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MEASURING ANNUAL REAL EXCHANGE RATE SERIES FOR TURKEY

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ABSTRACT

This study deals with the problem of measuring the real exchange rate (RER). We consider four aspects of this measurement problem: (a) Using end-of-period or period averages of the nominal exchange rate. (b) Choosing price indexes. (c) In obtaining the real effective exchange rates (REER), deciding upon the number of trading partners in calculating the weights. (d) Deciding upon the formula to use in aggregation. Considering all these aspects together led to the calculation of a great number of alternative series. Our analysis of these series yielded the following conclusions: (1) The end-of-period based results reflected the dates of the major devaluations more accurately but the period average based results gave us a more conservative picture of RER behaviour. (2) The consumer price index (CPI), the wholesale price index (WPI), and the GDP deflator (GDPD) were used as alternatives. When the same price indexes were used for both domestic and foreign prices, we found that the GDPD-based series appeared to overstate the depreciations and appreciations in the real exchange rate while the WPI-based results were the least volatile. When different price indexes were utilised, it was found that all series indicated changes in the competitiveness of Turkish tradables and nontradables to be in the same direction with a few periods of conflict. (3) We used four formulas to obtain the REER. In terms of the similarity in their results, we obtained two pairs. This pairing also showed itself in the sensitivity of these formulas to increases in the number of trading partners, which was chosen to be 5, 9 and 14. The sensitivity was observed when going from 5 to 9 trading partners. (4) When comparing the results from these pairs, no consistent disparity was obtained and conflicts were observed in very few cases. Hence, the choice within each pair or across pairs would be based on the assessment of the investigator as to which is easier to compute.

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1. INTRODUCTION

Exchange rates have been of increasing concern to both economists and policy makers. This attention has been magnified with the shift from fixed exchange rate regimes toward more flexible ones, beginning in the early 1970s. In addition, the experiences of the developing countries have proved that the exchange rate is a key policy instrument in liberalization and structural adjustment programs (Aşıkoğlu and Uçtum, 1992). In short, we can say that the exchange rate is one of the most important concepts in analysing international economic relations.

The exchange rate may simply be defined as the number of units of domestic currency per unit of foreign currency in nominal terms,

$$ER = \frac{\text{Domestic Currency}}{\text{Foreign Currency}} \qquad (1)$$

or vice versa. However, when the time comes to quantify this simple definition, we note that we have an array of alternatives to choose from. We may be interested in "nominal" or "real" exchange rates and these exchange rates may be "bilateral" or "aggregated" (or "effective"). Our concern here is with real exchange rates (RER) which is the nominal exchange rate deflated by a price index or indexes and we shall consider its measurement in both "bilateral" and "effective" terms.

One may express a bilateral RER as,

$$RER = \frac{\text{Domestic Currency}/P_d}{\text{Foreign Currency}/P_f}$$

where ER is the bilateral nominal exchange rate, P_d is a domestic price index and P_f is a price index of the trading partner. We immediately note that how each of these components are measured would lead to different measures of the RER (see Marquez (1992) for a discussion of this point). For example, ER may be an end-of-period value or a period average. It may be the rate used for imports or exports. Similarly, the price indexes may be the consumer price index (CPI), the wholesale price index (WPI) or the gross domestic product deflator (GDPD); or they may be import or export price indexes. Each choice would lead to a RER figure with a different objective in mind.

The bilateral RER's with the major trading partners may be aggregated to yield Real Effective Exchange Rates (REER). The choices discussed above with respect to bilateral RER's are, obviously, also relevant here; in addition, the formulas used in the aggregation may differ, yielding different REER's. This aggregation is usually done by weighting each bilateral RER by the share of each trading partner in some aspects of its trade with the domestic country. The "aspect" chosen would lead to different choice of weights, such as share in imports, share in exports and share in total trade. After this choice has been made, one then has to decide how to use these weights in the aggregation process. For instance, if we denote the weights by w_i, then we may do the aggregation in a straightforward manner, as

$$REER = \sum_{i=1}^{N} w_i \cdot RER_i \qquad (3)$$

or as,

$$REER = EER.\left|\frac{i=1}{P_d}\right| \qquad (4)$$

where N is the number of trading partners, $\sum_{i=1}^{N} w_i = 1$, and EER is the effective exchange rate, defined to be

$$EER = \sum_{i=1}^{N} w_i \cdot ER_i \qquad (5)$$

These descriptions are far from being exhaustive; we shall give much more precise and alternative descriptions later on. But, they do point to the need of constructing alternative series for the real exchange rate, which are based on a common data set and go as far back in time as possible. This will be the basic purpose of this study.

In pursuing this purpose, we shall, in the next Section, discuss, (i) the objectives that calculating real exchange rate measures may serve in relation to the implications these have on the choice of price indexes to use and (ii) the alternative ways of obtaining the aggregate or effective versions. In the third Section, we shall describe the data utilized and then present an analysis of the empirical results in terms of comparing the various real exchange rates obtained using different criteria. The final Section will contain our conclusions.

2. PROBLEMS OF MEASUREMENT

In the Introduction, we gave a general definition of a RER in equation (2) and indicated that these bilateral measures may be aggregated in various ways, to yield "effective" versions. Both the bilateral and aggregated measures have common conceptual problems. In the first subsection, we shall consider these problems. In the second subsection, we shall introduce the different ways of obtaining the effective measures.

a. Conceptual Problems: One faces problems of measurement, particularly in choosing the appropriate price index or indexes to use, depending upon the objective of calculating a RER [see also Kıpıcı and Kesriyeli (1997) on this point].

If the objective is to obtain *a measure of the international competitiveness* of a country, then we would need to represent foreign prices in local currency units relative to domestic prices and that would mean that we need to find a uniform measure of the price level in the countries involved. Thus, if the CPI is chosen, then one uses the CPI for both countries.

This concept of an RER is based on the purchasing power parity (PPP) theory since we can express ER from (2) as $ER = (P_d/P_f)RER$ and, assuming that the law of one price holds for every commodity, the absolute version of PPP would imply that RER = 1, while the relative version would require that it be a constant. A statistically more sophisticated way of expressing the relative version would be to say that lnRER should be covariance stationary. Hence, we shall refer to an RER constructed to measure the international

competitiveness of a country, the PPP version.

If the function of the RER is to *analyze resource allocation* due to a change in the exchange rate, then the price ratio in (2) need not be based on the same measure of the general price level in the countries involved. The underlying adjustment mechanism of the balance of payments, directed by an increase of the exchange rate, for example, is to induce consumers to buy domestic goods instead of imports and, symmetrically, to induce producers to produce tradables, whether import-competing or exportables, rather than non-tradables. Thus, the price ratio in (2) should now reflect the relative price of tradables to nontradables; i.e., P_T/P_N.

There are, however, two ways this ratio could be measured. One is to use $P_{T,d}/P_{N,d}$, the ratio of the domestic price of tradables to the domestic price of nontradables; this, of course, becomes directly equal to the RER. This definition summarises incentives that guide the allocation of resources across the tradables and non-tradables sectors; an increase in RER will make the production of tradables relatively more profitable, causing resources to shift toward the tradables sector (Edwards, 1989).

The other way of measuring the price ratio is to use $P_{T,f}/P_{N,d}$ where $P_{T,f}$ is now the world price of tradables. Of course, RER would now be obtained in more familiar fashion, as

$$RER = ER \left[\frac{P_{Tf}}{P_{N,d}} \right]$$

If the country has sufficiently detailed national accounts, tradable and non-tradable price indexes are built as averages of sectoral prices on the basis of the adequate sectoral partitioning. Otherwise, import and export price indexes, which are regularly published, are used to construct the price of tradables, and the price of constructions and services, the wage level, or even the GDPD are used as proxies for the non-tradable price. When general price indexes are used in this context, one observes different choices for P_T and P_N.

Thus, from this perspective, it would be useful to take a closer look at the various candidates to use in constructing the price ratio.

i. Consumer price indexes : The most widely used index is constructed using both foreign and domestic Consumer Price Indexes. It has been argued that this indicator will provide a comprehensive measure of changes in competitiveness by including a broad group of goods. Another advantage of this index is that it is easy to find data for any periodicity (that is, annually, quarterly or monthly) on the CPI in almost every country. Therefore, this kind of RER index has historically been the most popular index in policy analysis.

CPIs used as a proxy for total unit costs attempt in fact to measure relative costs. In this case, it is implicitly assumed that consumer prices are relevant to the determination of wages and other factors of production, that is, that they have some effects on both unit labour costs and other unit costs. It is also implicitly assumed that no considerable time lags are involved in the adjustment of production costs to consumer prices. However, it is a meaningful proxy only for short-run changes in relative costs, it does not directly reflect profitability of the primary producing sectors and its coverage tends to be concentrated in the urban areas of the country.

By definition, however, CPIs reflect patterns of consumer spending that may differ widely from one country to another. In addition, CPIs have also a drawback of including a large number of non-traded and imported goods so it is not so reasonable to use it as a proxy for $P_{T,d}$ or P_f (Edwards, 1988a). Unlike wholesale price indexes, CPIs are heavily influenced by trends in the prices of goods and services that are in the non-traded category. When using CPIs, one has to weigh these negative features against the advantages.

In sum, it is quite common to use CPIs as proxy for the price of non-tradables or for the domestic price index (but less common for $P_{T,d}$ or P_f). To list some empirical examples; Harberger (1986,1989), Ghura and Grennes (1993), Edwards (1988a, 1988b) used CPI for $P_{N,d}$ and P_d.

ii. Wholesale price indexes: The second candidate for an appropriate price index is the wholesale price index. Wholesale prices may reflect underlying price developments for potentially exportable goods. In principle it is preferable to use wholesale price indexes rather than consumer price indexes to deflate both home and foreign currency because wholesales prices are more representative of the prices of the internationally traded goods. It has often been used to approximate for P_T (or P_f in PPP version) because WPIs contain mainly tradable goods. Edwards (1988a, 1988b), Harberger (1986, 1989), Ghura and Grennes (1993) used WPIs in their studies.

