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EXCHANGE RATES, FOREIGN TRADE PRICES AND PPPs IN OECD COUNTRIES:
AN ANALYSIS OF THE PERIOD 1960-2003

GUISAN, Maria-Carmen*

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Abstract

We analyse the evolution of Exchange Rates of Euro and previous national currencies of Euro Zone, as well as those corresponding to other currencies of OECD countries, with particular emphasis on the reaction of exchange rates to inflation differences, and the consequences of those changes on foreign trade and economic growth. We also compare the evolution of Exchange Rates and Purchasing Power Parities in those countries for the period 1960-2003. We present main comparative data and some econometric models which show the strong inverse relationships between the movements of relative domestic prices and exchange rates of domestic currencies to dollar, and test for homogeneity of this relationship among OECD countries.

JEL Classification: C5, E3, F1, O57

Key words: Foreign Trade Prices, Exchange Rates, Purchasing Power Parities, OECD countries.

1. Introduction.

The evolution of exchange rates of each currency with the US dollar, in OECD countries, depends at a great extent of the evolution of internal prices in each country in comparison with the United States, because the index of external prices of exports is usually in these countries very much alike to the United States index of internal prices of exports. In section 2 we present a short overview of some of the main approaches to the analysis of the evolution of exchange rates. In section 3 we analyse the evolution of these variables for the period 1965-95 in 24 OECD countries, as well as the evolution of exchange rate and estimate an econometric model which shows not only a high goodness of fit but also a high homogeneity of parameters among countries. We also present an econometric model that have into account the differences in short term interest rates on exchange rates. In section 4 we analyse the evolution of Exchange Rates and PPPs for the period 1980-2003, and the effects of exchange rates on foreign trade and economic growth. Finally section 5 presents de main conclusions.

* Maria-Carmen Guisan is Professor of Econometrics and Director of Master on International Sectoral Economics at the University of Santiago de Compostela, Spain, eccgs@usc.es
<http://www.usc.es/economet/eea.htm>

2. Main approaches to the analysis of the evolution of Exchange Rates and Purchasing Power Parities

During the first decades of the 20th century many economists expected that prices in a common currency should be the same all over the world, and that the deviations from this would be transitorial differences between supply and demand or to the fact that exchange rates were not allowed to float. A convergence of Exchange Rates (ER) to Purchasing Power Parities (PPPs) was expected, but this seems not to be the general rule, as we can see in the Annex for OECD countries and can be seen in other studies for non-OECD countries as well.

Some interesting studies related with the evolution of ER and PPPs are the following ones:

Balassa(1964) and Samuelson(1964) analysed international differences in local prices and considered the effect that a negative relationship between prices and income per inhabitant in many goods and services could have to explain differences between exchange rates and purchasing power parities, so the higher the income per inhabitant the higher the price in dollars of those products would be in local markets. It has been confirmed by several studies, particularly in the case of goods and services which are “non tradable” while tradable goods are more affected by international prices. So individuals in poorest countries have access to some goods and services to a much lower price than in richest countries, and international comparisons of income per inhabitant are more realistic when the variable are measured in a common currency (dollars for example) having into account the PPPs. Disparities between Exchange Rates and PPPs is associated with the differences in local prices.

Many economists have analysed the evolution of exchange rates having into account that approach and tried to find explanations related with productivity and other causes, with different results regarding empirical confirmation of different hypotheses. Thirty years after the Balasa-Samuelson, BS, approach, Samuelson(1994) presents new considerations in this regard. Alberola, Cervero, Lopez, and Ubide, A.(2000) consider a model which encompasses the balance of payments and the BS approaches to the explanation of real exchange rates, and show that the stock of net foreign assets and the evolution of sectoral prices are the main variables in the explanation of the exchange rate. Faria and Leon-Ledesma(2000) analysed the BS hypothesis in several countries and periods, and concude that their empirical study is not supportive for the BS hypothesis. They conclude that the PPP hypothesis holds although they do not agree with the implication of this approach for the lack or real impact of real exchange rate on the economy and conclude that real exchange rate seems to have a long run impact on relative growth rates.

During the 1970's some empirical models where estimated trying to explain the evolution of exchange rates, and a comparison of the performance of these models was presented in Meese and Rogoff(1983) with conclusions insisting on the convenience to develop more realistic models. During the eighties and nineties several models including different approaches and more variables where estimated. The distinction between tradable and non tradable goods and services, from the point of view of their local or international trade, was considered in several studies, as well as the effects of changes in productivity and other variables.

Chinn and Johnston(1996) found that the most empirically successful models to explain real exchange rate levels include productivity measures, government spending ratios and either the terms of trade of the real price of oil. MacDonald(1998) also presents an eclectic view including several explanatory variable, and Camarero and Tamarit(2001) following this

eclectic approach present a panel cointegration approach for the Spanish currency in comparison with another 9 European currencies during the period 1973-92. They found more support for the effect of real interest rates differentials than for the government spending ratios.

Other studies insist on the role of differences in interest rates to explain the exchange rate and the results of estimations are not always conclusive. Nagayasu and Mac Donald(2000) present a panel cointegration study with a data set of 14 industrialized countries and found evidence of significant long-run relationships between real exchange rates and real interest rate (RERI) differentials over the floating exchange period of 1976-97. Real exchange rate, defined as the ratio between the nominal exchange rate and the relative internal price index of the country respect to dollar or other foreign currency, is expressed in their model as a potential function of its expected future value (which is substituted by a constant) and the relative real interest rate (ratio between the domestic real interest rate and the foreign real interest rate). Hoffmann and MacDonald(2003) analyse data on bilateral exchange rates for the G7 countries, during the period 1978-97 and found support for the RERI approach, and consider that failures in several previous studies to support this approach were not due to the lack of relationship but to the low power of the cointegration tests employed. Gente and Leon-Ledesma(2004) analyses the effect of real interest rate on exchange rates in a set of South East Asian countries distinguishing the effects on debtor or creditor countries. Ho

Cheung, Chinn and Garcia-Pascual(2004) compare the forecasting ability of several exchange rate models proposed during the decade of the 1990's and they find that the forecasts are cointegrated with the actual values of exchange rates but with elasticity of forecasts with respect to actual values different from unity. They also found that what indicates that there are some relationships but that none of some models specifications work well in one period but not in another period, and that the results are not very much conclusive in favour of a particular approach.

In my view it may happen that some of these variables are related with the levels of prices and the exchange rates but not always the direction of causality is really the assumed by the authors. For example in some studies authors consider that the higher the productivity of workers in services the higher the effect on income per inhabitant, while the direction of causality very often is the opposite way, the higher the income per inhabitant of their customers the higher the income per worker in retail trade and other non tradable goods and services. The relationships between productivity and exchange rates may be due in some cases to the relationship that both variables have with income per inhabitant and other variables, more than to direct effects between them.

Fair(2004) includes an equation which relates nominal Exchange Rate of each country with the US dollar to the evolution of relative prices (local prices divided by the US prices) and the nominal short run interest rate (a function of local interest rate in comparison with the US), and finds a positive effect of the prices and a negative effect of interest rates. So a country with higher/lower inflation than the US is expected to have an increase/decrease of the exchange rate per one dollar, what means devaluation/appreciation, while a country with higher/lower interest rates than the US is expected to have lower/higher values of the exchange rates, what means appreciation/devaluation.

In the next sections we analyse the evolution of the exchange rates, prices and purchasing power parities in the OECD countries during the last decades of the 20th and found that the

main regularity that we can find is the convergence of external prices of exports among OECD countries, following the evolution of internal prices in the United States. We find that the main variable explaining the evolution of the nominal exchange rates is the differential in internal inflation of tradable goods and services. We also analyse the evolution of foreign trade and its effects on economic growth and development. In this regard we follow the economic literature more focused on the positive effects of imports from the supply side, as in Guisan(2005) and other related studies, and the important role of manufacturing to increase exports, as in Cancelo, Guisan and Frias(20021), and Guisan and Cancelo(2002).

