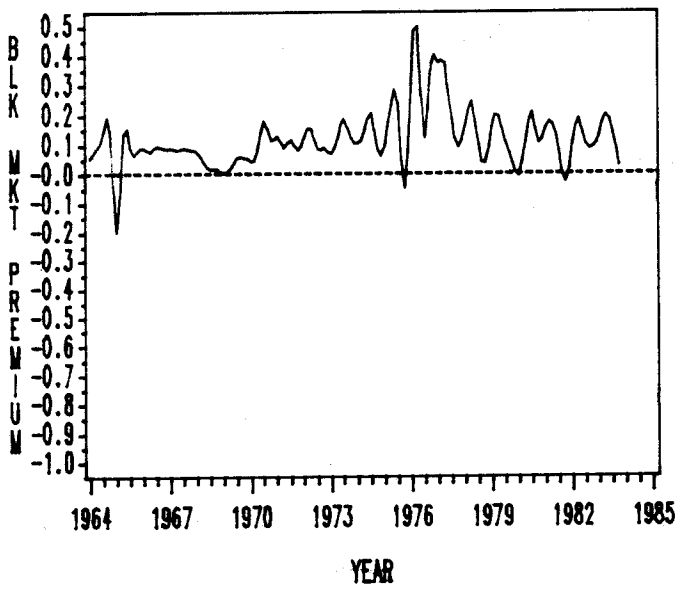


SOURCE: CONSTRUCTED FROM RAW DATA OBTAINED FROM PICKS CURRENCY YEARBOOK

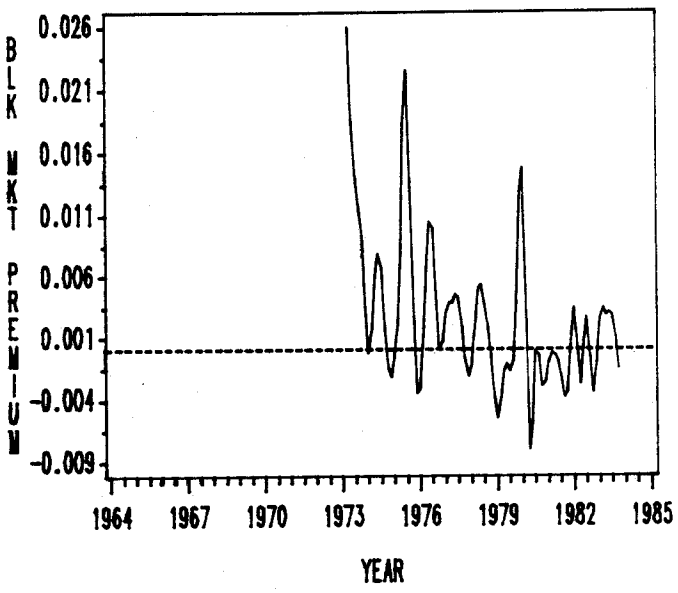
FIGURE 4.14

BLACK MARKET PREMIUM

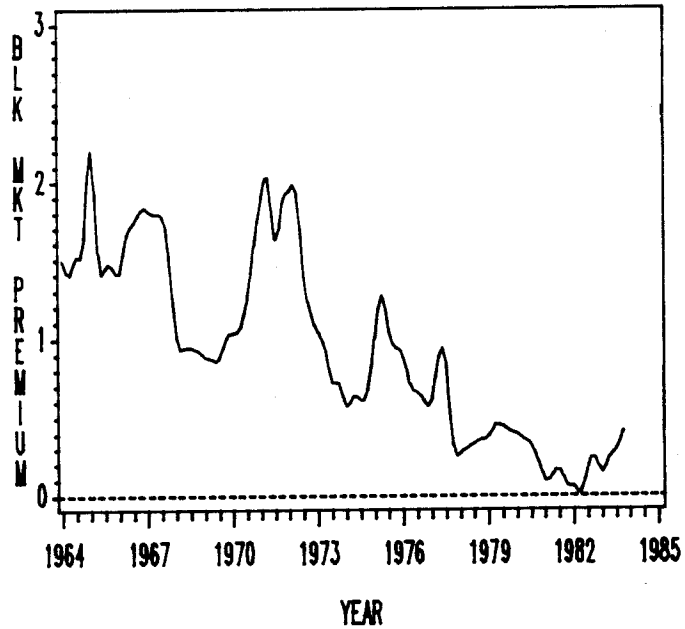
SOUTH AFRICA



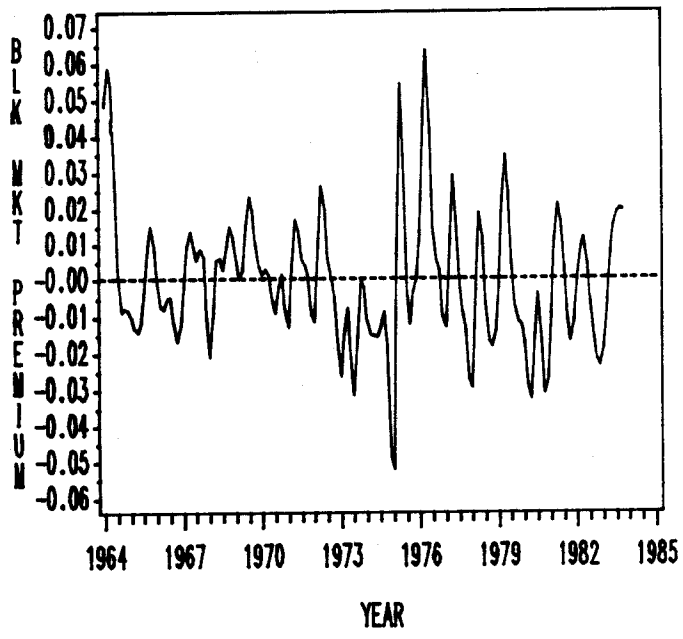
SINGAPORE



SRI LANKA



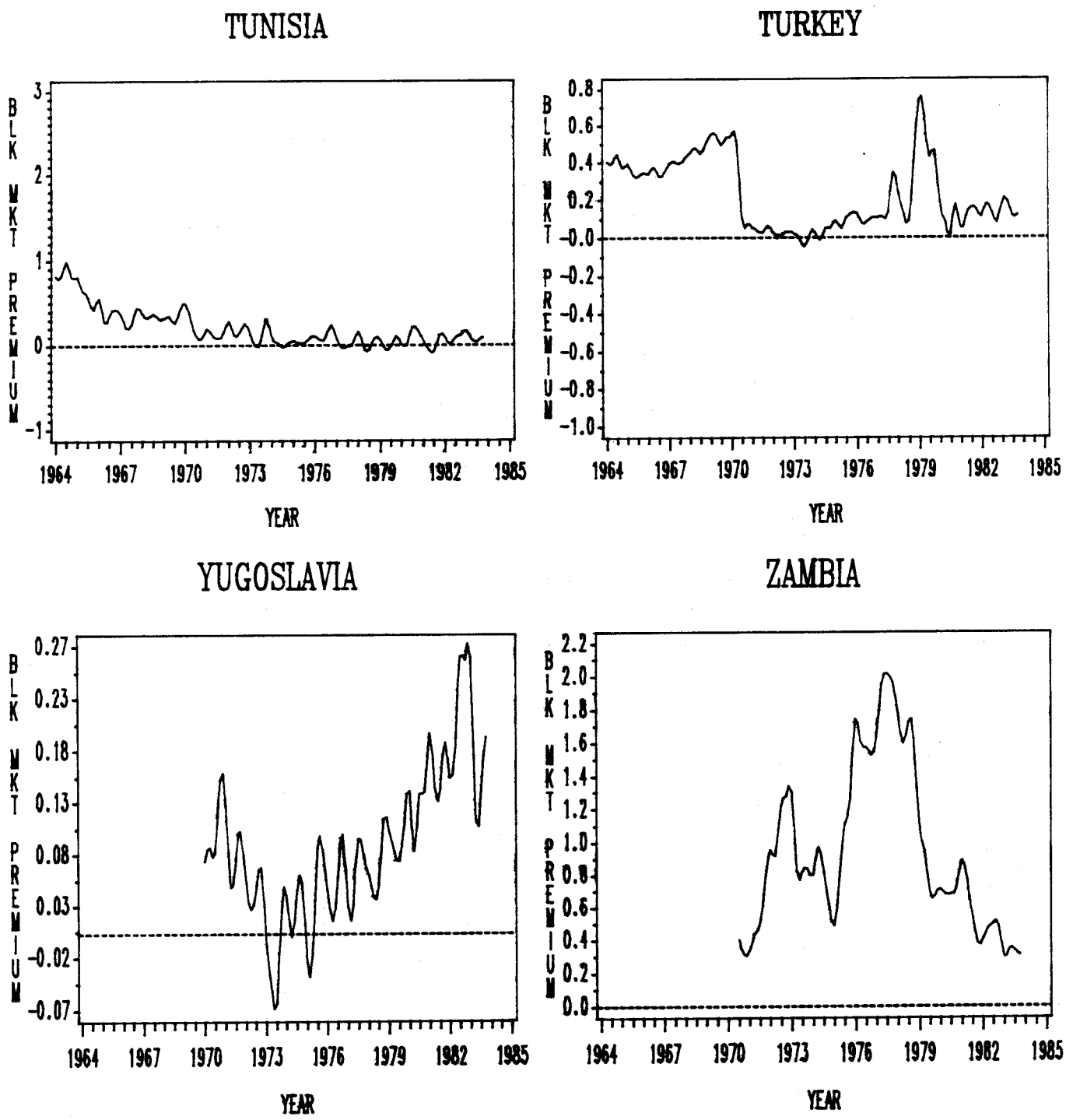
THAILAND



SOURCE: CONSTRUCTED FROM RAW DATA OBTAINED FROM PICKS CURRENCY YEARBOOK

FIGURE 4.15

BLACK MARKET PREMIUM



SOURCE: CONSTRUCTED FROM RAW DATA OBTAINED FROM PICKS CURRENCY YEARBOOK

(major) nominal devaluation, and falling quite drastically immediately following the devaluation. Perhaps the most remarkable example of this type of behavior is given by Pakistan. Table 4.5 contains a summary of the most important statistical properties of the parallel market premium for the 28 developing countries.

There is no reason why the parallel market RER index (PMRER) should move closely with the indexes constructed using the official nominal exchange rates. In fact, as pointed out in Chapter 3, there are a number of circumstances under which, in a country with pegged nominal official rates, these two RER indexes will tend to move in opposite directions. This will be the case, for example, when there is a massive domestic credit creation under generalized exchange controls and active parallel markets. Under these circumstances, the higher growth of domestic