However there are some criticisms about using WPIs. Because these indexes contain highly homogeneous tradable goods whose prices tend to be equated across countries when expressed in a common currency, the RER computed using WPIs will not vary enough to measure actual changes in competitiveness. In addition, international comparisons based on WPIs may be distorted by the use of different weights across countries (Edwards, 1988a).

It is argued that WPIs are often ruled out among other indexes on the argument that conceptually they are poorly defined, being neither consumer nor producer price indexes. The preference is most often given to GDPDs that have a clear methodological definition.

iii. GDP deflators: A real exchange rate index computed using gross domestic product deflators at home and abroad can be said to be a good indicator of changes in competitiveness in production because it is a genuine price index of aggregate production and is not subject to direct distortions stemming from price controls. However, main shortages of the deflators are being available only on a yearly basis for those countries who do not generate quarterly GDP series and having a large component of non-tradable goods (Edwards, 1988a).

GDPDs may best be viewed as a composite indicator of the cost of all primary factors of production. GDPDs are computed as quotients of the current and constant estimates of value added. However, such estimates may not always be factor-cost based and thus may incorporate the effects of changes in indirect taxes and subsidies. Unlike the WPI, the GDPD refers only to domestically produced goods and services and is not expected to be affected by double counting. At the same time, however, the GDPD may not represent a final product price. For instance, GDPDs for the manufacturing sector generally exclude the cost of intermediate inputs from all the

nonmanufacturing sectors. Thus, the GDPD may be a less comprehensive price indicator than is the WPI.

Harberger (1989) suggests that the deflating domestic price index should include non-tradables as well as tradables so the GDPD may be a good candidate for that.

iv. Wage rate indexes: Some authors, including the IMF staff, prefer to compute the RER as a ratio of unit labour costs (Edwards, 1988a). Namely this index is a direct measure of relative competitiveness across countries (Maciejewski, 1983). It is also argued that relative labour costs are more stable than relative goods prices. Nonetheless this index like the others is also not a perfect measure. First, an indicator based on wage rate behaviour will be highly sensitive to cyclical productivity changes. Second, it takes into account only one factor of production. Finally, the data on wages for developing countries are quite limited and of poor quality (Edwards, 1988a).

v. Some components of the existing price indexes: The above arguments are about general price indexes that have been used generally for the PPP definition of the real exchange rate. More recently many authors have tried to find good proxies for the relative price of tradables. Some argued for using some components of the existing price indexes. For example, it is suggested using the GDPD for services and government to construct a proxy for non-tradables and the deflators of the rest of the sectors to construct a proxy for tradables (Edwards, 1988a). Also, some price series of tradables and non-tradables have been constructed for a number of industrialised countries. Similarly, Harberger (1986) suggests that an index as a proxy for foreign price index, constructed from agricultural, mining and manufacturing components of the USA GNP deflator.

b. Aggregation: Obtaining Effective Rates: We mentioned two alternative ways of aggregating bilateral RER's in the Introduction and pointed out that there may be other ways of doing this. Most of these measures are applications of effective exchange rate formulas to RER's. The one given in (3) above is an example. An exception is the formula in (4) where the EER makes up a component of the REER.

In all the formulas given below the w_i or ω_i denote the weights, their definition, however, is not unique. We shall use the following four definitions:

$$w_{ix} = \frac{X_i}{\sum_{i=1}^{N} X_i}, \qquad \sum_{i=1}^{N} w_{ix} = 1 \quad (6)$$

$$w_{im} = \frac{M_i}{\sum_{i=1}^{N} Mi}, \qquad \sum_{i=1}^{N} w_{im} = 1 \quad (7)$$

$$w_{it} = \frac{M_i + X_i}{\sum_{i=1}^{N} (M_i + X_i)}, \qquad \sum_{i=1}^{N} w_{it} = 1 \quad (8)$$

$$\omega_x = \frac{X}{X + M} \quad \text{and}$$

$$\omega_m = 1 - \omega_x = \frac{M}{X + M} \quad (9)$$

where X_i = exports to ith trade partner, M_i = imports from ith trade partner, X = total exports of domestic country (is not equal to $\sum_{i=1}^{N} X_i$), M = total imports of the domestic

country (is not equal to $\sum_{i=1}^{N} M_i$). In forming the weights not all trading partners are considered. Only those, which constitute the major share in the trade of the domestic country, are chosen. Hence, $\sum_{i=1}^{N} X_i$ and $\sum_{i=1}^{N} M_i$ would not be equal to X and M respectively, since the latter covers all trading partners.

Now, in order to obtain effective (weighted) exchange rates, the following two approaches have been suggested:

$$EER = \sum_{i=1}^{N} w_i \cdot ER_i \qquad (10)$$

(see, e. g., Appleyard and Field, 1995) and

$$EER = \omega_x \left[\sum_{i=1}^{N} w_{ix} ER_i \right] + \omega_m \left[\sum_{i=1}^{N} w_{im} \frac{1}{ER_i} \right]^{-1} \qquad (11)$$

(see Rhomberg, 1976). A straightforward generalization of these to real exchange rates are possible if we first define

$$RER_i = ER_i \left[\frac{P_{fi}}{P_d} \right] \qquad (12)$$

and then write, from (10)

$$REER = \sum_{i=1}^{N} w_i \cdot RER_i \qquad (13)$$

and from (11),

Note that REER in (13) implies different measures depending upon which wi definition given in (6), (7) or (8) one uses. If w_{ix} and w_{im} are utilized we would then have export-weighted and import-weighted series while using w_{it} would yield a trade-weighted series. The REER in (14) is only a trade-weighted series but consists of a weighted average of export-weighted and import-weighted series.

The approach that makes the EER a component of the REER may be expressed as,

$$REER = EER \left[\frac{\sum_{i=1}^{N} \alpha_i P_{fi}}{P_d} \right] \qquad (15)$$

The weights for the foreign price aggregate (α_i) are denoted differently from the ω_i or w_i as they may or may not be the same as these weights.

One may now obtain different measures from (15) by using the EER definitions given in (10) or (11). If the definition (10) is used, then it would be natural, but not necessary, to set $\alpha_i = w_i$. On the other hand, if the definition in (11) is used, we may express each α_i as,

$$\alpha_i = \omega_x w_{ix} + \omega_m w_{im} \qquad (16)$$

[see Jin and McMillin (1993)]. In discussing the empirical results in Section 3, we shall refer to the (10)+(15) combination as equation (15a) and to the (11)+(15) combination as equation (15b).

It is customary to calculate real effective rates in index form. This may be done in either of two ways. One way is to choose a base year for the nominal exchange rates, the ER_i, denoting them by ER_{io} and then replace each ER_i in the equations given above by (ER_i/ER_{io}) and multiply the resultant figure by 100. The other approach would be to take average of the figures obtained from the formula above and divide each by this average and multiply by a 100. In the first case, we face the problem of choosing an appropriate base year and this is a task for which there is never a satisfactory solution. In the second case, such a problem does not exist but if the series are presented in this form one should not forget that they would need to be calculated anew as time passes and new data on exchange rates are generated. Hence, the real exchange rates were calculated both by using the ER_i and the (ER_i/ER_{io}) but, in analysing the results in Section 3, they were used in the second index form discussed above.

Some work in calculating REER's for Turkey has been undertaken, both by government agencies and by individual researchers. We shall consider two of these; the series calculated by the Central Bank and the one calculated by Togan (1993). There are also series calculated by the State Planning Organization and the State Institute of Statistics, and by Selcuk (1993, 1994) but they do not contain aspects which are methodically different from ours to be considered separately.

A trade weighted real effective exchange rate has regularly been calculated and published monthly by the Central Bank since 1970. It uses the buying prices of the USA dollar and the Deutsche Mark (DM) as bilateral nominal exchange rates and enters them in the calculations as $1/ER_i$. As price deflators, the average wholesale price of Turkey (60 percent of State Institute of Statistics and 40 percent İstanbul Chamber of Commerce after 1988), and the industrial product price indexes of the USA and Germany are used. The base year is taken to be 1981. The aggregation formula used is a special case of (15). The EER is calculated as,

$$EER = 0.75\left(\frac{1}{ER_{\$}}\right) + 0.25\left(\frac{1}{ER_{DM}}\right)\left(\frac{ER_{DM,0}}{ER_{\$,0}}\right) \qquad (17)$$

and the foreign price aggregate as,

$$0.75\ P_{US} + 0.25\ P_{GR}\left(\frac{ER_{DM}}{ER_{\$}}\right)\left(\frac{ER_{\$,0}}{ER_{DM,0}}\right) \qquad (18)$$

The measure, which we shall denote by REERCB, then becomes

$$REERCB = EER\left[\frac{P_{TR}}{0.75\ P_{US} + 0.25\ P_{GR}\left(\frac{ER_{DM}}{ER_{\$}}\right)\left(\frac{ER_{\$,0}}{ER_{DM,0}}\right)}\right] \qquad (19)$$

The weights are not based on the trade shares of these two countries and, thus, are somewhat arbitrary. Also, due to the way the ER's are entered into the formula, an increase (decrease) in REERCB implies a real appreciation (depreciation) in Turkey's real exchange rate.