3. Exchange Rates and Exports Prices: Pool of 24 OECD countries, 1965-97

Table 1 presents the evolution of the Index of the Exchange Rate, IER, given by the ratio between the current exchange rate of each currency with the US dollar in year t, and the value of this variable in the base year for prices, as well as the Relative Internal Prices of Exports, IPRINX given by the ratio between internal prices in country i and the USA.

$$\text{Index of the Exchange Rate: } IER_{it} = ER_{it} / ER_{i,90}; \quad (1)$$

$$\text{Relative Internal Prices of Exports: } IPRINX_{it} = IPINX_{it} / IPINX_{ut} \quad (2)$$

for $t=1965, 1966, \dots, 1995$, $i=1, 2, \dots, 24$; being ER_{it} the exchange rate in year t (units of national currency per US dollar) and $IPINX_{it}$ the index of internal prices of exports for year t in country i and $IPINX_{ut}$ the corresponding value of this variable in the USA. The base year ($t=0$) for prices and exchange rates is 1990.

The ratios between the corresponding values in year 95 and year 1965 are given by:

$$\text{Ratio of the Exchange Rate: } RER_{i,t} = IER_{i,95} / IER_{i,65} = ER_{i,95} / ER_{i,65} \quad (3)$$

$$\text{Ratio of Relative Internal Prices of Exports: } RPX_{i,95} = IPRINX_{i,95} / IPRINX_{i,65} \quad (4)$$

These ratios are presented in the last columns of table 1, for year 1995 in comparison with 1965, and graph 1 presents the relationship in natural logarithms.

Graph 1. Ratio of Exchange Rates ($RER_{i,95}$) and Ratio of Internal Prices of Exports ($RPX_{i,95}$)

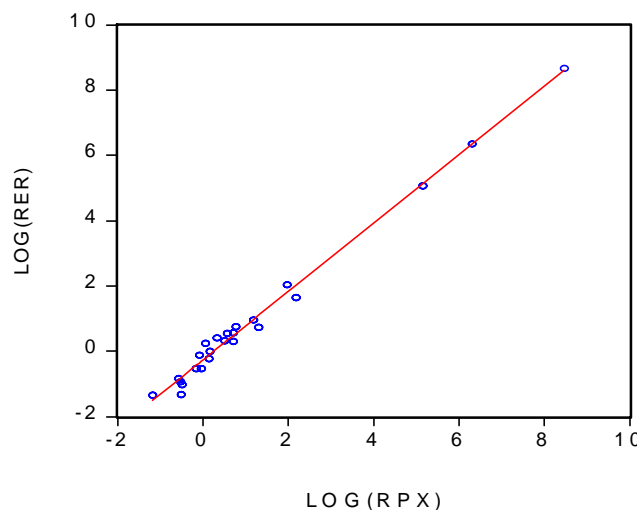


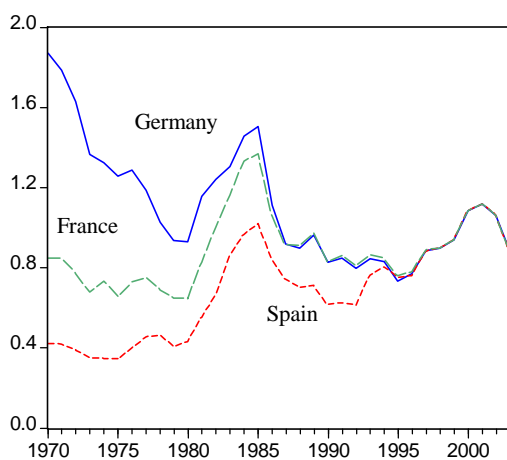
Table 1. Index of the Exchange Rate, IER, Prices of Exports, IRPINX, and Ratios 95/65

Country	IER _{it}				IPRINX _{it}				RER _{i,95}	RPX _{i,95}
	1965	1975	1985	1995	1965	1975	1985	1995		
Austria	2.287	1.532	1.820	0.887	1.754	1.361	1.126	1.019	0.39	0.59
Australia	0.697	0.596	1.118	1.053	0.705	0.687	0.927	0.985	1.51	1.40
Belgium	1.496	1.101	1.777	0.882	1.138	0.992	1.151	0.976	0.59	0.86
Canada	0.926	0.872	1.170	1.176	1.056	1.025	1.121	1.122	1.27	1.06
Denmark	1.116	0.928	1.712	0.905	0.862	0.869	1.128	0.988	0.81	1.15
Finland	0.837	0.962	1.621	1.142	0.575	0.833	1.035	1.168	1.36	2.03
France	0.907	0.787	1.650	0.917	0.843	0.737	1.104	0.990	1.01	1.17
Germany	2.475	1.522	1.822	0.887	1.701	1.326	1.112	1.034	0.36	0.61
Greece	0.189	0.202	0.871	1.461	0.220	0.236	0.684	1.599	7.73	7.27
Iceland	0.007	0.026	0.712	1.110	0.007	0.021	0.481	1.195	159	171
Ireland	0.590	0.747	1.564	1.031	0.586	0.683	1.156	1.047	1.75	1.79
Italy	0.522	0.545	1.594	1.360	0.392	0.432	1.017	1.271	2.61	3.24
Japan	2.486	2.050	1.647	0.650	2.526	2.100	1.325	0.788	0.26	0.31
Luxembourg	1.496	1.101	1.777	0.882	1.123	1.008	1.095	1.087	0.59	0.97
Mexico	0.004	0.004	0.091	2.282	0.004	0.004	0.104	2.188	570	547
Netherlands	1.988	1.389	1.824	0.882	1.672	1.386	1.361	0.961	0.44	0.57
Norway	1.141	0.835	1.373	1.012	0.989	0.912	1.202	0.906	0.89	0.92
New Zealand	0.429	0.496	1.207	0.909	0.463	0.451	0.930	1.005	2.12	2.17
Portugal	0.202	0.179	1.195	1.060	0.131	0.157	0.747	1.166	5.25	8.90
Spain	0.589	0.563	1.668	1.223	0.325	0.447	1.027	1.193	2.08	3.67
Sweden	0.874	0.701	1.454	1.205	0.705	0.716	0.990	1.180	1.38	1.67
Switzerland	3.148	1.858	1.769	0.851	1.713	1.361	1.036	1.031	0.27	0.60
Turkey	0.003	0.006	0.200	17.574	0.004	0.006	0.181	18.873	5858	4718
UK	0.634	0.803	1.384	1.126	0.567	0.674	1.060	1.168	1.78	2.06

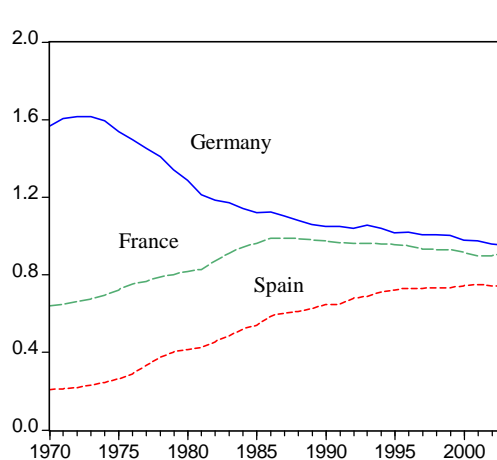
Source: Own elaboration from OECD Statistics. $RER_{i,95}=IER_{i,95}/IER_{i,65}$ and $RPX_{i,95}=IPRINX_{i,95}/IPRINX_{i,65}$

Graphs 2.1 and 2.2 presents the evolution of the Exchange Rate, ER, and Purchasing Power Parities, PPPs, of Euro per one dollar in 3 EU countries, applying the conversion exchange of previous domestic currencies to Euro for years before the arrival of Euro as official currency of these countries.