credit will simultaneously generate an appreciation of the official RER index and a depreciation of the parallel market RER. Table 4.6 contains coefficients of correlation between the parallel market RER and official RER bilateral indexes. The parallel market index was constructed as:

$$PMRER1_t = (PM)_t \frac{WPI^{US}}{CPI} \qquad (4.5)$$

where $(PM)_t$ is an index of the parallel market bilateral nominal exchange rate with respect to the U.S. dollar, WPI^{US} is the U.S. wholesale price index and CPI is the domestic country consumer price index. PMRER1, then is the bilateral parallel index equivalent to BRER1 in Section 4.1.[10] The coefficients of correlation in Table 4.6 clearly capture the fact that the parallel and official RER index indeed behave very differently. In fact in 13 out of the 28 cases the coefficients of correlation turned out to be negative. Table 4.7 contains a summary of the basic statistics for the

TABLE 4.6

Coefficient of Correlation of Bilateral Real Exchange Rate Indexes Constructed Using Official and Parallel Nominal Exchange Rates

	Coefficient of Correlation
Bolivia	-0.180
Brazil	0.642
Chile	-0.776
Colombia	0.337
Cyprus	0.124
Dominican Republic	0.422
Ecuador	0.230
El Salvador	0.434
Ethiopia	0.312
Greece	-0.436
India	-0.215
Israel	0.317
Kenya	0.217
Korea	-0.142
Malaysia	-0.053
Mexico	0.726
Pakistan	-0.007
Paraguay	-0.416
Peru	0.293
Philippines	0.620
Singapore	0.875
South Africa	0.326