Togan (1993) has also done some extensive REER calculations. His index is annual and covers the period 1961-1990. His aggregation formula is also (15) and he also uses the EER in (17), but now the ER's enter in the usual way to yield:

$$EER = 0.75\ ER_{\$} + 0.25\ ER_{DM}\left(\frac{ER_{\$,0}}{ER_{DM,0}}\right) \quad (20)$$

His foreign price aggregate is, however, different. He also uses two prices; P_{OECD} = OECD countries GDPD and $P_{ISL.}$ = GDPD for the Middle Eastern Countries and combines them by using the share of Islamic Countries in Turkey's total exports (α) and 1 - α as weights:

$$(1 - \alpha)P_{OECD} + \alpha\ P_{ISL} \quad (21)$$

His REER, which we shall denote by REERT, then becomes,

$$REERT = EER\left[\frac{(1 - \alpha)\ P_{OECD} + \alpha\ P_{ISL}}{P_{TR}}\right]100 \quad (22)$$

3. EMPIRICAL RESULTS

a. The Data: One of the aims of this study was to be able to calculate series from the beginning of the post Republican era (that is, from 1923 to 1995). In fact, the reason for concentrating on annual series also had this objective in mind. But various problems concerning data availability, both domestically and for foreign countries led us to limit the coverage of our calculations. Hence, the longest series we were able to calculate start in 1949.

There are three kinds of data sets used in the calculation of the effective exchange rate series. They are Turkey's exports to, imports from and total trade with the major trading countries. The last one is calculated by adding the volume of exports and imports. The data related to Turkey's international trade are obtained from the State Institute of Statistics (SIS). We have data problems especially in the war years and in some other years for some countries. However, all data are available for the five major trading countries except the volume of import data in 1945 for Germany. This is one of the reasons to limit the time period of the study.

Turning to exchange rate data, the end of period selling and buying rates were available from the Central Bank from 1950 to 1995. From these rates, their arithmetic means were calculated which is also very similar to *ae* line in the IFS. The *rf* line in the IFS representing the period averages of market exchange rates and official exchange rates for countries quoting rates in units of national currencies per the US dollar is available from 1936 to the present.

On the other hand, in the calculation of the real exchange rate series, price indexes are required. For our country, the WPI, CPI and GDPD can be obtained from the SIS. These data bases start from 1938. Additionally, the export and import price indexes are calculated both by the CB and SIS even though they are available just for the period 1970-1995. Therefore it is impossible to construct real exchange rate series by using these indexes before 1970. The price indexes for the foreign countries were taken from the International Finance Statistics Yearbooks published by the International Monetary Fund during the period 1936-1995.

Here it should be noticed that even though we can obtain exchange rate and price deflator series from the IFS yearbooks for the period 1936-1995, we will exclude the period of 1936-1949 in our calculations due to data inconsistency and insufficiency. So our starting year will be 1949 in order to

cover as long a period as possible although we have also some problems between the years 1949-1995.

We mentioned above that we also calculated the index form of the series with respect to a base year. For this purpose 1987 was chosen as the base year since all indicators suggested that it was a stable year as far as international trade flows were concerned. The rate of change in export and imports are 36.7 % and 27.5 % respectively. The ratio of exports to imports is 72 %. The foreign trade deficit is approximately 3968 million $US. The current account balance is rather low compared to other years. Finally, price movements are rather stable for the year 1987.

In deciding which countries to include as trading partners when calculating the weights used in obtaining the REER's, we considered their shares in Turkey's overall trade for the period in question. This information is given in Table 1. We note that the first ten countries in that table amount for 65.70 % of Turkey's trade. However, when we take into account the objective of constructing as long and complete series as possible, we find that Italy needs to be removed from the first five and be replaced by the Netherlands. If we consider expanding the number of countries, then we note, with the same objective in mind that this set may be increased by four countries to make N = 9 and these four are Japan, Austria, Spain and Greece. We attempted a final expansion by increasing N to 14 and added Italy, Switzerland, Iran, Saudi Arabia and Egypt. Thus the countries designated to be the first five (Germany, USA, UK, France and Netherlands) amount for 46.95 % of Turkey's trade while adding the four countries to raise N to 9 increases this share to 52.47 % and raising N to 14 raises this share to 68.62 %.

Finally, some notation needs to be introduced before we embark on the analysis of the results. We shall denote bilateral RER's by BRER and the effective rates by REER. These series will further be distinguished by price indexes used in their calculations. Thus, we will have

$BRER_1$ and $REER_1$: WPI's used for *both* Turkey and foreign trading partner(s).

$BRER_2$ and $REER_2$: CPI's used for *both* Turkey and foreign trading partner(s).

$BRER_3$ and $REER_3$: GDPD's used for *both* Turkey and foreign trading partner(s).

$BRER_4$ and $REER_4$: WPI's used for Turkey and CPI's for foreign partner(s).

$BRER_5$ and CPI's used for Turkey and WPI's for foreign partner(s).

$BRER_6$ and $REER_6$: GDPD's used for Turkey and WPI's for foreign partner(s).

b. Empirical Results: As we stated in the Introduction, this study is one of measurement. Thus the primary focus of the empirical results will be on the relative performance of the various measures of the real effective exchange rate (REER). These measures may be classified according to (a) whether end-of-year (*ae*) or annual averages (*rf*) of the nominal exchange rates have been used, (b) the number of trading partners used in calculating the weights, (c) which price indexes have been utilized, (d) the formula on which the calculations are based. All results reflecting these classifications are based on 59 tables given in Erlat and Arslaner (1997: 33-99). We shall, however, conduct our analysis using selected plots of these results. The figures containing these plots are given at the end of the paper.

Let us consider the classification in (a)

TABLE 1: MAJOR TRADING PARTNER COUNTRIES' TRADE SHARES IN TURKEY'S TOTAL TRADE (1949-95 Averages)

	Volume of trade share in Turkey's total volume of trade wit			Export share in Turkey's total export wix		Import share in Turkey's total import wim	
Order		Related	%		%		%
1	Germany	OECD, EU	17.41	Germany	19.05	Germany	16.45
2	USA	OECD	14.10	USA	11.93	USA	15.55
3	UK	OECD, EU	7.79	Italy	7.41	UK	8.47
4	Italy	OECD, EU	7.24	UK	6.73	Italy	7.16
5	France	OECD, EU	5.12	France	5.27	France	4.98
Total of five			51.66		50.40		52.61
6	Switzerland	OECD, EFTA	3.33	Switzerland	3.93	Switzerland	2.95
7	Russia	BSEC, NIS	3.02	Russia	3.22	Russia	2.85
8	Iran	OIC, ECO	2.83	Iran	2.85	Iran	2.78
9	Netherlands	OECD, EU	2.53	Netherlands	2.60	Japan	2.76
10	BeLux.	OECD, EU	2.33	Iraq	2.57	Saudi Arabia	2.57
Total of ten			65.70		65.56		66.53
11	Japan	OECD	2.22	BeLux.	2.54	Netherlands	2.52
12	Saudi Arabia	OIC	2.18	Austria	1.65	BeLux.	2.22
13	Austria	OECD, EFTA	1.58	Saudi Arabia	1.55	Czech Republic	1.71
14	Spain	OECD, EU	1.08	Poland	1.39	Austria	1.53
15	Romania	BSEC	1.04	Japan	1.26	Sweden	1.35
16	Greece	OECD, EU, BSEC	0.64	Spain	1.20	Romania	1.13
17	Syria	OIC	0.59	Syria	1.19	Spain	1.00
18	Bulgaria	BSEC	0.58	Libya	1.16	Brazil	0.74
19	Egypt	OIC	0.57	Greece	1.12	Bulgaria	0.60
20	China		0.46	Egypt	1.07	South Korea	0.47
21	Others		23.36	Romania	0.87	Greece	0.30
22				China	0.65	China	0.28
23				Bulgaria	0.54	Egypt	0.23
24				Others	18.26	Syria	0.21
25						Others	19.17
General Total			100.00		100.00		100.00

Note: If the data are not available in any year, that year was not included in the calculation of 1949-95 averages.

Abbreviations

OECD : Organization for Economic Co-operation and Development
EU : European Union
BSEC : Organization of Blacksea Economic Co-operation
EFTA : European Free Trade Association
ECO : Organization for Economic Co-operation
NIS : New Independent States
OIC : Organization of Islamic Conference
BeLux. : Belgium and Luxembourg

first. The differences between the *ae* and *rf* versions of an REER as calculated by any equation and using any price index combination is very similar. Hence, by way of illustration, we provide, in Figure 1(a) the plots of the *ae* and *rf* based REERs using equation (13) with the WPI used as the price index used for both foreign and domestic prices, and in Figure 1(b) their annual percentage changes. We immediately note two points: (a) The *ae* plots reflect the major devaluations in 1958, 1970, 1980 and 1994 on the dates they had taken place while the *rf* plots show the full force of these devaluations a year later. (b) With the termination of the fixed exchange rate period

in 1980 we note that *ae* figures are consistently larger than the *rf* figures and that percentage changes are sharper and overstated. Of course, the reason for both observations is the fact that the *rf* values represent a smoothed value of the exchange rates for each year and thus provide us with more conservative measures of real appreciations and depreciations. Hence, in what follows, we shall use the *rf* results only and, by doing so, we shall also be able to compare our results with those of the Turkish Central Bank and Togan.

Turning to the results according to classification (b), we note that we have three sets of results depending on whether the number of trading partners N = 5, 9 or 14. The most complete results for the period under consideration (1949-1995) are obtained for N = 5 and the least complete for N = 14. In fact the longest series for N = 14 are obtained for the 1963-1995 period and only when the CPI is used. Thus, in order to assess the extent to which the various measures calculated using the four equations in question are sensitive to the number of countries, we used the REER's based on using the CPI for both foreign and domestic prices. However, we first transformed the series in question into index form by dividing each by its arithmetic average and then multiplying by a 100. We thereby eliminated the effect of a given base year, 1987 in the present case, which works through the price indexes.