Graph 2.1. Euros per dollar (ER)



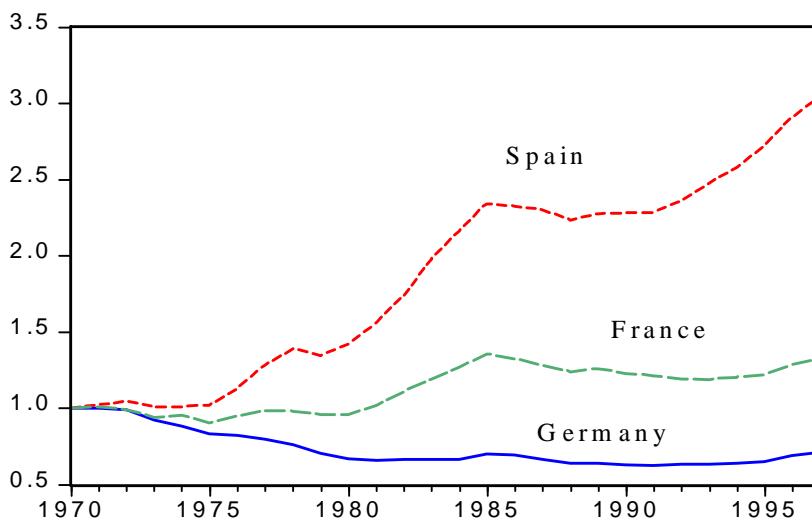
Graph 2.2. Euros per dollar (PPPs)



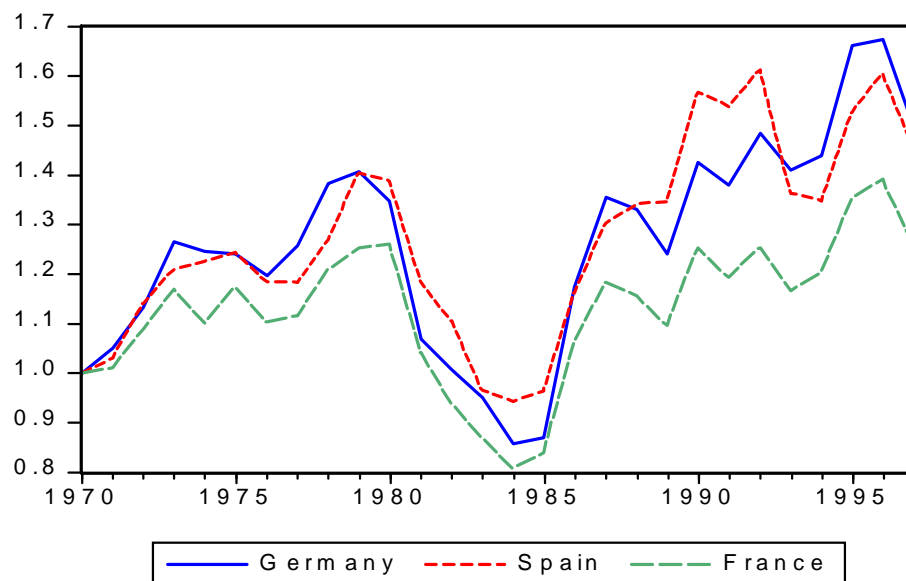
From 1970 to 1995 Germany experienced an appreciation of the currency, with an outstanding depreciation for 1980-86 and posterior recovery, which is shown but the upwards and downwards movements of the exchange rate. France also experienced a depreciation and recovery similar to Germany but the final result was an exchange rate with little change in 1995 in comparison with 1970. Spain experienced an important depreciation during the period 1970-95, due to its higher level of increase in internal prices during that period. This country shows also a movement upwards and downwards in the exchange rate for the period 1980-90 although softer than in Germany and France.

Graphs 3 and 4 present the evolution of internal (in local currency) and external (in dollars) prices of exports relative to the United States price index, in these three countries, with base equal to 1 in 1970.

Graph 3. Internal prices of exports relative to the United States



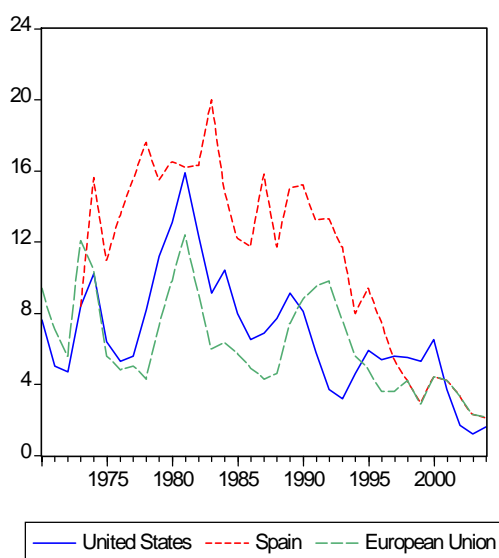
Graph 4. External prices of Exports relative to the United States



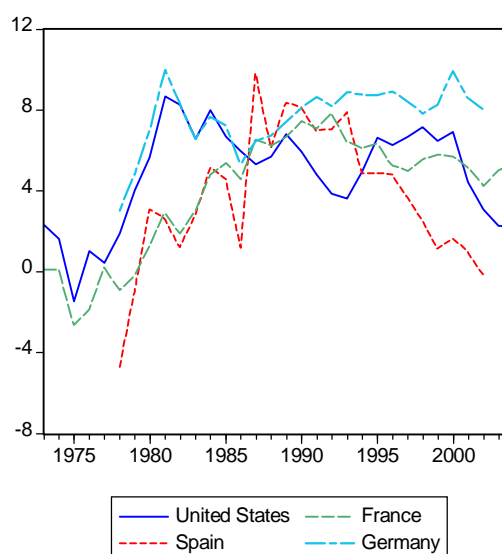
We can notice that there were important differences in internal prices between Spain and the other two EU countries, but the evolution of external prices was very similar in the three countries. In comparison with the United States external prices grow more in these EU countries for the period 1970-1979, with an important decrease for 1979-85, and a recovery afterwards, particularly in Germany and Spain, while France showed a more moderate evolution. The outstanding decrease of external prices of EU countries in comparison with the US could be due to effects of interest rates differentials, or other variables, on the exchange rate, or to a policy addressed to foster real exports at lower prices.

Graphs 5.1 and 5.2 show a comparison of nominal and real interest rates of some EU countries and the United States, with data from UN(2005) and WB(2005).