Sri Lanka	-0.044
Thailand	-0.419
Tunisia	-0.688
Turkey	-0.347
Yugoslavia	0.477
Zambia	-0.091

Source: See text.

TABLE 4.7

Basic Statistical Properties of Black Market Real Exchange Rate Index

(Quarterly Data: 1965-1985)

	Mean	St. Dev.	C.V.	Max	Min
Bolivia	131.11	47.81	36.47	318.54	90.88
Brazil	89.92	25.36	28.20	188.98	60.50
Chile	195.24	251.32	128.72	1473.40	94.13
Colombia	118.96	14.98	12.59	156.03	94.77
Cyprus	110.08	14.10	12.81	148.12	85.19
Dominican Republic	99.64	7.75	7.78	122.05	70.60
Ecuador	117.09	22.00	18.79	197.67	93.80
El Salvador	77.04	12.72	16.51	124.02	57.07
Ethiopia	128.82	39.36	30.55	265.86	91.21
Greece	107.73	8.84	8.21	141.76	96.02
India	109.12	13.38	12.26	137.84	77.74
Israel	103.26	14.04	13.59	138.44	76.97
Kenya	133.30	22.80	17.10	198.95	98.56
Korea	102.51	7.30	7.12	116.44	90.53
Malaysia	98.53	5.34	5.42	108.53	83.19
Mexico	122.99	29.81	26.38	246.98	86.57
Pakistan	105.24	13.72	13.04	148.03	84.65
Paraguay	141.84	26.39	18.60	241.07	99.82
Peru	102.56	19.54	19.05	142.47	65.61
Philippines	105.24	17.73	16.84	206.32	78.74
Singapore	96.05	6.17	6.42	103.48	80.90
South Africa	110.35	13.96	12.65	165.86	78.14
Sri Lanka	74.98	20.78	27.72	120.61	48.93
Thailand	107.16	3.71	3.46	115.85	100.00
Tunisia	107.45	18.32	17.05	160.82	75.64
Turkey	103.45	18.31	17.69	149.52	80.84
Yugoslavia	110.25	22.08	20.03	190.18	86.72
Zambia	120.21	30.13	25.06	183.79	82.00

Source: See text.

parallel market RER index PMRER1.