The plots in question are given in Figures 2(a) to 2(d). We first note that the information provided by the measures obtained from equations (13) and (15a) for all N (Figures 2(a) and (c) respectively) the same for the fixed exchange rate period and reflect the fact that REER appreciates after major devaluations due to the disparity in the rates of inflation between Turkey and its trading partners.

After 1980 we find that the REER's for N = 5 and 9 follow quite similar paths while the REER for N = 14 shows an appreciation in 1983 before continuing on its path of depreciation. After 1988, when the exchange rate is further liberalized, we find that there is not much to distinguish between the series with respect to the size of N.

The same can not be said, however, for the results obtained from equations (14) and (15b) [Figures 2(b) and (d), respectively]. These equations appear to be sensitive to changes in N, in particular, when N goes from 5 to 9. This is the case for both the pre and post fixed exchange rate periods. In the pre-1980 period we note that the behaviour of the REER's for N = 9 and 14 are much more volatile, particularly for the 1973-1980 subperiod. This difference in the behaviour of the three series appears to continue until 1988 after which it is considerably reduced.

In discussing the results for the remaining two classifications we shall only consider the REER's based on N = 5. We *first* consider the classification in (c) based on the price indexes utilized. We shall denote the real effective exchange rate measures obtained by using the *same* price indexes for both foreign and domestic prices by $REER_1$ (WPI), $REER_2$ (CPI) and $REER_3$ (GDPD). These represent the PPP based measures and their plots for all four equations are given in Figure 3, while Figure 4 contains the plots of their annual percentage changes. What we note, in particular from Figure 4, is that GDPD-based series overstate the depreciations and appreciations in the real

exchange rate while the evidence provided by the CPI-based series are milder. The WPI-based results appear to be the least volatile. Again the pattern given by equations (13) and (15a) [Figures 4(a) and (c)] and equations (14) and (15b) [Figures 4(b) and (d)] are similar.

Turning to the measures based on *different* indexes being used for foreign and domestic prices, we consider essentially two cases. The measure we denote by $REER_4$ uses the CPI to measure the foreign price index and the WPI to measure the domestic price and aims to measure the competitiveness of Turkish tradables vis-a-vis foreign non-tradables [see Öztürk (1993)]. The measures we denote by $REER_5$ and $REER_6$ use the WPI to represent foreign prices and the CPI and GDPD, respectively, to represent domestic prices. The objective here is to assess the competitiveness of Turkish non-tradables vis-a-vis foreign tradables. Their plots in levels are given in Figure 5 and in rates of change in Figure 6.

The evidence from Figure 6, in particular, points to the fact that $REER_4$ may reflect a depreciation while neither $REER_5$ or $REER_6$ do. This may be noted during the 1975-1976 and 1986-1987 periods. In other words, during these periods we may state that the competitiveness of Turkish tradables have increased vis-a-vis foreign non-tradables while the competitiveness of Turkish non-tradables have reduced vis-a-vis foreign tradables. In all other cases, however the competitiveness of Turkish tradables and non-tradables appear to move in the same direction. It is also interesting to note that $REER_5$ and $REER_6$ may indicate conflicting results. For example, in Figures 6(a), (b) and (c), while $REER_6$ indicates a depreciation in 1991-1992, $REER_5$ does not.

From our discussion so far, there are sufficient points regarding the evidence from the final classification regarding the use of different equations to reach some calculations: (a) Equations (13) and (15a), and (14) and (15b) give very similar results. This is not very surprising as each pair uses the same weighting scheme. (b) The results from the first pair of equations are not sensitive to changes in N while the second pair is.

In addition to these two points, it would be instructive to check if these equations give conflicting results regarding the appreciation or depreciation of the real exchange rate. For this purpose, we plotted the percentage changes in each REER measure obtained from only equations (13) and (14) on the same graph. These are presented in Figure 7. We first note that there is no consistent disparity between the results given by each equation. When there are conflicts, they appear to occur mainly in the pre-1980 period [e.g. 1963-1964 and 1973] with equation (13) indicating appreciation while equation (14) indicates depreciation [e.g., Figure 7(a) for the period 1963-1964].

Having completed our discussion with respect to the four classifications given above, we need to deal with two additional questions: (a) How do our results compare with those of the Central Bank and of Togan? (b) How different are the results obtained from the REER's and the bilateral real exchange rates (BRER)?

With respect to question (a), we first note that the Central Bank measure, which we shall call REERCB, covers the period 1970-1995, and is based on the WPI, while

Togan's measure (REERT) covers the period 1961-1990 and is based on the GDPD. Both measures are variants of equation (15a) with REERCB using only $US and DM exchange rates and combining them and their associated price indexes using arbitrary fixed weights, while REERT uses the same arbitrary weights to combine the same two exchange rates but use variable weights to obtain foreign prices, the components of which are aggregated price indexes for OECD and Islamic countries. Thus, in our comparisons, we plotted the annual percentage changes in REERCB together with $REER_1$ from equations (13) and (14), and the annual percentage changes in REERT together with $REER_3$'s again from the same two equations. The period in both plots is 1971-1990 to facilitate comparisons. These are given in Figures 8(a) and (b).

We first note that percentage changes in the REERT usually lie above those of the $REER_3$ and this, in certain instances, lead to conflicting results as in the 1975-1978 period where REERT indicates depreciation for the whole period while there are certainly subperiods of appreciation indicated by both our measures and by REERCB. Similarly, both our measures indicate an appreciation in 1985 while REERT does not. The reverse, however, is true for REERCB and our measures for the same period. In general, it is safe to say, however, that conflicting results are observed much less for the post-1980 than for the pre-1980 periods.

Finally, turning to question (b), we sought to provide answers within the context of a representative case. Similar analysis can be made for other cases; the necessary information can be found in the Appendix of Erlat and Arslaner (1997). Hence, we only consider the $REER_1$ as calculated by (13) and (14) and compared their annual percentage changes with those of the $BRER_1$'s for the USA and Germany. These are given in Figure 9(a) to 9(d). We note that the $BRER_1$ for the USA shows the least amount discrepancy with $REER_1$ obtained from equation (13). There is only one period in which there is a conflict and that is the 1986-1989 period where $BRER_1$ implies an appreciation while $REER_1$ does not. The relationship between $REER_1$ based on equation (14) and the US $BRER_1$ is much less smooth and, in addition to the 1986-1989 period, there are conflicts in 1963 and 1975-1976.

The behaviour of the Germany $BRER_1$ is even less smooth, particularly in the post-1980 period but we no longer have the conflict for the 1986-89 period we mentioned above. This is replaced by an overstatement of the depreciation in that period by the Germany $BRER_1$. This overstatement occurs in other instances and, in fact, causes a conflict in 1981. We may conclude, in general, that as a REER is compared with BRER's which enter its composition with less weight, the more will there be discrepancies between their results. This is borne out by comparisons carried out for the UK, France and Netherlands but not reported herein.

4. CONCLUSIONS

This study has focused on the measurement of the real exchange rate. This endeavour involved both bilateral and aggregated (or effective) real exchange rates. There were aspects of these measurements which were common to both bilateral and aggregate rates. These aspects were the

choice between *ae* and *rf* exchange rates and the choice of which price indexes to use. Then there were the aspects particular to the aggregate rates; namely, the number of trading partners to use in calculating the weights used in obtaining the aggregated series.

The choice of price indexes led to the calculation of six series for both *ae* and *rf* exchange rates, and this set of twelve series were repeated for the fourteen bilateral series, for the four equations used in aggregation and for the three choices of N. This constituted a great deal of evidence on the real exchange rates. Our analysis of this evidence led us to the following conclusions:

1. In comparing the *ae* based results with the *rf* based ones, we found that even though *ae*-series reflected the actual dates of major devaluations more accurately, the *rf*-series gave us a more conservative picture of real exchange rate behaviour which may be preferable in practice by providing us with a better safety margin against possible errors. Thus, the remaining conclusions are based on the *rf* series.

2. Our conclusions on the choice of price indexes depend upon whether the *same* (the PPP approach) or *different* (the tradables - non-tradables approach) has been utilized. We found that, in the first case, the GDPD-based series appeared to overstate the depreciations and appreciations in the real exchange rate while the WPI-based results were the least volatile. In the second case, we found that all three series indicated changes in the competitiveness of Turkish tradables and non-tradables to be in the same direction but that there may be periods of conflict.

3. With regard to the choice of N, we found that the equation pairs (13)+(15a) were not sensitive to increase in the number of trading partners while the (14)+(15b) pair was. This sensitivity was observed when going from N = 5 to N = 9 but not when we change N from 9 to 14.