Graph 5.1. Nominal interest rates (short term)



Graph 5.2 Real interest rates



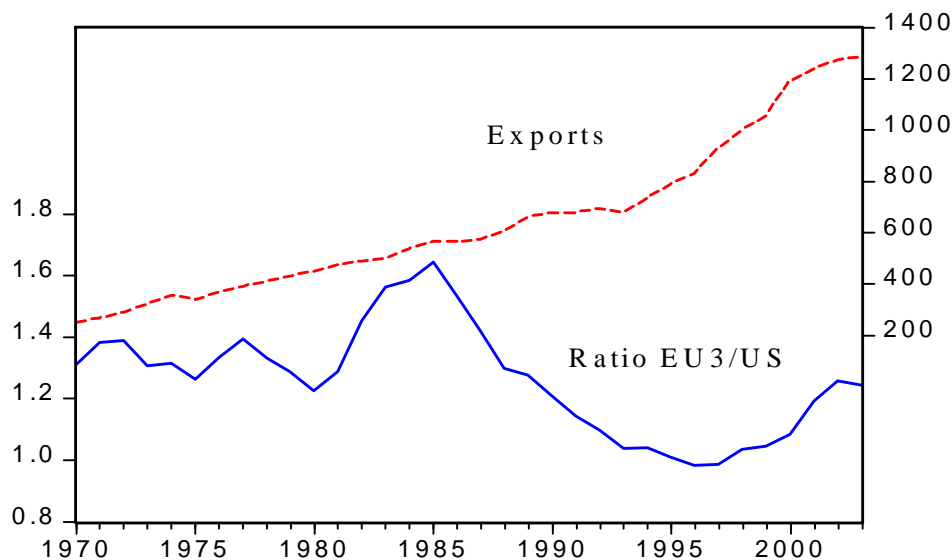
Graph 5.1 shows that the nominal interest rates in US and EU were very alike, both with upwards movement during the period 1976-81 and downwards after that year, with small recoveries in some years, although there has been differences within EU as it is shown in the case of Spain with very high nominal interest rates in comparison with the United States and the European Union during the period 1975-92.

Graph 5.2 shows an outstanding change in the evolution of real interest rate of Germany in comparison with the US, after 1990, with higher values in Germany. Bibow(2001) and (2005) has criticized the EU policy of relative high interest rates as one of the causes of the European low rates of growth and high levels of unemployment. For the period 1975-85 some EU countries, like Spain and France showed more moderate values of the real interest rate than the US and Germany. In the case of Spain the moderation in nominal and real interest rates since 1993 has had a positive impact on economic growth and employment.

Regarding the effect of relative prices in real exports, we find that the diminution of external prices of the period 1980-85 and the increase of the period 1985-95 are related with, respectively, the increase and the decrease in the ratio between real Exports of these three

countries and the US (EU3/US) but seem to have had small effect on the evolution of real Exports, as it can be seen in graph 6.

Graph 6. Real Exports in 3 EU countries: Germany, Spain and France
(billion dollars at 2000 prices and ERs)



Note: Elaborated from OECD Statistics. The left scale refers to the ratio between Exports of the 3 EU countries and the same variable in the United States. The right scale measures the sum of real Exports of goods and services in the 3 EU countries, including intra-trade among them and extra-trade with another countries.

In the Annex we show the evolution of Exchange Rates and Purchasing Power Parities of the 24 OECD countries of table 1, as well as the evolution of IER, IPRINX and the relative price index of Consumption (IPRC) in several OECD countries. The graphs in the annex show that countries with high levels of income per inhabitant have usually an exchange rate below the PPP, what means that their currencies are overvalued, while the OECD countries with lower levels of income per inhabitant usually show an exchange rate over the PPP, what implies that their currencies are undervalued. This observations confirms the views of Balassa, Samuelson and other authors, respect to the relationships between the existence of lower prices in many non-tradable goods and services in countries with relatively low levels of income per inhabitant in comparison with the richest ones.

We agree with some criticisms shown by Bibow(2001) and (2005) to EU policies which do not give enough priority to economic development and employment in EU countries in regions, but we think that the relatively high of interest rates have been only a part of the problem. Other important differences, in relation with the US and other countries, also have an important role to explain the lower average levels of the rates of employment and real wages in EU, which are related with the relative low expenditure of EU in human capital and other variables, as seen in Guisan(2005) and other studies.

In spite of the evolution of prices, interest rates and exchange rates, foreign trade has evolved positively and softly during the period 1970-2004 in OECD countries. In section 4 we analyse some of the main effects of this evolution on demand and supply.

3. Econometric models of the Exchange Rate

Model 1 presents the estimation of the following relationship with panel of 24 OECD during the period 1961-97:

$$Model\ 1 \quad IER_{it} = \beta_1 IER_{it}(-1) + \beta_2 D(IPRINX_{it}) + \varepsilon_{it} \quad (5)$$

being $IER = ER/ER_{90}$ the index of the exchange rate, or ratio between the exchange rate in year t and the exchange rate in year 1990 (local currency per one dollar), where $i=1, \dots, 24$ refers to country and $t=1, 2, \dots, 37$ ($t=0$ in 1960) is time.

Model 1.1 and 1.2 present the estimations for two periods 1961-97 and 1973-7.

Model 1.1: IER and IPRINX in 24 OECD countries, 1961-1997

Dependent Variable: IER?		Method: Pooled Least Squares		
Sample: 1961 1997. Included observations: 37.				
Number of cross-section used: 24. Total panel observations: 888				
White Heteroskedasticity-Consistent Standard Errors & Covariance				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
IER?(-1)	0.983626	0.004518	217.6933	0.0000
D(IPRINX?)	0.910196	0.013193	68.99314	0.0000
R-squared	0.998155	Mean dependent var		1.155409
Adjusted R-squared	0.998153	S.D. dependent var		2.342189
S.E. of regression	0.100649	Sum squared resid		8.975371
Log likelihood	779.9350	F-statistic		479454.2
Durbin-Watson stat	1.867406	Prob(F-statistic)		0.000000

Note: Symbol ? represents the sub-index i , U=US, and (-1) represents subindex (t-1).

Model 1.2. IER and IPRINX for 24 OECD countries, 1973-97

Dependent Variable: IER?=ER?/ER90?		Method: Pooled Least Squares. Sample 1973-97		
Included observations: 25. Cross-sections 24. Total panel: 600 obs.				
White Heteroskedasticity-Consistent Standard Errors & Covariance				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
ER?(-1)/ER90?	0.977605	0.007478	130.7373	0.0000
D(IPINX?/IPINXU)	0.916658	0.014781	62.01491	0.0000
R-squared	0.998186	Mean dependent var		1.208537
Adjusted R-squared	0.998183	S.D. dependent var		2.788996
S.E. of regression	0.118874	Sum squared resid		8.450291
Log likelihood	427.4555	F-statistic		329127.2
Durbin-Watson stat	1.922815	Prob(F-statistic)		0.000000

Note: Symbol ? represents the sub-index i , U=US, and (-1) represents subindex (t-1).

During the period 1961-73 there are many observations corresponding to fixed exchange rates, and the relationship between IER and IPRINX holds due to the adaptation of relative prices to the exchange rate.

The goodness of fit is very high and the coefficients are highly significant, while the direction of causality is clear, because usually the exchange rate responds to changes in relative prices between the country and the international level, here represented by the USA as

the leader country in this regard. The estimation is White-heteroskedasticity consistent, and the parameters are highly homogeneous among countries, accordingly to the following test:

Test of homogeneity for equation 1.1:

$$S_1 = 1.943527 \quad df_1 = (37-3)*5 + (24-3) = 191$$

$$S_3 = 2.216444 \quad df_3 = 209 - 3 = 206$$

$$\Delta_3 = (S_3 - S_1) = 0.272917 \quad \Delta df = 15$$

$$F = (\Delta_3/15)/(S_3/206) = 1.7880 > 1.67 \quad (\text{almost accepted at 5\% level})$$

The hypothesis of homogeneity of parameters is accepted at 1% level and almost accepted at 5% level of significance.

Test of Cointegration for equation 1.1:

ADF(C,1) statistic has taken values between -3.69 in the United Kingdom and -6.33 in Iceland, and thus all countries are in the region of refusal of the non-cointegration hypothesis, with McKinnon limits of -2.94 at 5% level of significance and -3.63% at 1% level of significance, in the case of equation 1.1.