4.3 Deviations from PPP and Stationarity of Real Exchange Rates in Selected Developing Countries

An important question, and one that has recently received increased attention in the industrial countries (Frankel and Meese, 1987), is whether the real exchange rate series have behaved according to the Purchasing Power Parity (PPP) theory of real exchange rates. According to the strict absolute version of PPP, the log of the real exchange rate is characterized by a white noise process. That is, any deviation of the log of the RER from its constant equilibrium level should be completely random. This question has important implications for the analysis of real exchange rate misalignments. If the RER indeed behaves as suggested by the PPP theory any (large) deviations of the actual RER from its PPP level will reflect misalignment.

In order to test the PPP proposition a time series procedure was used. Autocorrelation functions were estimated for detrended series of the log of MRER1 and PMRER1, for the period 1965-1985, using 24 lags. Table 4.8 contains estimates of the first 6 lags for the (log of the) detrended official multilateral index MRER1; Table 4.9, on the other hand, contain the equivalent estimates for the parallel market index PMRER1. These tables also contain the value of the Box-Pierce statistic with 18 degrees of freedom for each country. The null hypothesis is that the log of these real exchange rate indexes can be characterized as a white noise process.[11] As can be seen from these four tables, in all cases the null hypothesis that (the log of) the real exchange rate can be characterized by a white noise is strongly rejected. This provides strong evidence which indicates that in all cases the observed variability of the real effective exchange rate index around its mean or around its trend cannot be described as a white noise

TABLE 4.8

Autocorrelation Coefficients of Detrended MRER1

Quarterly Data: 1965-1985

Lag:	1	2	3	4	5	6	Q(18)
Bolivia	0.665	0.409	2.402	0.366	0.291	0.185	86.5
Brazil	0.827	0.659	0.441	0.316	0.167	0.106	78.5
Colombia	0.897	0.757	0.688	0.679	0.635	0.577	260.0
Cyprus	0.891	0.794	0.717	0.652	0.570	0.465	247.1
Dominican Rep.	0.756	0.538	0.366	0.252	0.191	0.159	94.1
Ecuador	0.903	0.797	0.717	0.620	0.523	0.448	239.8
El Salvador	0.941	0.880	0.815	0.747	0.679	0.611	316.9
Ethiopia	0.878	0.748	0.640	0.539	0.450	0.363	191.2
Greece	0.708	0.608	0.492	0.519	0.393	0.409	144.9
Guatemala	0.865	0.778	0.706	0.643	0.583	0.519	244.7
Guyana	0.936	0.878	0.826	0.749	0.670	0.591	310.7
Honduras	0.937	0.866	0.793	0.723	0.657	0.581	302.2
India	0.814	0.534	0.311	0.142	-0.005	-0.090	89.7
Israel	0.858	0.705	0.549	0.428	0.317	0.242	158.5
Kenya	0.810	0.644	0.588	0.535	0.449	0.314	169.9
Korea	0.885	0.732	0.583	0.463	0.366	0.271	134.4
Malaysia	0.914	0.787	0.672	0.509	0.468	0.353	218.3
Malta	0.957	0.903	0.843	0.777	0.711	0.641	337.8
Mauritius	0.670	0.533	0.364	0.236	0.166	0.227	84.3
Mexico	0.848	0.639	0.390	0.180	-0.005	-0.150	111.7
Pakistan	0.926	0.788	0.656	0.528	0.406	0.308	207.0
Paraguay	0.923	0.813	0.718	0.637	0.567	0.492	254.8
Peru	0.880	0.755	0.647	0.508	0.400	0.265	190.5
Philippines	0.906	0.782	0.657	0.546	0.455	0.391	213.6
Singapore	0.926	0.804	0.684	0.569	0.447	0.317	209.2
South Africa	0.900	0.772	0.664	0.553	0.460	0.407	214.5
Sri Lanka	0.923	0.807	0.714	0.645	0.502	0.515	258.1
Thailand	0.927	0.825	0.747	0.684	0.598	0.497	269.7
Tunisia	0.857	0.667	0.508	0.364	0.208	0.092	136.3
Turkey	0.782	0.582	0.391	0.245	0.143	0.068	80.7
Yugoslavia	0.615	0.156	0.069	0.066	0.023	-0.009	34.3
Zambia	0.821	0.663	0.489	0.324	0.208	0.095	126.9

Source: See text.

