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Keskusteluaiheita
Discussion papers

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REAL EXCHANGE RATES AS A TIME SERIES PROCESS - A CASE OF FINLAND*

No 248 30.10.1987

* This discussion paper was originally published in a slightly different form in May 1987 as Kiel Advanced Studies Working Paper N:o 92 by the Kiel Institute of World Economics

ISSN 0781-6847

SUNI, Paavo, REAL EXCHANGE RATES AS A TIME SERIES PROCESS - A CASE OF FINLAND. Helsinki : ETLA, Elinkeinoelämän Tutkimuslaitos, The Research Institute of the Finnish Economy, 1987. 29 s. (Keskusteluaiheita, Discussion Papers, ISSN 0781-6847 ; 248).

ABSTRACT: This paper describes briefly the behaviour of some real exchange rates defined as relative prices in the common currency with the aid of graphs and tables. The hypotheses for the behaviour of real exchange rates (RE) are derived from the balance of payments theory, from the conventional purchasing power parity (PPP) theory and from the formulations, which take into account some structural changes in the economy.

By testing the derived hypotheses we try to resolve whether real exchange rates follow any deterministic process or whether RE follow a non-stationary random walk process. The random walk behaviour has often been found in many other studies.

Our results presently give support to the view that real exchange rates in Finland follow a deterministic process predicted by the PPP theory if the terms of trade effect is taken into account. The results for the productivity effect in shifting the equilibrium level of RE were mixed. On the other hand, the terms of trade effect was surprisingly strong. The interpretation of this result is based on the fact that Finland is a price taker in the world markets and so changes in RE due to terms of trade changes reflect partly different weights in the price indices.

KEY WORDS: Real exchange rates, purchasing power parity, structural changes

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1. Introduction

The interpretation of real exchange rates is mainly based on purchasing power parity (PPP) theory and real exchange rates are usually thought to reflect the deviations of PPP. It is shown that PPP does not hold in the short run and sometimes it is argued whether it can be a useful concept at all.

We try to study whether any version of PPP can hold in the longer run, i.e. does real exchange rate follow a time series process predicted by PPP theory. In section two we discuss theoretical aspects of this issue. In section three we describe the behaviour of real exchange rates with graphs and tables. In section four we try to study econometrically e.g. whether real exchange rate follow deterministic time series process derived from PPP theory or whether it is only an unstationary process without any limits. Finally, we present the conclusions.

2. Theoretical Considerations

Real exchange rates describe in principle deviations from purchasing power parity (PPP). So-called absolute version of PPP or law of one price means that

(2.1) $P = E \cdot P^*$ E = exchange rate

P,P* = domestic and foreign prices respectively

This version of PPP can hold only under very strict conditions (see e.g. McKinnon 1980, Jonassen-Suni 1986). If these conditions, e.g. transport costs, duties, etc., stay constant over time then changes in exchange rate should equal with the difference between changes of domestic and foreign prices. This is called relative version of PPP. It is shown in many studies that neither of these versions of PPP is valid in short run either under fixed or floating exchange rate regimes (see e.g. Suni 1984, Junge 1985). However, it is still possible that PPP is a useful long run relationship between exchange rate and relative prices, excpecially if real shocks are taken into account.

However, if we use indices in measurement of either version of PPP we have usually a problem of different weights in indices of domestic and foreign country. In fact we compare purchasing power of different moneys with different measures.

Real exchange rate (RE) is usually calculated as nominal exchange rate index deflated by indicators of relative prices. As a formula RE can be expressed as (2.2).

$$(2.2)\quad RE = \frac{E.P*}{P}$$

E = exchange rate index

P,P* = domestic and foreign price indices respectively

Prices are usually price indices with a certain base year. Thus RER shows how the actual exchange deviate from PPP relative to the base year. It can, in addition, be measured also bilaterally, i.e. between tow individual countries or effectively, i.e. between an individual country and a group of countries. There are of course numerous difficulties in measurement, i.e. the selection of a price index, base year, etc. (see Jonassen-Suni 1986). In any case, if PPP holds all the time, then real exchange rate should equal unity. However, when PPP holds in period t while it does not hold in base period, then the equilibrium value of PPP differs from unity (or one hundred).

There are many interpretations of relative version of PPP. According to most interpretations RE is constant and PPP holds at least in the long run, if shocks facing the economy are monetary.

So-called real shocks, e.g. changes in transport costs, customs, productivity, terms of trade, etc. may change the equilibrium level of real exchange rate. The equilibrium rate of RE changes, if the real shocks change relative prices of the home country relative to the foreign country.