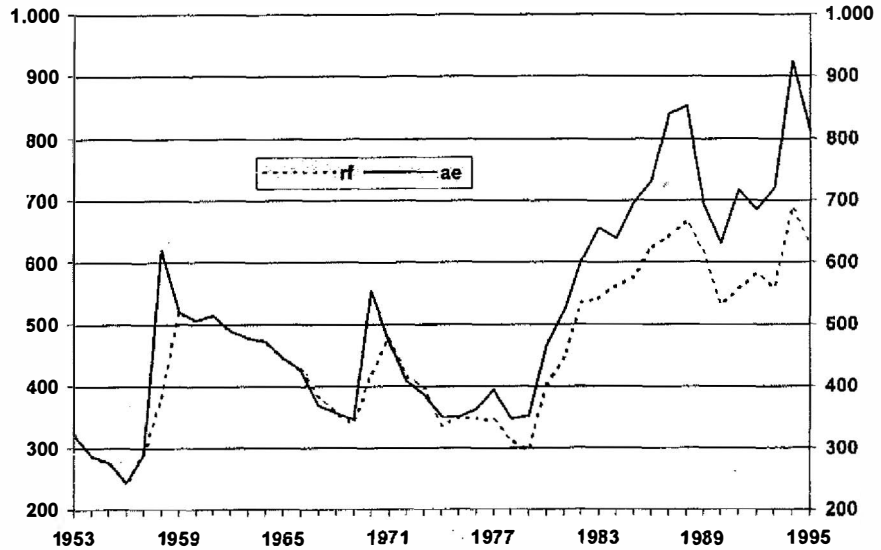
4. Finally, regarding the choice of aggregating formula to use, we found that equations (13) and (15a) formed a pair in the similarity of their results while equations (14) and (15b) formed another pair. Thus, the choice between each equation in a given pair would be the assessment of the investigator as to which is easier to compute. When the results from equation (13) and (14) were compared, no consistent disparity between their results were obtained, and conflicts were observed in very few cases.

We also compared the bilateral and effective rates for selected series, and found that the amount of discrepancies increase as the weight of the component BRER decreases, implying that if an aggregated series is not available to reflect the behaviour of the real exchange rate for the country as a whole, or, in other words, if such a series is not available to assess a country's competitiveness in world trade, then the nearest proxy may be the BRER of the trading partner with the highest trade share.

In concluding, we would like to point out that probably the best way to assess the performance of these series is to use them in econometric models of imports and exports (a la Marquez (1992)) but this lies beyond the scope of this study but may well be the subject of another research.

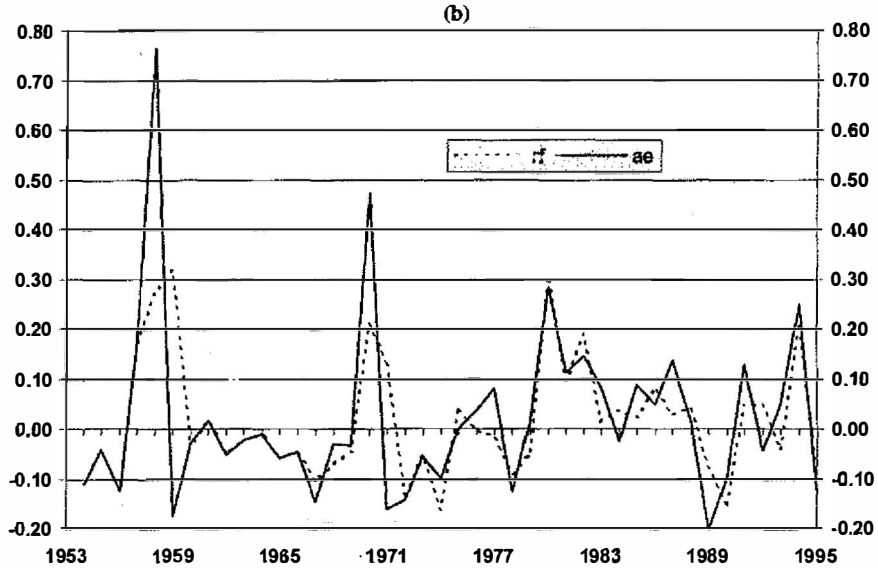
Figure 1. REER using (ae) and (rf) based on equation (13) and the WPI and its percentage annual change, t=1953-95

(a)



Logarithmic first differences

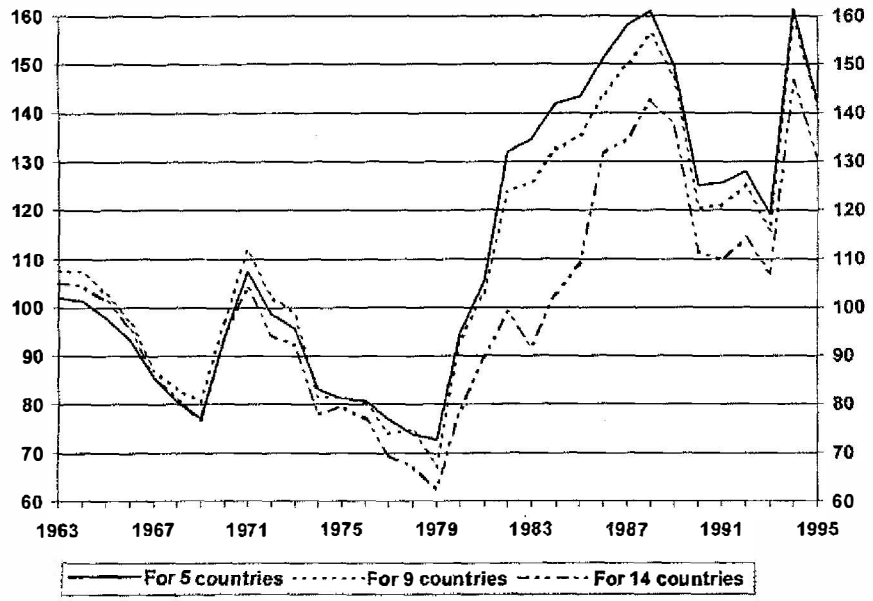
(b)



Source: Erlat and Arslaner (1997, Table 22)

Figure 2. REER indexes based on all four equations and the CPI for N=5, 9 and 14, t=1963-1995 [Average=100]

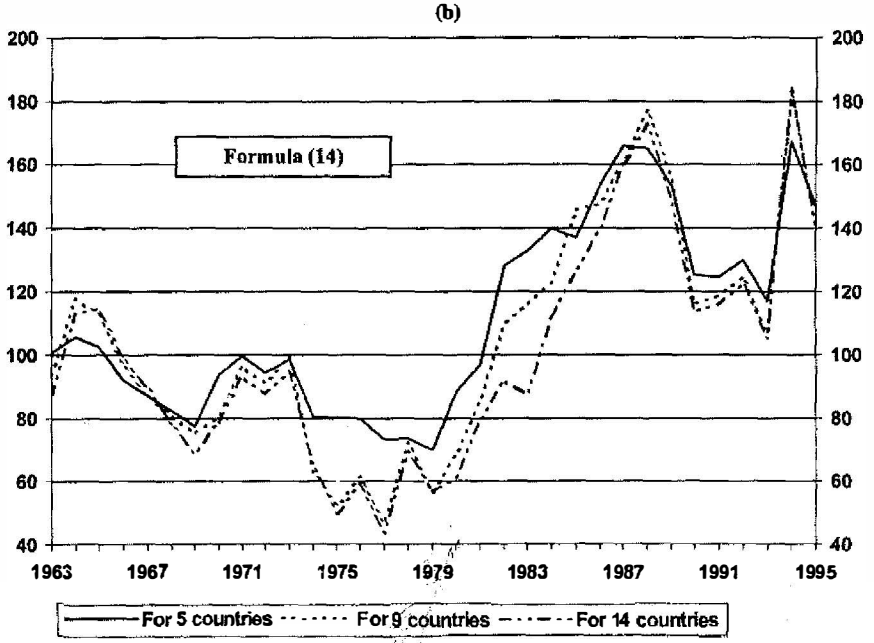
(a)



Source: Erlat and Arslaner (1997, Tables 22, 23 & 24)

Figure 2. REER indexes based on all four equations and the CPI for N=5, 9 and 14, t=1963-1995 [Average=100] (continued)

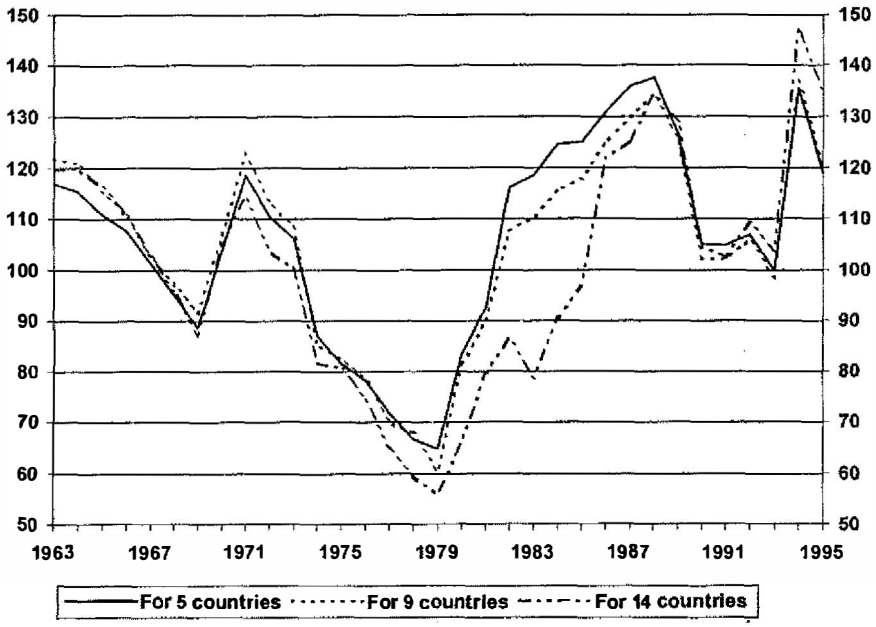
(b)



Source: Erlat and Arslaner (1997, Tables 25, 26 & 27)

Figure 2. REER indexes based on all four equations and the CPI for N=5, 9 and 14, t=1963-1995 [Average=100] (continued)