TABLE 4.9

Autocorrelation Coefficients of Detrended PRER1

Quarterly Data: 1965-1985

Lag:	1	2	3	4	5	6	Q(18)
Bolivia	0.882	0.780	0.612	0.437	0.292	0.130	164.9
Brazil	0.796	0.606	0.435	0.256	0.126	0.041	101.8
Chile	0.808	0.486	0.215	0.037	-0.046	-0.048	46.6
Colombia	0.821	0.610	0.490	0.431	0.400	0.343	141.3
Cyprus	0.744	0.517	0.419	0.320	0.182	0.089	66.2
Dominican Rep.	0.423	0.189	0.048	0.003	-0.103	-0.083	18.7
Ecuador	0.919	0.777	0.624	0.471	0.344	0.234	179.5
El Salvador	0.681	0.593	0.428	0.218	-0.017	-0.146	85.7
Ethiopia	0.860	0.655	0.468	0.342	0.275	0.202	94.4
Greece	0.757	0.659	0.533	0.416	0.287	0.261	130.0
India	0.843	0.690	0.593	0.445	0.259	0.115	146.9
Israel	0.668	0.429	0.387	0.301	0.135	0.153	73.3
Kenya	0.880	0.748	0.613	0.492	0.408	0.340	131.2
Korea	0.525	0.101	0.053	0.145	0.147	0.072	20.0
Malaysia	0.868	0.705	0.575	0.525	0.457	0.355	177.0
Mexico	0.860	0.637	0.389	0.157	-0.026	-0.148	107.1
Pakistan	0.874	0.740	0.681	0.640	0.562	0.467	220.5
Paraguay	0.865	0.697	0.564	0.411	0.252	0.105	144.1
Peru	0.905	0.796	0.676	0.607	0.546	0.492	228.4
Philippines	0.754	0.612	0.484	0.402	0.303	0.214	118.9
Singapore	0.653	0.449	0.318	0.264	0.189	-0.018	39.4
South Africa	0.578	0.398	0.477	0.417	0.229	0.105	77.2
Sri Lanka	0.878	0.741	0.602	0.459	0.311	0.135	161.4
Thailand	0.632	0.500	0.341	0.220	-0.063	-0.046	65.6
Tunisia	0.778	0.606	0.588	0.566	0.432	0.364	158.6
Turkey	0.834	0.707	0.635	0.561	0.474	0.376	148.0
Yugoslavia	0.855	0.732	0.678	0.386	0.456	0.374	147.32
Zambia	0.900	0.763	0.618	0.499	0.391	0.288	132.4

Source: See text.

process; as in previous analyses on industrial countries' data the strong absolute version of PPP fails miserably.

An important related question refers to whether the time series of real exchange rates have unit roots and thus are nonstationary.[12] Whether RERs are stationary has a number of important implications. First, under non-stationarity there are serious problems with interpreting standard regressions that attempt to explain the behavior of the (log of the) real exchange rate. In this case the standard errors of the estimated parameters are meaningless. Second, if the log of RER is a random walk, the variance of forecast of log RER into the future would be infinite; in a way the system would not be anchored. As can be seen from Tables 4.8 and 4.9, the one lag autocorrelation coefficients are in most cases high, and in some instances even higher than 0.9. These high autocorrelation coefficients, of course, don't necessarily reflect nonstationarity: they can indeed capture slowly convergent mean reverting processes. In fact, when this implied quarterly speed of adjustments (one minus the first order autocorrelation coefficient) are translated into annual terms they don't appear to be that high. For example, a quarterly AR1 coefficient of 0.92 corresponds in annual terms to 0.732. Unfortunately, the existing tests for unit roots have limited power. In the case of our series the use of the Box-Pierce statistic indicates that in the majority of our cases -- in 19 out of 33 countries -- we can reject the hypothesis of a random walk processes. When the more powerful augmented Dickey-Fuller test is used we cannot reject nonstationarity for a larger number of these cases. However, if moving average components are allowed into the analysis the hypothesis of no random walk cannot be rejected for most of our countries. For example, for 25 of our countries it is not possible to reject the hypothesis that the detrended log of the multilateral

real exchange rate folows an ARMA(1,1). For these twenty five countries the value of the $\chi^2(15)$ statistic ranged from 4.2 to 21.6. The critical value of the χ^2 with 15 degrees of freedom and at 10% level of significance is 22.3. Although there are strong indications of slow mean reverting processes, these tests do not allow us to fully resolve the stationarity issue for every country.[13]

4.4 Summary

The purpose of this chapter has been to provide a broad and preliminary look at real exchange rates in a large group of developing countries. The chapter started by constructing two multilateral and two bilateral RER indexes using data on official nominal rates for 33 countries. The evolution of these indexes through time was analyzed, and it was found that while for most countries the two alternative indexes of multilateral real rates had moved closely together, they had behaved significantly different from the bilateral indexes.