Some authors argue that real exchange rate are constant only on expected level and unexpected monetary shocks and real shocks cause the deviations from PPP. In this case the real exchange rate follows unstationary process, e.g. random walk. The unstationary property of the real exchange rates follow from shocks, which happen only occasionally. If the process of shocks is unstationary, then if PPP holds, real exchange rates adjusted for shocks is stable.

In the following the effects of changes in productivity and terms of trade on RE are examined with the dependent economy model (Scandinavian and Australian models, see Dornbusch, 1980, pp. 93 110). We make a small country assumption, i.e. exports and imports prices are given for a home country in international markets. The home country is a price taker for exportables and importables.

In a dependent economy model the economy is divided (at least) into tradable and non-tradable sectors. Non-tradables exist because of transport costs. If we want to study also the effects of terms of trade we can introduce the exportables and the importables. In theory terms of trade is often assumed to be given and fixed, but in practice it may fluctuate a lot.

Exportables, importables and non-tradable goods are assumed to be composite goods, i.e. there are no relative price changes inside these aggregates. But now we can allow changes in relative prices between non-tradables (P_N) and tradables (P_T) and between exportables (P_X) and importables (P_I).

First, we consider effects of productivity changes when terms of trade is assumed to be fixed. If productivity in the tradables goods sector increase it leads to increase in production of tradables and to decrease in production of non-tradables. To restore the external and internal balance the relative price of non-tradables must increase. This may happen either by an appreciation of a currency or by an increase in the nominal price of non-tradables, if exchange rate is fixed. The equilibrium real exchange rate has decreased, if we can consider foreign prices as fixed. Adjustment has happened either through a decrease of tradables goods price due to appreciation or through an increase in price of non-tradables.

More generally, if the equilibrium relative price between tradables and non-tradables changes, e.g. due to productivity changes in the home country and/or in the foreign country, the equilibrium real exchange rate changes. As a formula

$$(2.3)\ RE = e.P^*/P = e.P_N{}^{*a}P_T{}^{*1-a*}/(P_N{}^{a}P_T{}^{1-a}) =$$

$$e.P_T{}^*/P_T \cdot (P_N{}^*/P_T{}^*)^{a*}/(P_N/P_T)^{a} =$$

$$(P_N{}^*/P_T{}^*)^{a*}/(P_N/P_T)^{a}$$

$$\text{If } P_T = e.P_T{}^*$$

a, a* = weights of the domestic and foreign country

Thus, RE is a function of relative prices in both countries. Changes in relative prices can be explained, e.g. by changes in relative productivities.

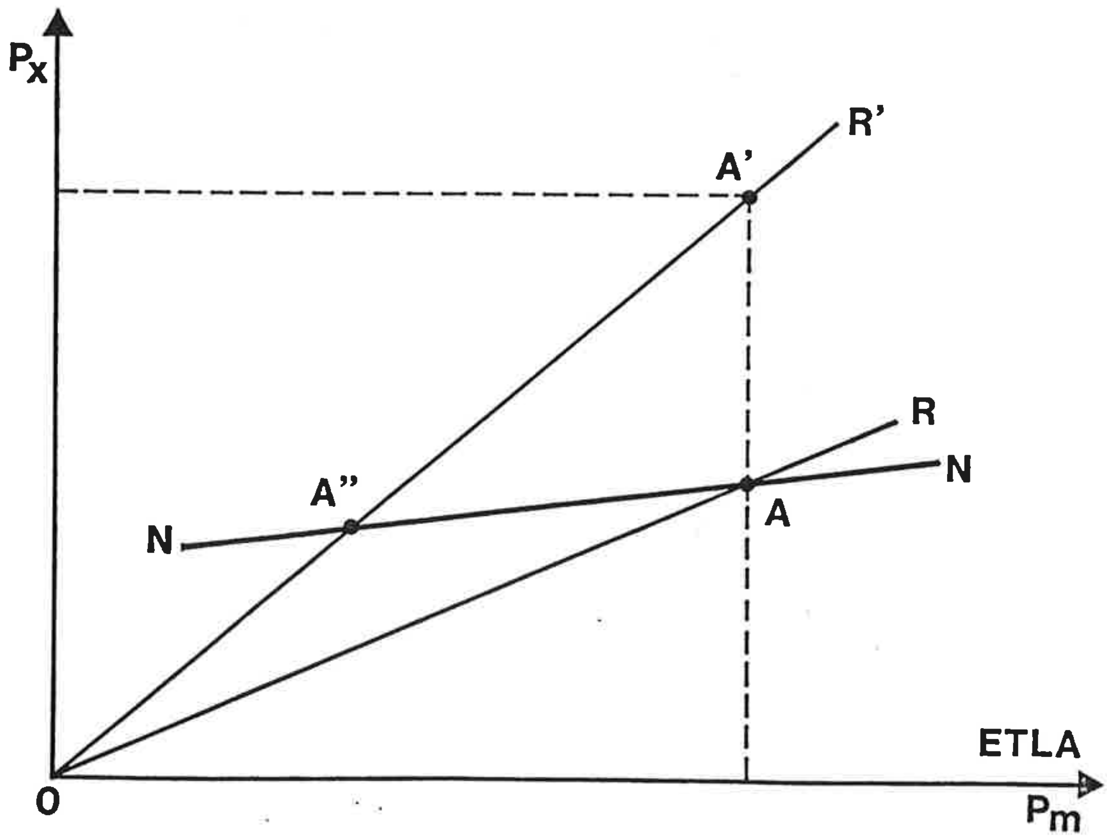
When we relax the assumption that traded goods aggregate is a composite good we can get also terms of trade effects. (See e.g. Dornbusch, 1980, pp. 108-110). On the supply side terms of trade induce substitution effects due changes in prices. On the demand side we get an additional income effect.