We can notice that there is a clear positive relationship between both variables, which is due to the following relationships, between the Index of External Prices of Exports (IPEXX) and the Exchange Rates (ER). $IPEXX_{it}$ is the index of prices of exports in dollars, corresponding to country i in year t , so we divide the internal index of prices of exports, $IPINX$, by IER_{it} to get relation (6):

$$IPEXX_{it} = (IPINX_{it}/IER_{it}) = IPINX_{it}/(ER_{it}/ER_{i0}) = IPINX_{it} \cdot ER_{i0}/ER_{it} \quad (6)$$

where ER_{i0} is the exchange rate in the base year (in this case $ER_{i,90}$). Relationship (6) implies that the index of the exchange rate $IER_{it} = ER_{it}/ER_{i0}$ may be expressed as the ratio between the index of internal and external prices of exports:

$$IER_{it} = ER_{it}/ER_{i0} = IPINX_{it}/IPEXX_{it} \quad (7)$$

If we consider that $IPEXX_{it}$ tries to adapt to the evolution international prices, and thus it is a function of the prices in dollars in the leading country:

$$IPEXX_{i,t} = f(IPEXX_{U,t}) = f(IPINX_{U,t}) \quad (8)$$

and thus IER may be expressed as a function of relative prices:

$$IER_{it} = f(IPINX_{it}/IPINX_{U,t}) = F(IPRINX_{i,t}) \quad (9)$$

Although other variable which have been considered in the literature can be useful to explain and forecast exchange rates, it is clear that the index of relative internal prices is usually the most important explanatory variable in this regard.

We know estimate Model 2, which consists in estimating (8) for IPEXX and calculate the estimate value of IER (IERF) in (7) as a function of the estimated value of IPEXX (IPEXXF).

Model 2 IERF = IPINX/IPEXXF, where IPEXXF= estimated in (10)

$$IPEXX_{it} = \beta_1 IPEXX_{i,t-1} + \beta_2 D(IPEXX_{ut}) + u_{it} \quad (10)$$

Equation (10) expresses the influence of the leading country on the evolution of the Index of External Prices of the other countries. Here we consider the United States as the leading country, although there are other options in this regard, as for example to consider a group of leading countries.

Model 2. Estimation of equation (10)

Dependent Variable: IPEXX? Method: Pooled Least Squares

Sample(adjusted): 1961 1997. Observations: 37. Cross sections: 24

Total panel (balanced) observations: 888

White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
IPEXX?(-1)	1.003092	0.004248	236.1276	0.0000
D(IPEXXU)	0.902344	0.068566	13.16024	0.0000
R-squared	0.964397	Mean dependent var	59.68750	
Adjusted R-squared	0.964357	S.D. dependent var	30.98894	
S.E. of regression	5.850532	Sum squared resid	30326.65	
Log likelihood	-2827.697	F-statistic	23999.50	
Durbin-Watson stat	1.724362	Prob(F-statistic)	0.000000	

The Sum of Squares of Residuals, SSR for IER in Model 2 results equal to 11.59 higher than the SSR of IER in Model 1.1, which was 8.97. If we exclude the residuals corresponding to Turkey, which are the highest due to disparities in years 1994-95, the SSR is equal to 6.31 in Model 2 and 6.69 in Model 1. Thus the results of Models 1 and 2 are very similar if we exclude the particular case of Turkey.

Model 3 includes the effect of the general price index of Private Consumption (IPC) and short run interest rates (RS) of each country in comparison with the United States. This sample includes 4 countries: France, Germany, Spain and the UK.

Model 3. Exchange Rate, General Price Index and Rates of Interest

Dependent Variable: LOG(IER?).		Method Pooled Squares		
Sample: 1973 1998. Included observations 26. Cross-sections 4. Total panel 103				
White Heteroskedasticity-Consistent Standard Errors & Covariance				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(IER?(-1))	0.900921	0.049268	18.28609	0.0000
D((LOG(IPC?/IPCU)))	0.705431	0.308371	2.287601	0.0243
D(LOG((1+RS?/100)/(1+RSU/100)))	-0.069331	0.521565	-0.132929	0.8945
R-squared	0.817445	Mean dependent var	0.073636	
Adjusted R-squared	0.813793	S.D. dependent var	0.245584	
S.E. of regression	0.105974	Sum squared resid	1.123044	
Log likelihood	86.56164	F-statistic	223.8893	
Durbin-Watson stat	1.426786	Prob(F-statistic)	0.000000	

Note: ? is indicator of country i, U=USA and (-1) refers to (t-1)

Model 4 is similar to Model 3 but with IPRINX (relative internal price of exports) instead of IPRC (relative internal price of private consumption) and including as a new variable the increase in the ratio between real exports and real imports, with a positive and significant coefficient, which needs further investigation, to analyse the direction of causality. This positive coefficient shows that there is a trend to devalue when a country tries to increase the ratio between Exports and Imports.

Model 4. Exchange Rate, Prices of Exports, Interest Rate and Exp/Imp

Dependent Variable: LOG(IER?)		Method: Pooled least squares		
Sample(adjusted): 1973 1997. Included observations: 25				
Number of cross-sections: 4. Total panel (unbalanced): 99 observations				
White Heteroskedasticity-Consistent Standard Errors & Covariance				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(IER?(-1))	0.916934	0.034342	26.70025	0.0000
D(LOG(IPRINX?))	1.243480	0.155530	7.995120	0.0000
D(LOG(1+RS?/100)/(1+RSU/100))	-0.079656	0.400546	-0.198868	0.8428
DLOG((EXP90?/IMP90?))	0.425672	0.169956	2.504602	0.0140
R-squared	0.894215	Mean dependent var	0.070417	
Adjusted R-squared	0.890874	S.D. dependent var	0.248629	
S.E. of regression	0.082133	Sum squared resid	0.640848	
Log likelihood	109.0092	F-statistic	267.6827	
Durbin-Watson stat	1.585450	Prob(F-statistic)	0.000000	

Comparison of Model 1 with Models 3 and 4 for the set of 4 OECD countries:

Model 1 with IPRINX (instead of IPRC=IPC/IPC_U) for this set of 4 countries during the period 1973-97 presents a SSR of 0.6910 for IER, while Model 1 with IPRC instead of IPRINX gives a value of SSR of 1.0658 for IER, being both values lower than the value of SSR for IER in Model 3 (1.1230). To account for the degrees of freedom we compare the S.E. of regression which results also lower in Model 1 with 0.0848 in the first case (use of IPRINX) and 0.0920 in the second case (use of IPRC) than in Model 3 with 0.1059. The effect of the variable related with the rates of interest is negative, as expected accordingly to Fair(2004) and other studies, although not significant. It is reasonable to suppose that this variable has a negative effect on the index of the exchange rate, but it seems not so outstanding as the effect of internal prices. Model 4 performs similarly to Model 1 with IPRINX, with a SSR of 0.6408 for IER and a value of the Standard Error of 0.0821. Having into account these results we conclude that Models 1, 2, and 4 perform better than model 3, due to the effect of including the prices of tradable goods instead of a general price index.

The main conclusion from this section is that the evidence of OECD countries during the last decades of the 20th century shows that exchange rates and internal prices usually adjust to reach a value of external prices of exports compatible with the evolution of leader countries, in order to avoid a loss of competitive of exports. So if the exchange rate is fixed the changes in internal prices will make the adjustment and in case of floating or variable exchange rates the main changes will be experimented by the exchange rate although some adjustments are also made through changes in the internal price index of exports. Besides we can conclude that although a general price index like the Consumption Price Index (IPC or CPI) is useful in many circumstances to calculate relative prices, when data are available it is better to use IPINX as the goodness of fit is better with this variable. In the graphs of the Annex we can notice that IPRINX evolves close but not identical to IPRC.