Some important statistical properties of the time series of the "official" multilateral real exchange rate indexes were also analyzed in Section 4.1. The main findings of that analysis can be summarized as follows: first, in a large number of countries real effective exchange rates have exhibited no significant long-run trends. Over the more recent period, however, some strong evidence of generalized real exchange rate appreciation could be detected. Second, the multilateral real exchange rate indexes have been quite volatile throughout the period. In addition, this variability has been very different across countries; the ratio of the highest to lowest coefficient of variation of the real effective rate was almost equal to nine. Third, the degree of RER variability has increased

significantly through time, being much larger in the recent years than during the Bretton Woods period.

Section 4.2 dealt with parallel markets for nominal exchange rates and RER indexes. Data on nominal exchange rate quotations on parallel markets for 28 countries were used to construct alternative RER indexes. It was found that in many of these countries the "official" and "parallel" RER indexes have moved very differently and even in opposite directions. This is an important result, since it introduces some important degree of skepticism on the relevance of conventional computations of RERs. These results indicate that since for many transactions the relevant marginal exchange rate is the parallel market one, analysts and policymakers should usually look closely at the parallel market spread and at the parallel market real rate when undertaking economic decisions.

In Section 4.3 the results from a univariate time series analysis of the log of the official multilateral RER index MRER1 and of the parallel bilateral index PMRER1 for all countries are reported. The results obtained clearly showed that, contrary to the traditional PPP theory of RER behavior, these time series could not be characterized as a white noise process.

These findings generate a number of important questions, some of which will be tackled in the chapters that follow. Among the more important ones it is possible to mention: (1) if the (log of the) real exchange rate cannot be represented as a white noise process, how can we explain RER behavior? (2) Is it possible to explain the wide movements of the real effective rate index by the behavior of the fundamental determinants derived in the theoretical analysis of Part I? (3) Is it possible to explain the observed differences across countries in the degree of variability of the real exchange rate by some characteristics specific to each country? And

(4) Is it possible to relate some of the more acute movements of the real exchange rate to changes in the nominal exchange rate and other policy variables?

FOOTNOTES FOR CHAPTER 4

[1]For a review of the literature on RER measurement problems see Edwards (1985a) and Edwards and Ng (1985). See also Wood (1986) and Dornbusch and Helmers (1987).

[2]See Edwards (1985-).

[3]The partners and weights used for constructing the multilateral indexes are given in the Appendix to this chapter.

[4]The possibility of having the bilateral and multilateral real exchange rates moving in opposite directions can be easily seen by using the triangular arbitrage condition for nominal exchange rates to rewrite the MRER index as:

$$MRER = \frac{E_{US}}{P} (\Sigma \alpha_i E_{US,i} P^*_i)$$

where E_{US} is an index of the bilateral nominal rate between the country in question and the U.S., and where $E_{US,i}$ is the bilateral nominal exchange rate between the U.S. and the i^{th} partner. It is clear from this expression that even if this country pegs with respect to the dollar (i.e., E_{US} is fixed), the fact that the U.S. is floating against other major currencies ($E_{US,i}$ moves) will affect the MRER.

[5]As noted, the real multilateral exchange rate indexes used above were constructed using trade weights for 1975 and each country's ten largest trade partners. An important question is: How different will these indexes behave if other weighting schemes and a larger number of partners are used in the computation? In theory the effective indexes constructed using a different number of partners and weighting schemes can be quite different. From a practical perspective, however, once a large enough number of

partners is used (say, 8 to 10) and a fairly normal year is used as the base, the addition of other countries or use of other weighting schemes will generate little variation in the index. In order to illustrate this point, 19 indexes of the effective real exchange rate were constructed for some of these countries and their behavior was compared between 1960 and 1983. The alternative indexes considered 20 partner countries (instead of ten) and used, alternatively, trade, export and import weights. Also, the weights were taken from averages for 1975-80 (instead of 1975 only). The results obtained strongly support the claim that further refinements would not add much to the indexes constructed for this study. For instance, for the case of Colombia, the correlation coefficient between the MRER1 index, constructed with 10 partners and 1975 trade weights, and the index constructed using average 1975-80 import weights and 20 partners was 0.999. When the MRER1 index was compared with other more complete indexes the resulting coefficients of correlation had similar magnitudes.

[6]The countries were: Greece, Turkey, Yugoslavia, Colombia, Ecuador, El Salvador, Guatemala, Mexico, Israel, India, Korea, Pakistan and Singapore. The data on wages were obtained from various issues of the ILO Labor Market Yearbook.

[7]Remember, however, that in those countries with multiple official rates the "most common" rate was used.

[8]For the other five countries -- Guatemala, Guyana, Honduras, Malta and Mauritius -- it was not possible to find data on parallel market quotations.