In figure 1. we study effects of changes in terms of trade. NN is a market equilibrium curve for non-tradables with various terms of trades and with a constant home good price. Now, if home country's terms of trade increase due to an exogenous increase in exports price from OR to OR', then we move from A to A', because Pm is fixed. In A' we have trade surplus and excess demand for non-tradables. To restore and equilibrium the relative price of non-tradables (P_N/P_T) must increase. this may happen again either through revaluation to A'' or through an increase in the price of a non-tradable until NN curve shifts to A'.

We have assumed that effect of changes in terms of trade are similar in spite of the source of terms of trade change. For example an increase in exports price and a decrease in imports price lead to the real appreciation. In figure by Dornbusch (1980) with decreasing NN curve the effects are opposite. Dornbusch does not discuss this problem but the effects depend on price elasticities of consumption and production in three commodity groups (exportables, importables, non-tradables). We have assumed that both an increase in exports price and a decrease in imports price lead to trade surplus and excess demand of non-tradables and thus to real appreciation.

If we have only two similar countries and no percussion effects, then both countries face the same change in the relative price. However, if the domestic country faces an increase in terms of trade then foreign country faces a decrease. If the foreign country is large ("the rest of the world") and the home country

Figure 1.[1] The effects of terms of trade on the real exchange rate



1) Modified from Dornbusch (1980) p.110

small, then terms of trade change affect only the prices of the home country. When comparing two countries in a multi-country world, both countries quite probably face a different terms of trade (against the rest of the world) changes and thus both changes have an effect on the equilibrium real exchange rate. As noticed before, the terms of trade changes affect also the relative price between tradables and non-tradables and so there is an additional effect on the real exchange rate.

The equilibrium real exchange rate is thus an increasing function of relative internal productivities $(Prod_T*/Prod_N*)/(Prod_T/Prod_N)$ and an increasing function of relative terms of trade $(P_X*/P_I*)/(P_X/P_I)$. However, terms of trade effect should cancel out in effective testing situation.

Naturally there are a lot of other possible factors ("real shocks"), which may change the equilibrium value of RE, and thus cause a persistent deviation from PPP. E.g. Heitger (1987) introduces "a demand bias" due to non-homothetic preferences. In this case economic growth leads to additional demand and absorption of non-tradables. Finally, the relative price of non-tradables will increase.

However, the one aim of this study is to test whether real exchange rate has been constant, when adjusted for (only) two real factors, relative productivity and relative terms of trade.