The relationship between index of external prices of Exports of each country and that of the United States is very clear in all the 24 countries of table 1. In the section A2 of the Annex we include the graph for 8 countries: the 4 countries of Models 3 and 4, and countries with particular features in the evolution of the Exchange Rate, such as Mexico, Turkey, Japan and Switzerland. Although some particular movements of the Exchange Rate have been widely analyzed, such as it has happened with the Mexican currency in 1994-95, we can notice that the evolution of IPEXX of Mexico in those years is quite coherent with IPEXXU, and thus the movement in the exchange rate seem to be mainly explained by the need to maintain an adequate level of prices of exports given the high increases in the internal prices. Even in the case of Turkey, with a high inflation, the relationship between IPEXX and IPEXXU holds very clearly. A more detailed analysis of the evolution of Mexico and Turkey, in comparison with other OECD countries, during the last decades of the 20th century is presented in Guisan(2005).

4. Foreign Trade Prices and Economic Growth

A high emphasis has been given in the economic literature to the positive effects of foreign trade from the demand side, while usually less studies have focused on the positive effect of the supply side. Both sides are indeed important, but accordingly to Guisan, Aguayo and Exposito(2001) and other studies we found that for many countries foreign trade is particularly important due to the positive effect that Imports of complementary inputs have on domestic real production.

Model 5 relates the real value of Exports (in billion dollars at 1990 prices and exchanges rates) with real Gross Domestic Product (in the same units) and with IPREXX. Data correspond to a pool of the 24 OECD countries of table 1 for the period 1965-97, given or elaborated from OECD(1998).

The relative external price index of Exports, given by the ratio of the external price index of Exports in each country and the value of this index in the United States: $IPREXX_{it}=IPEXX_{it}/IPEXX_{Ut}$, shows a negative impact on real Exports in model 5.

Model 5. Real Exports, GDP and Prices.

Dependent Variable: LOG(EXP90?) Method: Pooled Least Squares

Sample: 1965 1997. Included observations: 33

Number of cross-sections used: 24. Total panel (balanced): 792 obs.

White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(EXP90?(-1))	1.006722	0.000787	1279.246	0.0000
D(LOG(GDP90?))	1.105888	0.085219	12.97702	0.0000
D(LOG(IPREXX?))	-0.135194	0.028782	-4.697204	0.0000
R-squared	0.998330	Mean dependent var		3.556350
Adjusted R-squared	0.998326	S.D. dependent var		1.392335
S.E. of regression	0.056975	Sum squared resid		2.561203
Log likelihood	1146.898	F-statistic		235798.5
Durbin-Watson stat	1.780643	Prob(F-statistic)		0.000000

As IPREXX is very often close to unity, its natural logarithm is zero and its influence is in that case relatively small on the evolution of real Exports. The increase in production, particular in industrial production is usually the main factor explaining the growth of foreign

trade, provided that there are not problems from the external demand side. More detailed models should consider the role of supply and demand in the explanation of Exports, as in Guisan and Cancelo(2002) and other studies.

Of course there is some degree of interdependence between Exports and Gdp and a more detailed study should have it into account, estimating a multiecuacional model by TSLS or another consistent method for that case. Here we have obtained consistent estimators by Instrumental Variables with the following results, which are very similar to the LS estimation of Model 5.

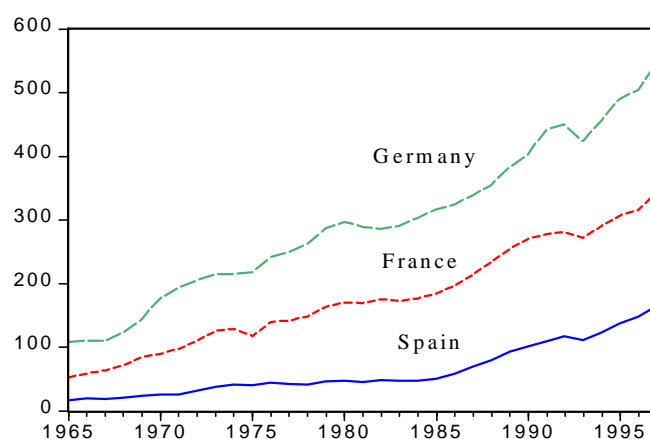
Instrumental Variables Estimation of Model 5

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(EXP90?(-1))	1.008141	0.000770	1309.291	0.0000
D(LOG(GDP90?))	0.912262	0.074539	12.23879	0.0000
D(LOG(IPREXX?))	-0.124557	0.022974	-5.421720	0.0000

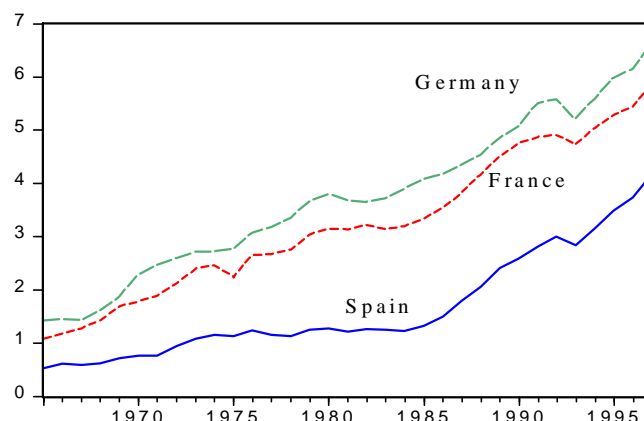
It is important to remark that usually the main role of Exports in economic growth is to increase the capacity to increase Imports, because economic growth needs to exchange raw materials, intermediate inputs and other goods and services with other countries in order to increase the availability of several production inputs in the domestic market. Many OECD countries have devaluated their currencies during the period 1980-85 to cope with the negative effects of the increase in oil prices on their economic growth in order to favour exports, but this type of policy is often not too much effective because the increase of real imports is slightly affected when the increase in real exports is accompanied by a decreased in the relative external price index of Exports, as it may be seen if we compare graphs 4 and 7.

Graphs 7 and 8 show the evolution of real Imports in these countries. We can notice that the decrease in the external prices of Exports did not increase the capacity to import during the period 1980-85.

Graph 7. Real Imports of goods and services in Spain, France and Germany (billion dollars at 1990 prices and exchange rates)



Graph 8. Real Imports per inhabitant in Spain, France and Germany (thousand dollars at 1990 prices and exchange rates)



The capacity to import is usually very important for economic growth and development, particularly in small countries as they usually have a more limited domestic trade than the big ones. Model 6 presents the least squares an estimation of the relationship between real Gross Domestic Product per inhabitant and Foreign Trade during the period 1964-2003. We have included and AR(1) to have into account the effect of missing variables not related with the included ones. We have estimated Model 6 by instrumental variables, IV, in order to guarantee consistency in the case of interdependence among the variables.

Model 6. Real Gdp per inhabitant and Foreign Trade

Dependent Variable: Gdp90h Method: Pooled Least Squares

Sample(adjusted): 1964 2003. Included observations: 41.

Number of cross-sections: 24. Total panel: 845 observations

White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP90H?(-1)	1.010527	0.001670	605.1607	0.0000
D(IMP90H?)	0.501556	0.065676	7.636802	0.0000
D(EXP90H?)	0.249964	0.065205	3.833519	0.0001
AR(1)	0.412821	0.044349	9.308429	0.0000
R-squared	0.998440	Mean dependent var	15.10978	
Adjusted R-squared	0.998435	S.D. dependent var	7.488273	
S.E. of regression	0.296256	Sum squared resid	73.81252	
Log likelihood	-169.0291	F-statistic	179462.0	
Durbin-Watson stat	2.028549	Prob(F-statistic)	0.000000	

Instrumental Variables estimation of Model 6

	Coefficient	Std. Error	t-Statistic	Prob.
GDP90H?(-1)	1.013102	0.001258	805.5528	0.0000
D(IMP90H?)	0.685756	0.043688	15.69650	0.0000
D(EXP90H?)	-0.074678	0.059348	-1.258296	0.2087
AR(1)	0.384214	0.033809	11.36410	0.0000

The results show a very important and positive effect of Imports on Gdp, while Exports show a lower effect in the LS estimation and do not show a significant effect in the

IV estimation. Although in some sectors Exports have an important direct role to explain the increase of real Gdp, for example when there is not possibility to increase the domestic demand, usually the main effect of Exports on economic growth and development is indirect: the increase of Exports increases the capacity to import, and Imports have a positive role as complementary factors of production to increase real Gross Domestic Product. Imports may have both complementary and substitutive effects on domestic production, being the complementary effects usually more outstanding than the substitutive ones.