[9]Notice that these diagrams show that in some countries with no exchange controls the premium has even been briefly negative. This can either be a reflection of poor quality data or may be reflecting the fact that during some periods the Central Bank didn't buy all the foreign

exchange, causing the freely determined parallel rate to be below the official rate. In other cases the negative premium may be reflecting the fact that, at times, foreign exchange remittances from illegal activities (i.e., drugs) generated gluts in the foreign exchange market. In most cases, however, the premium has been positive and significantly so.

[10]Unfortunately, since there are only quotations of the parallel market rate with respect to the U.S. dollar, it is not possible to directly construct multilateral parallel market rates.

[11]In rigor r_k refers to the first K autocorrelations from an ARIMA (p,d,s) process and n is the number of observations (x minus d). In the present case, however, the log of the real exchange rate is supposed to follow an ARIMA (0,0,0) process.

[12]For a good discussion on nonstationarity and real exchange rates in the industrialized countries see Kaminsky (1987).

[13]Most studies on real exchange rates in industrial countries during the floating period have not been able to reject nonstationarity. For longer periods of time, however, the evidence is consistent with (slow) mean reverting processes for real exchange rates. For example, in their recent massive study Frankel and Meese (1987) argue that "the evidence for a unit root in real exchange rates is much less convincing than the evidence for a unit root in nominal exchange rates..."

APPENDIX TO CHAPTER 4
Trade Weights Used in the Construction of Real Effective Exchange Rate Indexes for Selected Developing Countries

1. **Bolivia**: U.S. (32.3), U.K. (7.3), Japan (11.5), Belgium (1.9), W. Germany (6.6), Netherlands (1.9), Switzerland (3.0), Argentina (23.2), Brazil (10.6), Chile (1.8).

2. **Brazil**: U.S. (35.3), U.K. (5.3), Japan (14.4), France (4.7), W. Germany (16.2), Italy (7.4), Netherlands (5.8), Spain (3.6), Argentina (4.7), Belgium (2.8).

3. **Chile**: U.S. (27.1), U.K. (8.5), Japan (12.1), Belgium (3.5), France (4.8), W. Germany (16.7), Italy (4.8), Netherlands (5.7), Spain (4.5), Argentina (12.5).

4. **Colombia**: U.S. (49.3), U.K. (4.2), Canada (2.5), Japan (6.9), France (4.4), W. Germany (15.4), Italy (3.4), Netherlands (5.2), Spain (3.9), Venezuela (4.8).

5. **Cyprus**: U.S. (4.0), U.K. (41.5), Japan (4.4), Austria (2.1), France (8.3), W. Germany (8.4), Italy (8.5), Netherlands (4.5), Greece (16.2), Spain (2.2).

6. **Dominican Republic**: U.S. (69.9), U.K. (2.0), Canada (2.5), Japan (4.4), Belgium (1.7), W. Germany (1.8), Italy (2.8), Netherlands (4.4), Switzerland (2.6), Venezuela (7.8).

7. **Ecuador**: U.S. (58.2), U.K. (2.9), Japan (11.0), France (1.8), W. Germany (8.5), Italy (3.3), Netherlands (2.1), Argentina (6.3), Colombia (4.4), Spain (1.5).

8. **El Salvador**: U.S. (35.6), U.K. (3.0), Japan (11.0), Belgium (2.6), W. Germany (10.9), Italy (2.1), Netherlands (5.3), Costa Rica (6.6), Guatemala (17.8), Venezuela (5.1).

9. **Ethiopia**: U.S. (19.6), U.K. (8.6), Japan (16.1), France (5.5), W. Germany (16.7), Italy (12.5), Netherlands (4.4), Iran (7.8), Israel (3.2), Egypt (5.8).

10. **Greece**: U.S. (11.0), U.K. (7.9), Japan (10.4), Belgium (4.2), France (10.5), W. Germany (28.6), Italy (13.5), Netherlands (7.4), Spain (3.3), Tunisia (3.3).

11. **Guatemala**: U.S. (37.4), U.K. (7.0), Japan (9.2), Canada (2.2), W. Germany (11.1), Italy (4.9), Netherlands (3.1), Costa Rica (5.1), El Salvador (12.7), Venezuela (7.3).

12. **Guyana**: U.S. (39.2), U.K. (37.0), Canada (5.6), Japan (4.5), Denmark (1.6), France (2.4), W. Germany (3.6), Italy (1.4), Netherlands (2.7), Norway (2.1).

13. **Honduras**: U.S. (55.7), U.K. (2.1), Japan (6.5), Belgium (2.3), W. Germany (8.0), Netherlands (3.1), Costa Rica (3.5), Guatemala (6.1), Mexico (1.5), Venezuela (11.3).

14. **India**: U.S. (30.1), U.K. (11.9), Canada (4.6), Japan (15.6), Australia (3.3), France (5.1), W. Germany (9.4), Italy (3.0), Belgium (3.0), Iran (13.9).