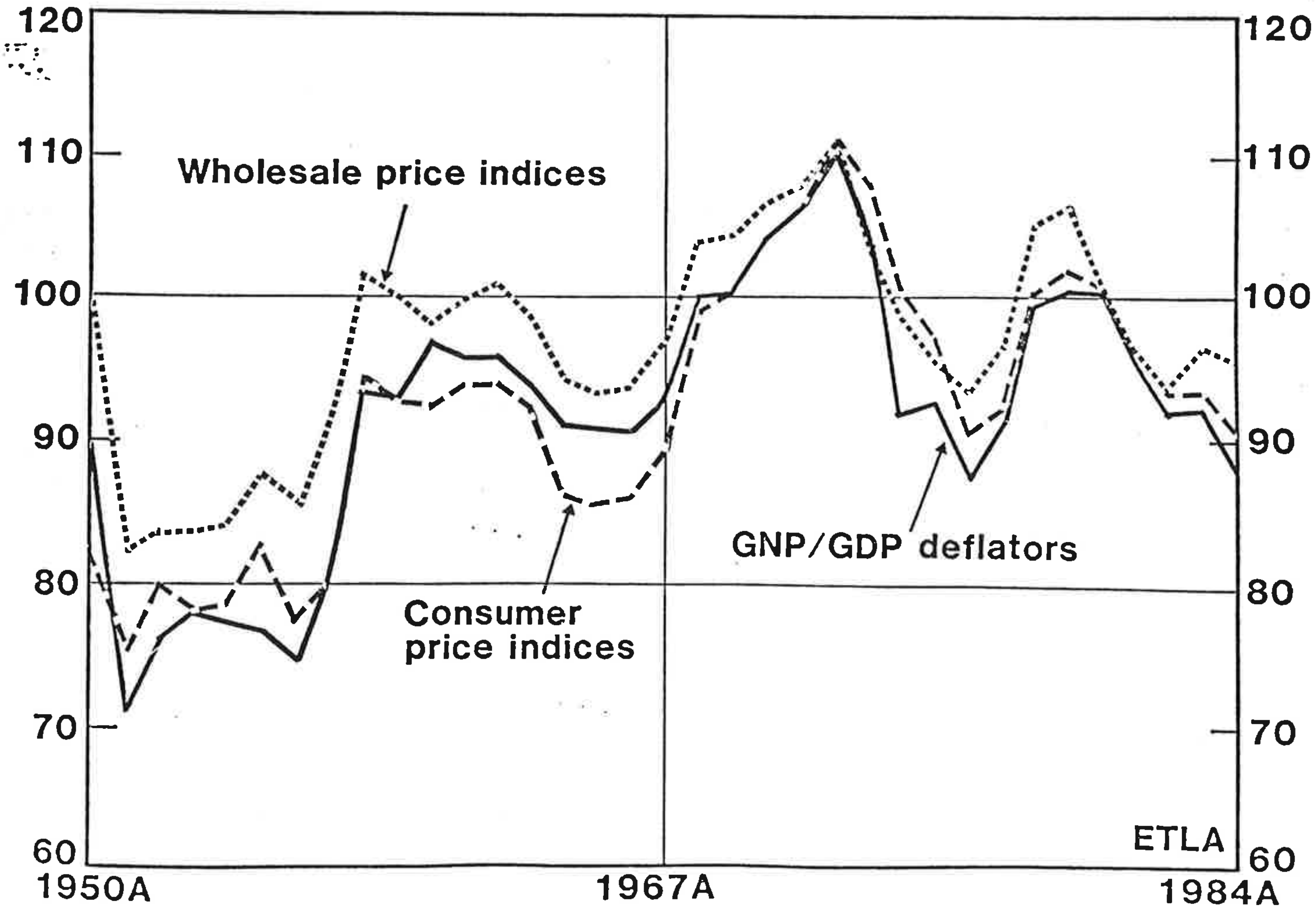
3. Description

In graph 1 there are drawn the real exchange rates defined as nominal exchange rates adjusted with GNP/GDP deflators, consumer prices and wholesale prices. Graphs are for real exchange rates of Finnish markka against average of ten competitors.

In all graphs it can readily be seen that real exchange rates behave cyclically with amplitude around ten years. These cyclical movements are often called devaluation cycles, because upward swings are due to the big devaluations, e.g. in the years 1957, 1967 and three devaluations during 1977 and 1978. Also in 1982 we had a 6 % devaluation because of big Swedish devaluations in 1981 and 1982. And finally in 1987 we had again a small devaluation in spite of the attitudes to avoid devaluations. The bilateral real exchange rates behave similarly. However, the bilateral real exchange rate between U.S. dollar and Finnish markka fluctuates most due to big swings in nominal dollar rate during 1970s and 1980s.

According to Korkman (Korkman, 1978), "the large parity changes undertaken at a ten year interval have been observed to result in the following sequence of events: during the first years after the devaluation the relative price of tradable goods rises, the relative share of profits increases at the expense of wage income, investment and growth accelerates and unemployment gradually falls; during the latter years, however, the above process is reversed until a new devaluation is undertaken". However, when this process has been recognized in Finland more emphasis has been

Graph 1. Real effective exchange rates defined as different relative price indices in the same currency



given to other economic policy tools, e.g. small revaluations in 1979 and 1980.