5. Conclusions

Our analysis has shown that the differences in internal prices are the main variable explaining differences in exchange rates, because external prices of tradeable goods evolve very similarly in OECD countries to prices of exports in the US.

We have found evidence to support that countries with lower levels of income per inhabitant usually have exchange rates with values higher than PPPs what means undervaluation of their currencies, while countries with higher levels of income per inhabitant usually have overvaluation of their currencies.

The evolution of exchange rates and foreign trade prices has shown little influence on the evolution of real exports and imports.

Although exports are important to foster economic growth from the demand side, usually their main role in this regard is to allow an increase in imports of complementary goods which increase real Gross Domestic Product from the supply side.

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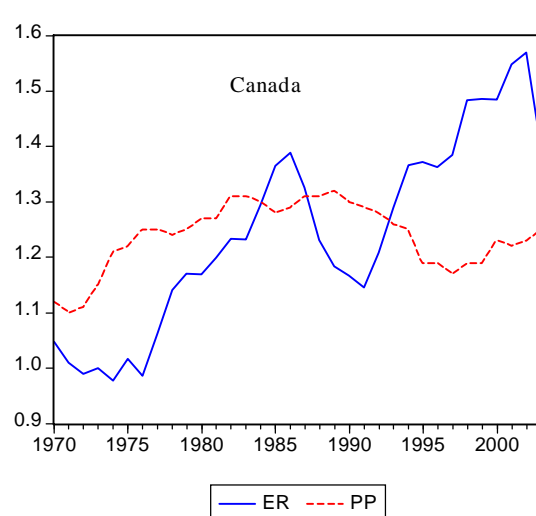
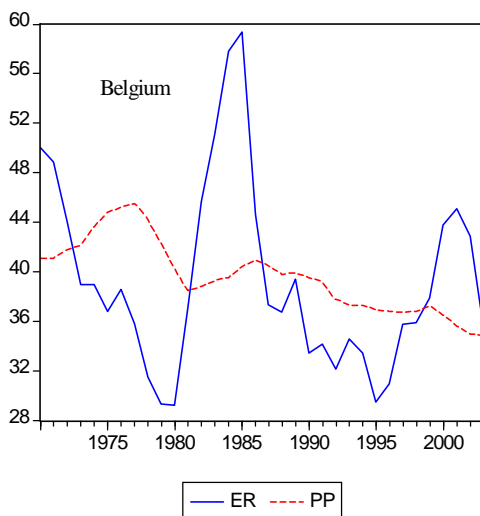
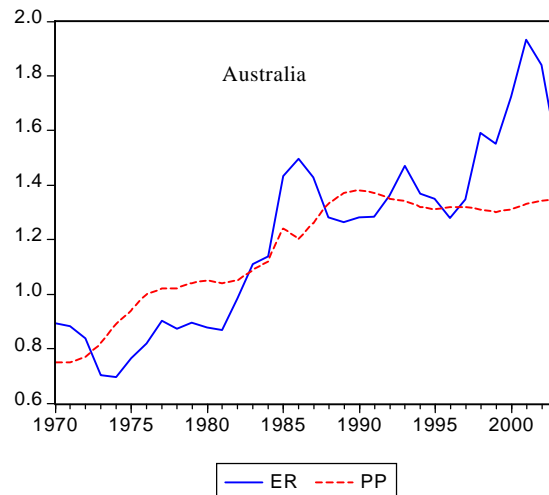
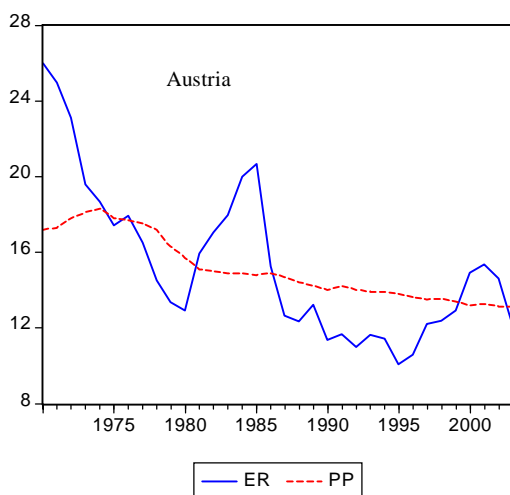
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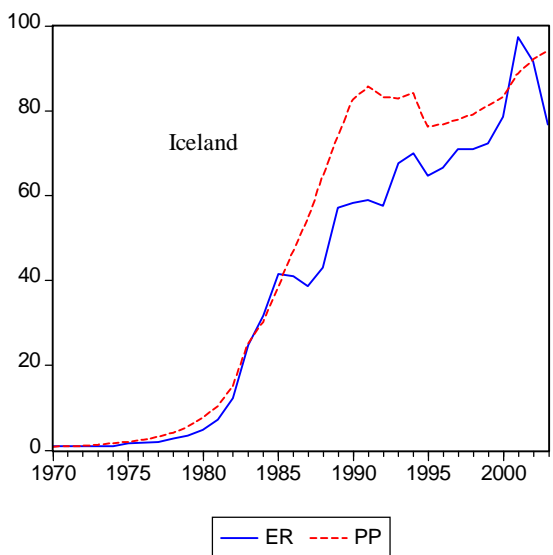
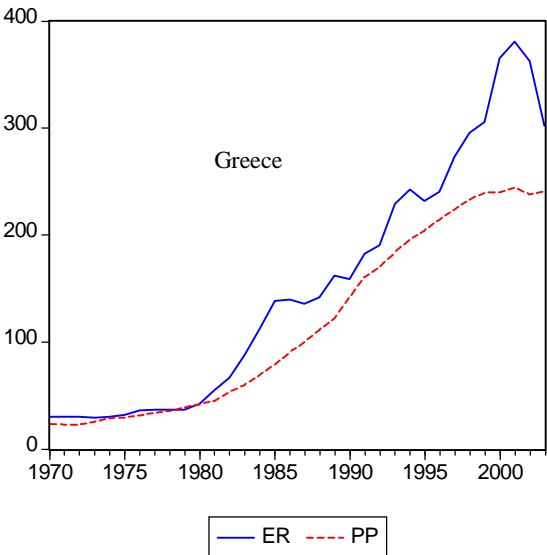
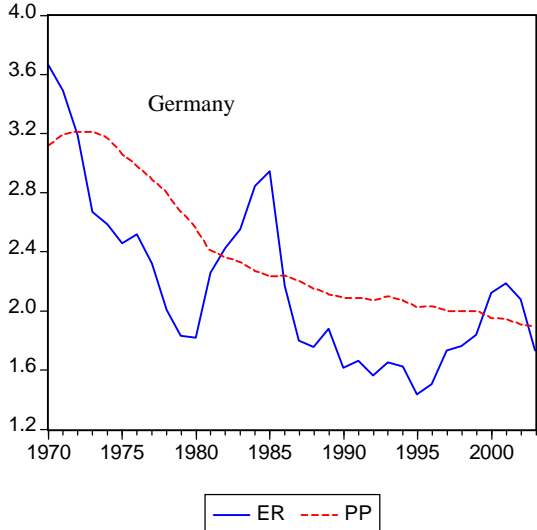
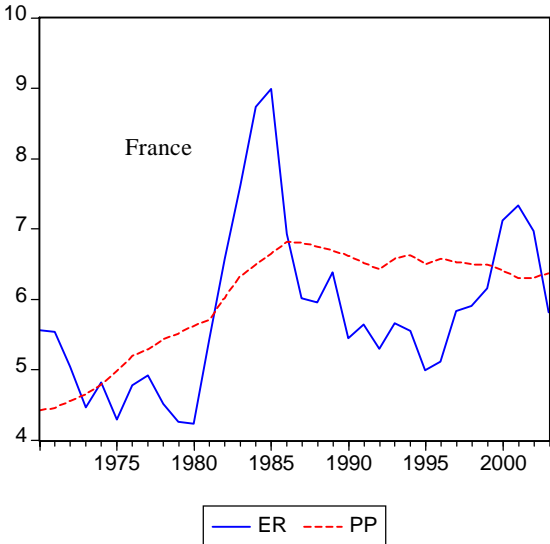
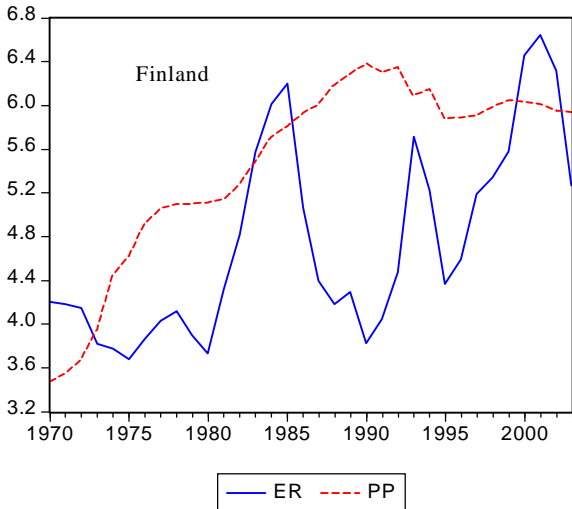
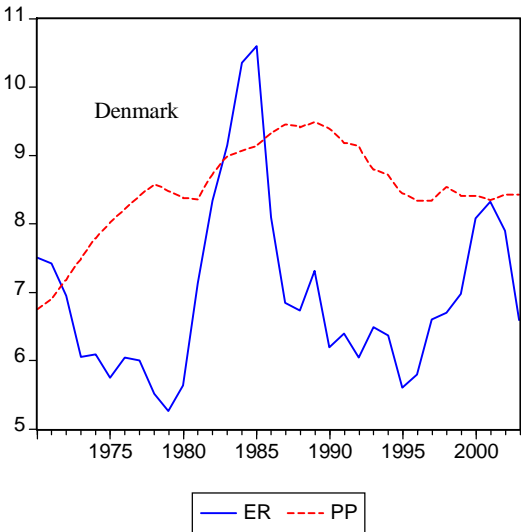
¹ Document available at <http://ideas.repec.org>