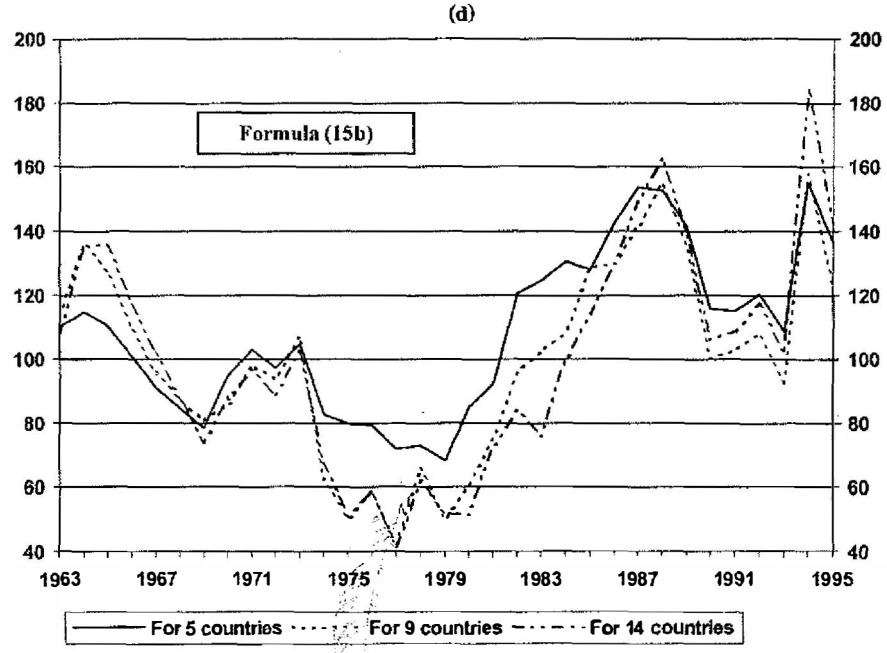
(c)



Source: Erlat and Arslaner (1997, Tables 28, 29 & 30)

Figure 2. REER indexes based on all four equations and the CPI for N=5, 9 and 14, t=1963-1995 [Average=100] (continued)

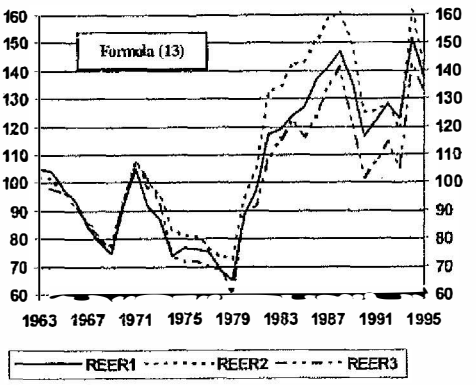
(d)



Sources: Erlat and Arslaner (1997, Tables 31, 32 & 33)

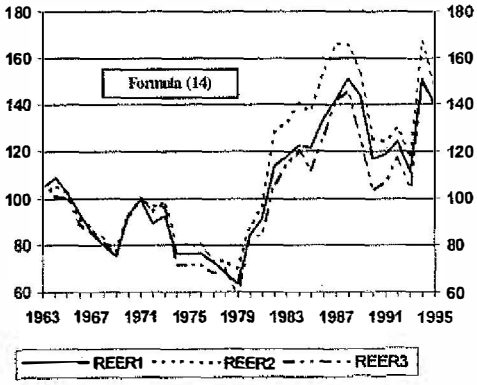
Figure 3. $REER_1$, $REER_2$ and $REER_3$ indexes for N=5 and obtained from all four equations, t=1963-1995 [Average=100]

(a)



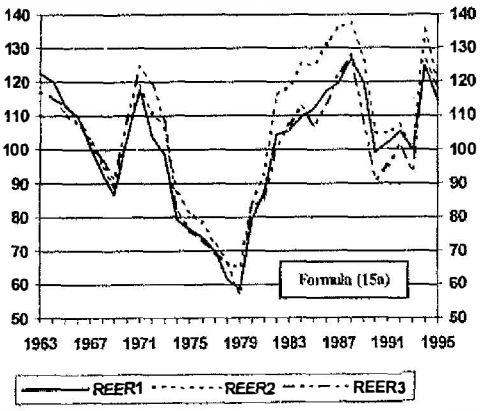
Source: Erlat and Arslaner (1997, Table 22)

(b)



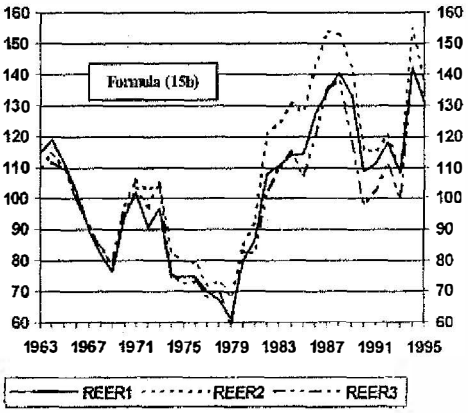
Source: Erlat and Arslaner (1997,Table 25)

(c)



Source: Erlat and Arslaner (1997,Table 28)

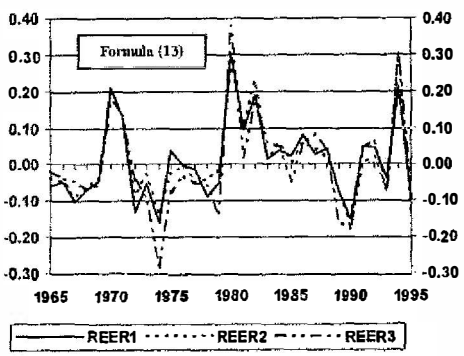
(d)



Source: Erlat and Arslaner (1997,Table 31)

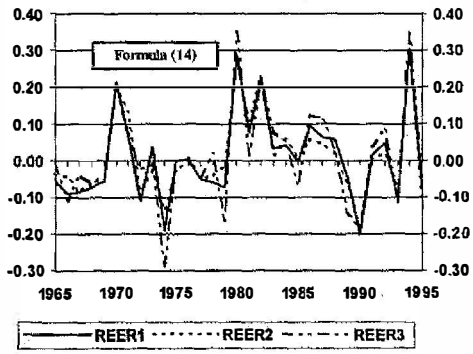
Figure 4. Annual pecentage changes in $REER_1$, $REER_2$ and $REER_3$ for N=5, t=1965-1995
[Logarithmic first differences]]

(a)



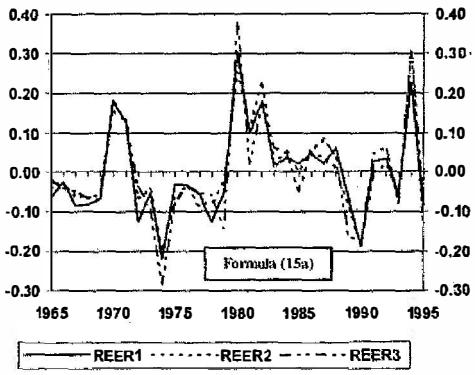
Source: Erlat and Arslaner (1997,Table 22)

(b)



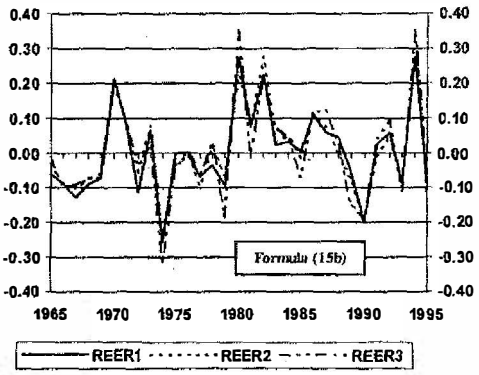
Source: Erlat and Arslaner (1997,Table 25)

(c)



Source: Erlat and Arslaner (1997,Table 28)

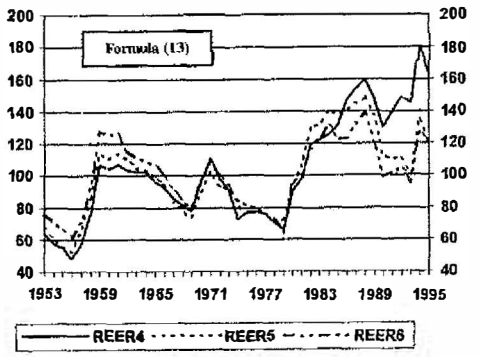
(d)



Source: Erlat and Arslaner (1997,Table 31)

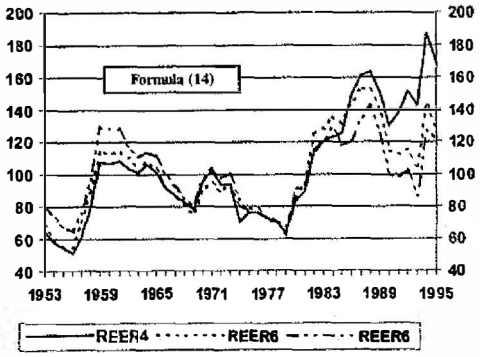
Figure 5. $REER_4$, $REER_5$ and $REER_6$ indexes for N=5 and obtained from all four equations, t=1953-1995 [Average=100]

(a)



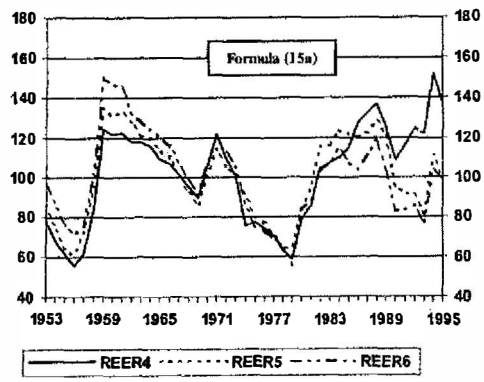
Source: Erlat and Arslaner (1997, Table 22)