Real exchange rates have fluctuated mainly due to faster increase in prices than in competitor countries and due to related central bank actions (mainly devaluations). Thus, it can be thought that some rather stabile constant levels around which real exchange rates fluctuate mirrors partly the central bank view of the equilibrium. If it is so, we can ask whether central bank has also taken real shocks into account. Also, we can ask whether it has taken them into account with a way theory predicts, i.e. relative productivity and terms of trade, see chapter 2.

Table 1 - Means and standard deviations of some real exchange rates[1)]

	1901-84[2)]	1901-49[2)]	1950-84	1950-59	1960-69	1970-79	1980-84
GNPUSA	148.2 (34.7)	168.3 (42.4)	130.0 (20.9)	134.9 (14.4)	148.5 (10.2)	125.6 (23.4)	123.2 (16.8)
GNPGER	-	-	93.4 (10.9)	70.3 (10.6)	81.8 (3.6)	101.5 (7.6)	89.1 (6.8)
GDPUK	103.6 (32.3)	130.8 (34.0)	86.4 (10.3)	77.5 (9.4)	91.2 (3.3)	81.1 (11.4)	94.7 (6.6)
GDPSWE	98.9 (24.3)	110.6 (31.8)	97.8 (9.0)	75.4 (7.9)	95.9 (5.8)	102.3 (6.4)	88.4 (8.8)
REG	-	-	96.2 (6.6)	80.9 (7.8)	94.5 (3.7)	98.4 (7.7)	93.4 (4.6)
CPI'S							
USA	134.7 (18.8)	153.1 (15.6)	128.4 (15.5)	131.6 (9.8)	134.8 (11.6)	121.3 (20.5)	123.4 (17.2)
GER	98.0 (30.3)	109.5 (40.7)	88.8 (12.9)	77.4 (9.6)	83.5 (5.0)	104.3 (7.1)	91.0 (5.6)
UK	95.1 (18.9)	122.6 (12.0)	85.6 (8.7)	79.1 (7.6)	87.9 (3.7)	85.0 (9.6)	95.3 (5.6)
SWE	93.6 (13.1)	100.5 (7.1)	91.3 (13.9)	75.4 (8.8)	93.2 (7.1)	105.9 (7.0)	89.8 (8.2)
REC	-	-	91.9 (9.3)	81.9 (6.4)	91.5 (5.3)	101.0 (6.6)	94.5 (3.7)
WPI'S							
USA	147.7 (32.7)	174.1 (21.8)	123.7 (13.6)	125.5 (8.8)	130.9 (8.8)	116.4 (14.2)	120.3 (15.4)
GER	113.8 (33.3)	169.4 (28.0)	93.8 (10.7)	85.5 (11.9)	90.9 (4.3)	104.9 (6.6)	93.6 (4.5)
UK	107.4 (24.1)	123.3 (8.7)	87.6 (9.0)	80.0 (8.6)	91.4 (6.5)	87.4 (10.2)	95.6 (3.5)
SWE	99.9 (14.9)	103.4 (8.8)	92.8 (10.3)	80.2 (7.5)	95.2 (5.4)	102.7 (3.2)	93.4 (4.3)
REW	-	-	96.4 (7.2)	89.7 (7.5)	98.0 (4.0)	101.9 (5.8)	96.0 (2.5)

[1)] STDDEV'S in parenthesis

[2)] Number of observations vary

4. Testing

In order to evaluate the explanatory power of various theories, introduced in table 2, we test them against each other in a sequential testing procedure. The idea is to use all a priori information to construct a most general model in which all other models are special cases (see e.g. Harvey 1983).

The various models, which have been tested against each other, are shown in figure one and table two. There are of course a lot of other possible models, but these are the models which we can base on the conventional theory.

The most general model consists of a constant, lagged dependent variable, relative productivity and relative terms of trade variables. It can be tested against model five, to study whether only constant, productivity and terms of trade variables can give statistically at least as good explanation than model six. However, in order to solve whether model (5) is better than model (2) we can test model six also against both models. This kind of unnested testing situation, model (5) against model (2), can be solved in a more general model (6), or just by comparing adjusted R^2. In a nested path we can continue path, e.g. (6), (5), (3), (1) and always drop the "losers".

We make the comparisons of the models with the aid of F-tests. In tables 3A and 3B there are shown the F-statistics of the comparisons described in figure 1. The null hypothesis is that restrictions are valid, i.e. submodel is a correct model. Thus, if the test statistic is significant we regard the more general model as better.