15. **Israel**: U.S. (30.7), U.K. (17.6), Japan (4.4), France (6.3), W. Germany (14.0), Italy (6.2), Netherlands (7.3), Belgium (5.6), Switzerland (4.9), Iran (2.9).

16. **Kenya**: U.S. (10.4), U.K. (28.9), Japan (10.7), France (3.5), W. Germany (14.5), Italy (5.7), Netherlands (4.5), Canada (3.3), Australia (2.2), Iran (16.3).

17. **Korea**: U.S. (37.6), U.K. (3.1), Canada (3.8), Japan (41.0), Australia (2.9), France (2.0), W. Germany (5.6), Italy (0.8), Netherlands (1.6), Iran (1.6).

18. **Malaysia**: U.S. (22.5), U.K. (13.3), Australia (8.0), Japan (28.5), France (2.9), W. Germany (7.8), Italy (2.7), Netherlands (8.0), Philippines (1.9), Thailand (4.5).

19. **Malta**: U.S. (7.6), U.K. (33.7), Japan (2.7), Belgium (5.4), Denmark (2.8), France (4.8), W. Germany (16.5), Italy (19.1), Netherlands (5.9), Canada (1.5).

20. **Mauritius**: U.S. (6.5), U.K. (54.3), Canada (2.6), Japan (4.9), Australia (3.9), Belgium (1.7), France (8.7), W. Germany (5.2), S. Africa (6.9), Iran (5.5).

21. **Mexico**: U.S. (71.5), U.K. (2.7), Canada (2.3), Japan (5.0), France (2.5), W. Germany (7.0), Italy (1.9), Switzerland (1.6), Argentina (3.1), Brazil (2.3).

22. **Pakistan**: U.S. (20.7), U.K. (13.1), Canada (5.5), Japan (23.0), Australia (8.6), Belgium (3.3), France (5.2), W. Germany (11.6), Italy (6.3), Netherlands (2.7).

23. **Paraguay**: U.S. (13.0), U.K. (11.7), Japan (4.3), Belgium (1.9), France (3.5), W. Germany (12.4), Netherlands (5.3), Switzerland (4.7), Argentina (28.0), Brazil (15.3).

24. **Peru**: U.S. (41.7), U.K. (5.3), Japan (14.1), France (3.2), W. Germany (13.1), Italy (3.4), Netherlands (5.2), Brazil (4.5), Chile (4.5), Venezuela (5.2).

25. **Philippines**: U.S. (33.1), U.K. (4.9), Canada (2.0), Japan (41.7), Australia (3.9), France (2.1), W. Germany (4.6), Italy (0.9), Netherlands (5.1), Iran (1.7).

26. **Singapore**: U.S. (29.4), U.K. (9.2), Japan (26.7), Australia (7.9), France (3.0), W. Germany (6.8), Italy (2.1), Netherlands (3.2), Iran (6.6), Thailand (5.2).

27. **South Africa**: U.S. (18.7), U.K. (26.2), Canada (2.7), Japan (14.4), Belgium (2.9), France (4.7), W. Germany (19.5), Italy (3.9), Netherlands (3.0), Switzerland (4.0).

28. **Sri Lanka**: U.S. (12.3), U.K. (11.9), Canada (3.5), Japan (13.9), Australia (12.0), France (10.5), W. Germany (8.2), Iran (7.4), Pakistan (12.5), Thailand (7.9).

29. **Thailand**: U.S. (21.1), U.K. (5.2), Japan (48.4), France (2.9), W. Germany (6.7), Italy (2.1), Netherlands (7.6), Australia (2.8), Switzerland (1.8), India (1.5).

30. **Tunisia**: U.S. (10.7), U.K. (4.6), Belgium (2.8), France (38.1), W. Germany (10.8), Italy (16.2), Netherlands (3.2), Greece (9.1), Spain (2.8), Brazil (1.8).

31. **Turkey**: U.S. (13.7), U.K. (9.9), Japan (5.7), Belgium (3.8), France (8.1), W. Germany (32.6), Italy (10.5), Netherlands (4.5), Switzerland (9.0), Austria (2.0).

32. **Yugoslavia**: U.S. (12.3), U.K. (5.4), Japan (3.4), Austria (7.1), France (7.9), W. Germany (31.7), Italy (22.4), Netherlands (3.1), Switzerland (4.4), Belgium (2.2).

33. **Zambia**: U.S. (9.5), U.K. (28.7), Japan (17.4), Belgium (3.7), France (6.4), W. Germany (14.2), Italy (10.8), Netherlands (2.5), S. Africa (5.4), India (1.4).

Note: Figures in parentheses are percentage of trade weights in 1975. Trade partner countries are based on the ten largest trading partners whose price indexes are also available.

Source: Directions of Trade, International Monetary Fund.