(b)



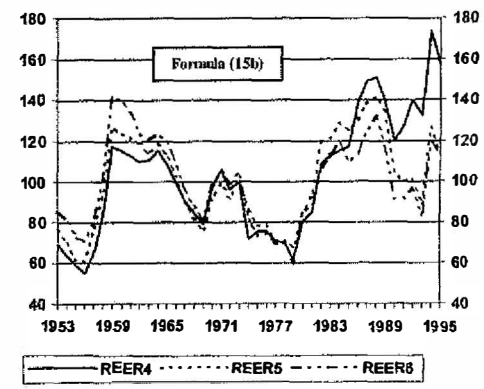
Source: Erlat and Arslaner (1997, Table 25)

(c)



Source: Erlat and Arslaner (1997, Tabla 28)

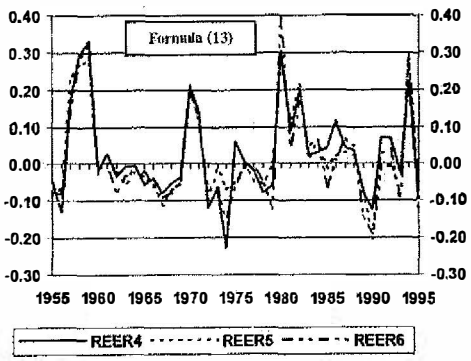
(d)



Source: Erlat and Arslaner (1997, Table 31)

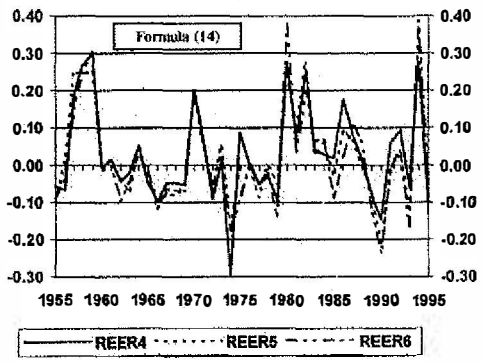
Figure 6. Annual pecentage changes in $REER_4$, $REER_5$ and $REER_6$ for N=5, t=1955-1995 [Logarithmic first differences]]

(a)



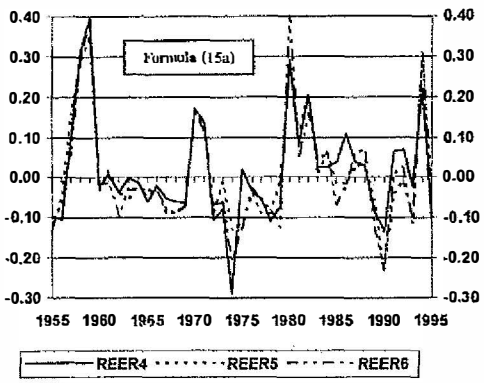
Source: Erlat and Arslaner (1997,Table 22)

(b)



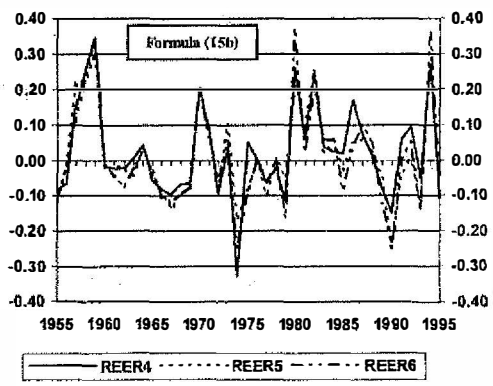
Source: Erlat and Arslaner (1997,Table 25)

(c)



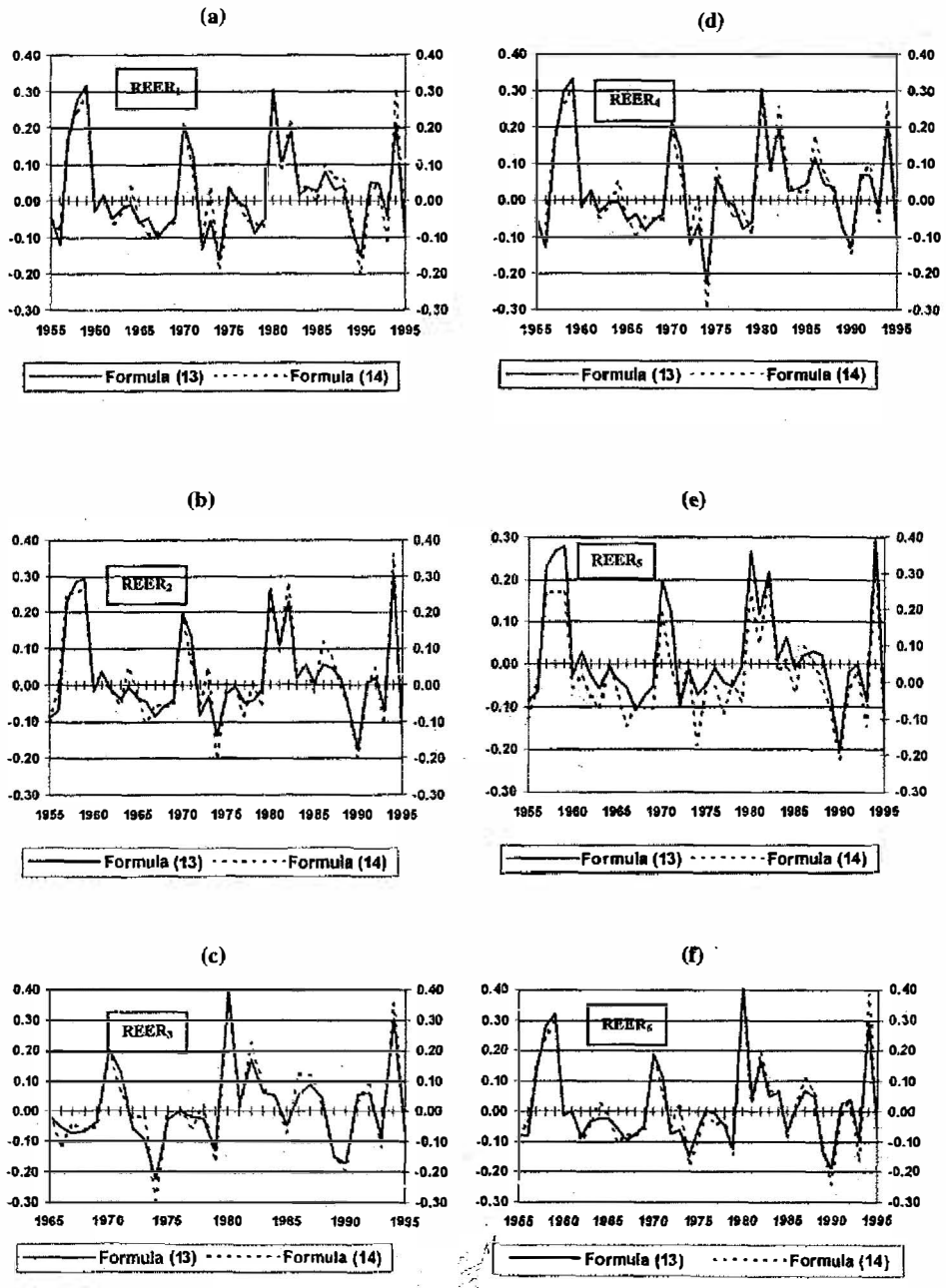
Source: Erlat and Arslaner (1997,Table 28)

(d)



Source: Erlat and Arslaner (1997,Table 31)

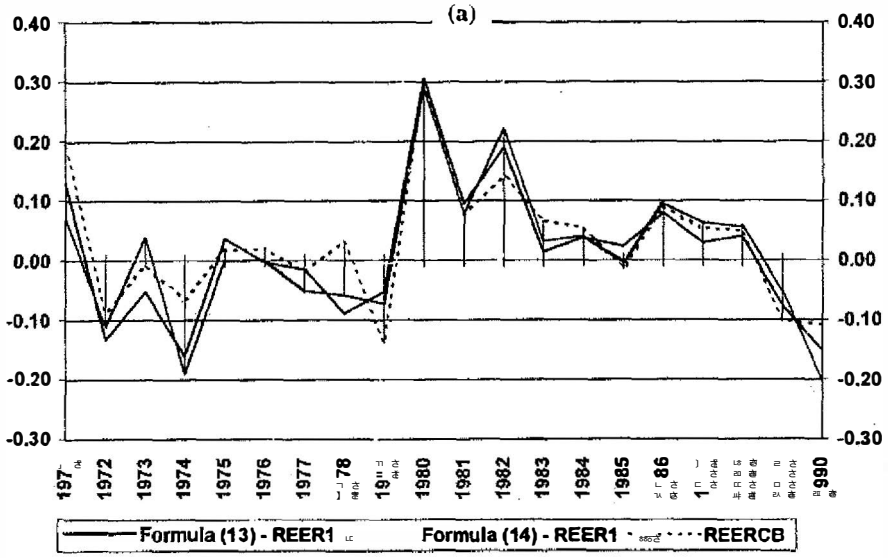
Figure 7. Annual percentage changes in $REER_1$ - $REER_6$ for N=5, t=1953-1995
[Logarithmic first differences]



Source: Erlat and Arslaner (1997, Tables 22, 25, 28 & 31)