Figure 1 - The sequential testing procedure

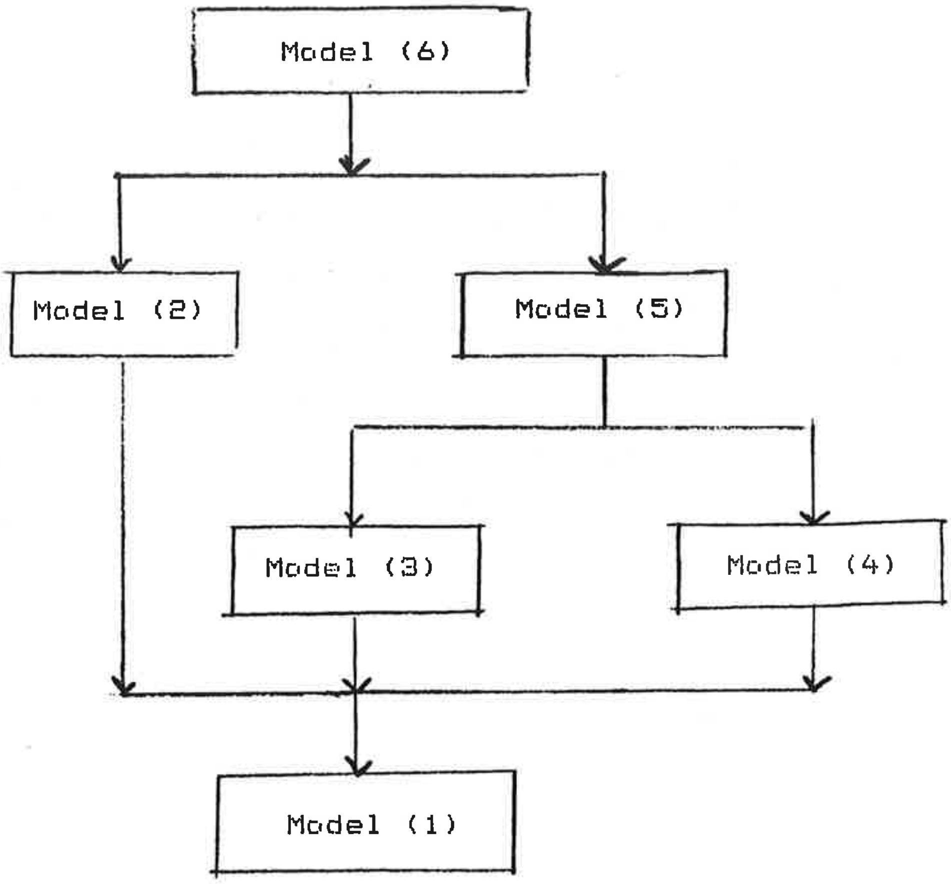


Table 2 - Models in the path of ordered hypotheses

(1)	$\ln RE = C + u$	traditional hypothesis
(2)	$\ln RE = C + a.\ln RE_{-1} + u$	if a = 1 then random walk model with a drift
(3)	$\ln RE = C + a.\ln RP + u$	productivity hypotheses
(4)	$\ln RE = C + a.\ln RTOT + u$	terms of trade hypotheses
(5)	$\ln RE = C + a.\ln RP + a_1.\ln RTOT + u$	(3) + (4)
(6)	$\ln RE = C + a.\ln RE_{-1} + a_1.\ln RP + a_2.\ln RTOT + u$	

If $a \neq 1$ then stationary model with AR(1) part and in addition relative productivity and terms of trade effects

RE = real exchange rate (index 1980 = 100)

RP = relative productivity in internal and external sector, $(Prod*_T/Prod*_N)/(Prod_T/Prod_N)$

$Prod_N$ = productivity in non-tradables sector[1)]

$Prod_T$ = productivity in tradables sector[1)]

RTOT = relative terms of trade, $(P*_x/P*_i)/(P_x/P_i)$

u = residual

[1)] The division between tradables and non-tradables is done in line with Goldstein and Officer (1979). However, in this study tradables mean only manufacturing sector and non-tradables mean the rest of the economy.

Table 3A - F-statistics for the restrictions implied by submodels

	6 vs 5	6 vs 4	5 vs 4	6 vs 3	5 vs 3	6 vs 2	5 vs 1	4 vs 1
RUSA	3.07*	-	3.03*	-	50.75	-	30.53	52.15
RGER	4.99	2.6*	-	11.11	-	7.15	-	14.48
RUK	0.15*	-	0.14*	-	24.5	-	18.32	32.85
RSWE	2.46*	-	0.73*	-	12.05	-	6.65	26.39
REF	1.34*	-	1.37*	-	15.86	-	7.99	39.33

RUSA, ... Bilateral real exchange rates of Finnish markka

REF Effective real exchange rate of Finnish markka against ten countries. Price indices in real exchange rates are GNP/GDP deflators. In all models first order autocorrelation is corrected.

6 vs 5 A comparison of models 6 and 5, etc.

* restrictions, i.e. null hypothesis (submodel is correct), accepted at 5 % risk level.

F-values are calculated according to formula:

$$F_{q,n-k} = \frac{(SSR_R - SSR_{uR})/q}{SSR_{uR}/(n-k)}$$

q - number of restrictions

n - number of observations

k - number of variables in unrestricted model including constant

Table 3B - F-statistics for the restrictions implied by submodels

	6 vs 5	6 vs 4	5 vs 4	6 vs 3	5 vs 3	6 vs 2	5 vs 2	4 vs 1
RUSA	3.51*	-	2.16*	-	26.98	-	16.2	30.89
RGER	2.5*	-	3.99*	-	16.73	-	9.03	10.96
RUK	0.99*	-	0.38*	-	12.89	-	18.91	33.79
RSWE	8.93	9.2	-	11.87	-	6.07	-	10.82
REF	5.56	7.25	-	9.87	-	5.31	-	10.08

Price indices used in calculations are consumer price indices.

Otherwise see previous table.

In case of real exchange rates calculated with aid of GNP/GDP deflators model (4) seems to be best in all cases (see table 3A). Thus, in statistical sense only constant and terms of trade variable explain best the behaviour of the real exchange rates. The sign is always positive as predicted in section 2. The same is true for consumer price real exchange rate except cases of Sweden (RSWE) and effective real exchange rate (REF). The most general model (6) is most satisfactory for these countries as you can see from table 3B. The terms of trade variable was significant even when real exchange rate was measured against most important competitors. This may be due to the fact that our ten competitors do not consist of the rest of world because e.g. Soviet Union and Third World countries are excluded.

The usual PPP hypothesis (1) with C = ln100 was not the worst model, but it cannot explain behaviour of real exchange rates well enough in this sample (1963-1983). Model (2) is so-called random walk model if a = 1. Most real exchange rates followed random walk with a drift c, especially when t-test correction was taken into account (this is due to autocorrelation correction). However, more general models, (which take account of some real shocks), explained the behaviour of real exchange rates better.

In the appendix in addition to the best models also models (5) or (6) are reported because they were usually the second best models and from those models we can get some impression about importance of the productivity effect. As in other tests evidence is mixed, the sign of the variable was correct in case of Germany and in group of all competitors. The productivity variable was statistically significant only in case of Germany.

However, the time period (1963-83) could be longer and also in sequential path of testing the most general model was perhaps not general enough. My purpose was to take account also more general autoregressive part as e.g. Nelson and Plosser (1982) have done in their studies concerning unstationarity of time series. By including these variables we could have diminished autocorrelation - which may be regarded as a sign of misspecification - from the models. Also, it would be interesting to include so-called error correction model into the sequential path.

5. Conclusions

In this study we have got support for the hypothesis that the behaviour of real exchange rates can be explained with a deterministic process related to PPP theory in case of Finland.

So-called productivity hypothesis by Balassa got only some support. However, surprisingly, relative terms of trade variable with constant explained best the behaviour of real exchange rates in statistical sense. Thus, Finland and its competitors have faced very much different terms of trade changes, which have changed the real exchange rate considerably. However, in this case Finland can be regarded as a price taker and changes in real exchange rates reflect changes in terms of trade with different weights in price indices.

Table A1 - Models accepted in sequential testing procedure. Dependent variable is natural logarithm of real exchange rate calculated with GNP/GDP deflaters

Model lnRE = C + a.lnRTOT

				C	lnRTOT
RUSA				4.666 (174.1)	1.262 (9.57)
	$\bar{R}^2$ = 0.95	NOBS = 21	SSR = 0.025297	F(1,18) = 332.7	
RGER				4.590 (94.5)	1.415 (3.84)
	$\bar{R}^2$ = 0.80	NOBS = 21	SSR = 0.0496718	F(1,18) = 78.9	
RUK				4.575 (120.1)	1.232 (7.49)
	$\bar{R}^2$ = 0.90	NOBS = 21	SSR = 0.027012	F(1,18) = 179.8	
RSWE				4.584 (117.7)	1.340 (3.68)
	$\bar{R}^2$ = 0.74	NOBS = 21	SSR = 0.033617	F(1,18) = 56.1	
REF				4.587 (114.5)	1.005 (3.85)
	$\bar{R}^2$ = 0.71	NOBS = 21	SSR = 0.025584		

t-statistic in parenthesis. Autocorrelation correction done.