Figure 8. Annual percentage changes in REERCB vs. $REER_1$ from equations (13) and (14), and annual percentage changes in REERT vs. $REER_3$ from equations (13) and (14), t=1971-1990
[Logarithmic first differences]

(a)



(b)

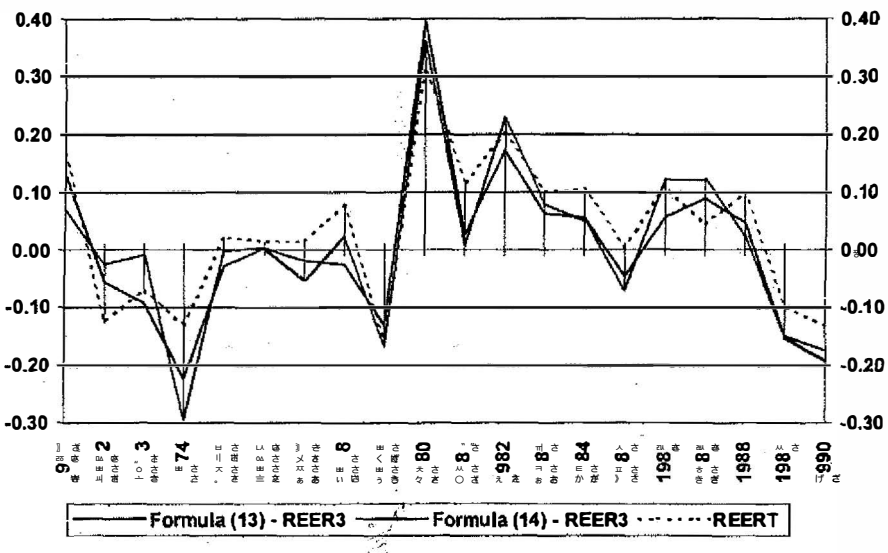
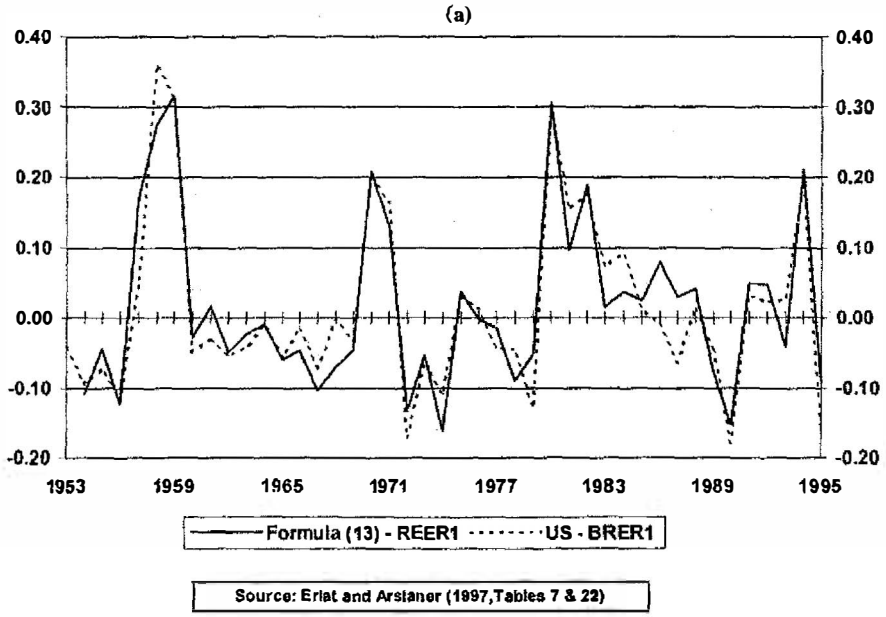


Figure 9. Annual percentage changes in $BRER_1$'s for the US vs. $REER_t$ from equation (13) for N=5, t=1953-1995 [Logarithmic first differences]

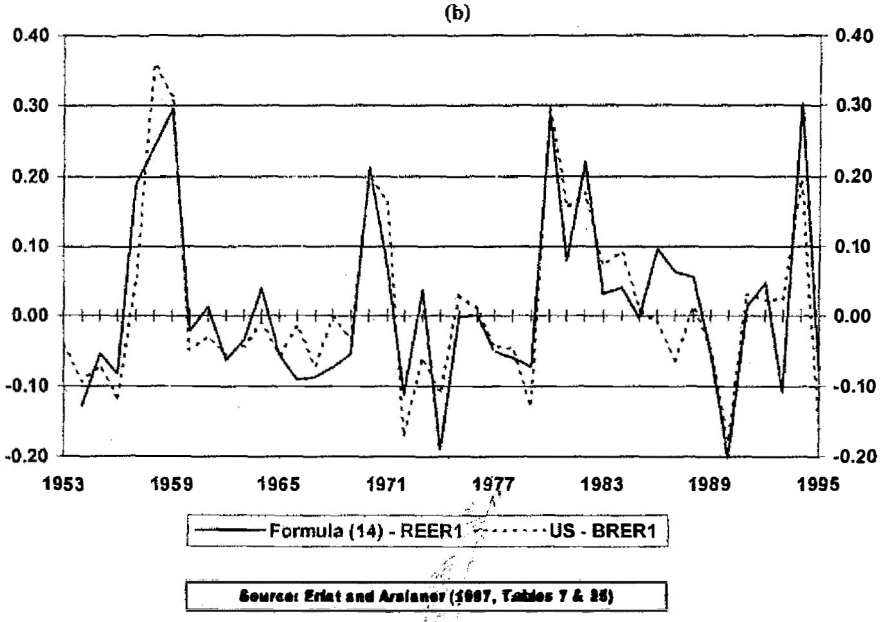
(a)



Source: Erlat and Arslaner (1997,Tables 7 & 22)

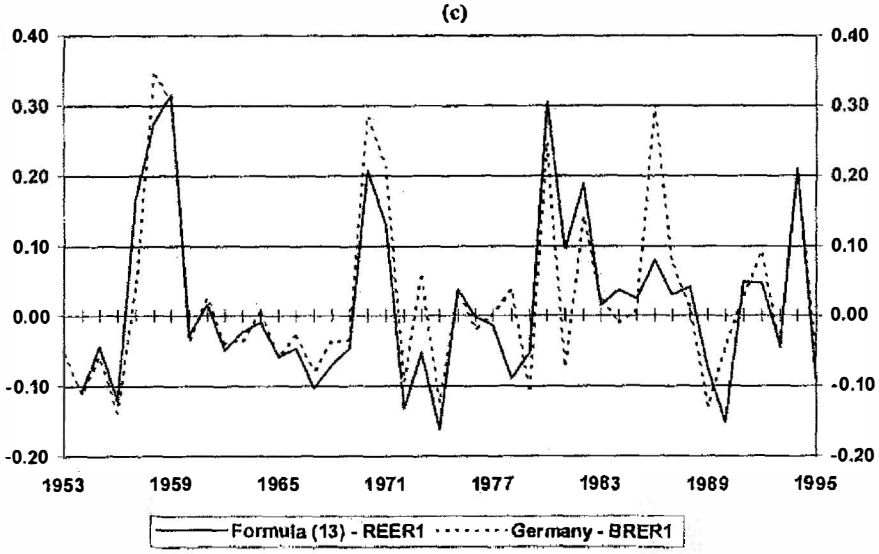
Figure 9. Annual percentage changes in $BRER_1$'s for the US vs. $REER_t$ from equation (14) for N=5, t=1953-1995 [Logarithmic first differences]

(b)



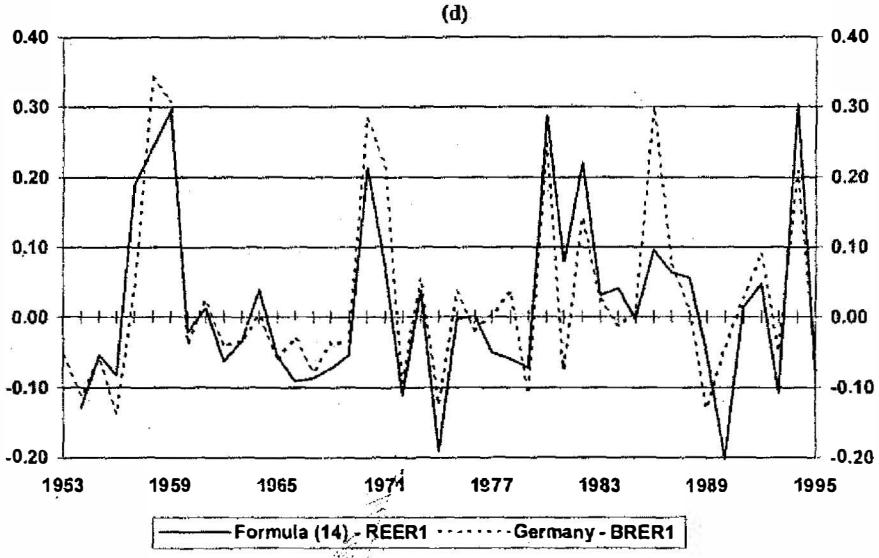
Source: Erlat and Arslaner (1997, Tables 7 & 25)

Figure 9. Annual percentage changes in $BRER_1$'s for Germany vs. $REER_1$ from equation (13) for N=5, t=1953-1995 [Logaritmic first differences] (c)



Source: Erlat and Arslaner (1997, Tables 8 & 22)

Figure 9. Annual percentage changes in $BRER_1$'s for Germany vs. $REER_1$ from equation (14) for N=5, t=1953-1995 [Logarithmic first differences] (d)



Source: Erlat and Arslaner (1997, Tables 8 & 25)

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