RUSA ... real exchange rates

RTOT relative terms of trade

REF is calculated against ten countries

Table A2 - Models accepted in sequential testing procedure. Dependent variable is natural logarithm of real exchange rate calculated with consumer price indices

Model: lnRE = C + a.lnRTOT

			C	lnRTOT
RUSA			4.650 (123.7)	1.078 (6.28)
$\bar{R}^2$ = 0.90	NOBS = 21		SSR = 0.0349938	F(1,18) = 171.8
RGER			4.605 (74.1)	1.268 (3.31)
$\bar{R}^2$ = 0.81	NOBS = 21		SSR = 0.053747	F(1,18) = 80.8
RUK			4.569 (155.0)	0.934 (5.98)
$\bar{R}^2$ = 0.85	NOBS = 21		SSR = 0.0268225	F(1,18) = 108.6
RSWE			4.597 (70.2)	1.195 (3.4)
$\bar{R}^2$ = 0.82	NOBS = 21		SSR = 0.0339503	F(1,18) = 89.4
REF			4.592 (81.7)	0.879 (3.19)
$\bar{R}^2$ = 0.77	NOBS = 21		SSR = 0.0253480	F(1,18) = 64.0

Explanation of models, see table A1.

Appendix 1

Table A3 – Model (5) in sequential testing procedure. Dependent variable is natural logarithm of real exchange rate calculated with GNP/GDP deflators

Model: $\ln RE = C + a.\ln RPROD + a_1 \ln RTOT$

	C	lnRPROD	lnRTOT	
RUSA	4.609 (106.4)	-0.247 (-1.76)	1.13 (7.74)	
$\bar{R}^2$ = 0.95	NOBS = 21	SSR = 0.02147	F(2,17) = 186.6	
RGER	4.669 (108.7)	0.559 (2.25)	1.60 (4.81)	
$\bar{R}^2$ = 0.83	NOBS = 21	SSR = 0.04105	F(2,17) = 46.8	
RUK	4.437 (60.08)	-0.576 (-2.1)	0.941 (5.27)	
$\bar{R}^2$ = 0.91	NOBS = 21	SSR = 0.024184	F(2,17) = 95.8	
RSWE	4.556 (77.56)	-0.243 (-0.86)	1.27 (3.49)	
$\bar{R}^2$ = 0.74	NOBS = 21	SSR = 0.0322286	F(2,17) = 28.0	
REF	4.680 (52.54)	0.271 (1.17)	1.07 (4.04)	
$\bar{R}^2$ = 0.71	NOBS = 21	SSR = 0.020880	F(2,17) = 24.6	

C = constant

RPROD and RTOT relative internal productivities and relative terms of trade. Productivity in tradables sector is productivity in manufacturing.

Table A4 – Model (5) or (6) in sequential testing procedure. Dependent variable is natural logarithm of real exchange rate calculated with consumer price indices.

Model: $\ln RE = C + a.\ln RE_{-1} + a_1 \ln RPROD + a_2 \ln RTOT$

	C	$\ln RE_{-1}$	lnRPROD	lnRTOT
RUSA	4.586 (66.76)	–	–0.294 (–1.70)	0.989 (5.22)
$\bar{R}^2$ = 0.91 NOBS = 21 SSR = 0.03105 F(2,17) = 92.52				
RGER	4.703 (106.3)	–	0.684 (2.68)	1.521 (4.46)
$\bar{R}^2$ = 0.84 NOBS = 21 SSR = 0.043523 F(2,17) = 49.11				
RUK	4.507 (46.61)	–	–0.247 (–0.67)	0.839 (3.75)
$\bar{R}^2$ = 0.84 NOBS = 21 SSR = 0.026238 F(2,17) = 52.60				
RSWE[1)]	2.117 (1.67)	0.536 (1.95)	–0.135 (–0.59)	1.06 (3.21)
$\bar{R}^2$ = 0.87 NOBS = 21 SSR = 0.021559 F(2,17) = 44.8				
REF[1)]	2.739 (2.29)	0.432 (1.68)	0.335 (1.66)	0.782 (3.03)
$\bar{R}^2$ = 0.82 NOBS = 21 SSR = 0.017443 F(2,17) = 29.96				

[1)] For these models t-values are corrected because of bias introduced by autocorrelation correction with models including lagged dependent variable. Explanation of variables, see table A1.

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0033A/30.10.1987