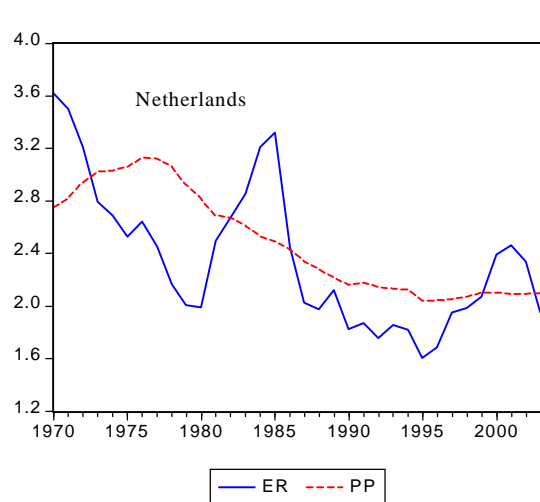
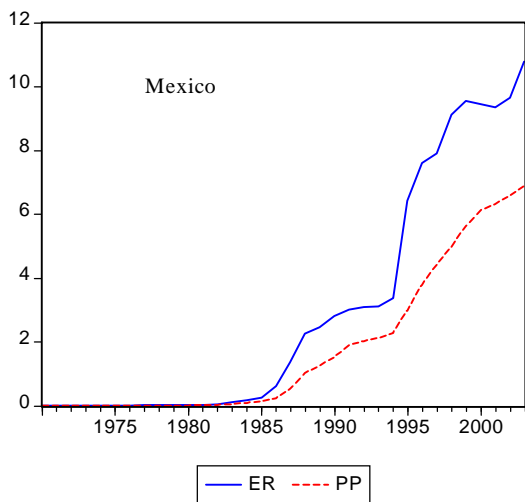
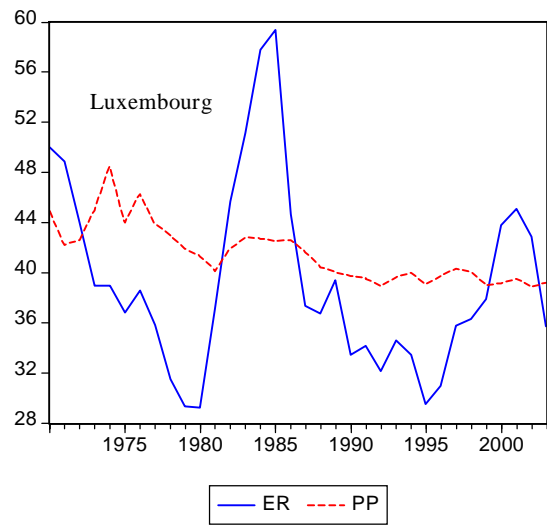
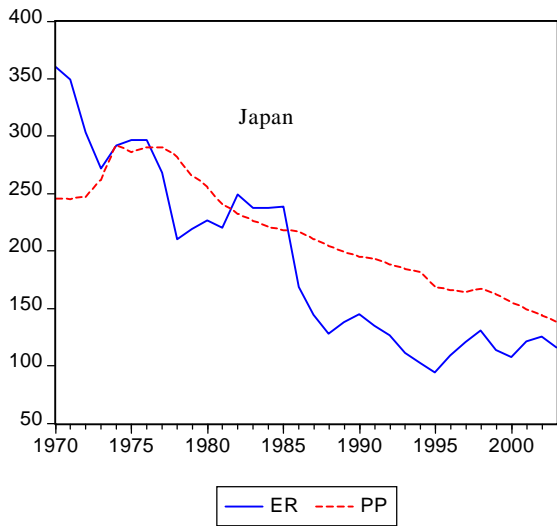
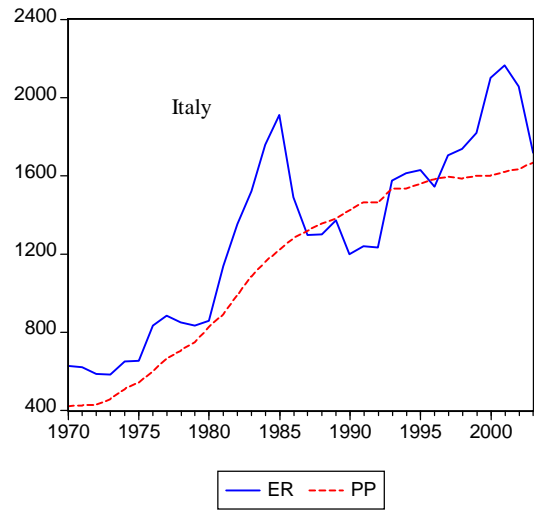
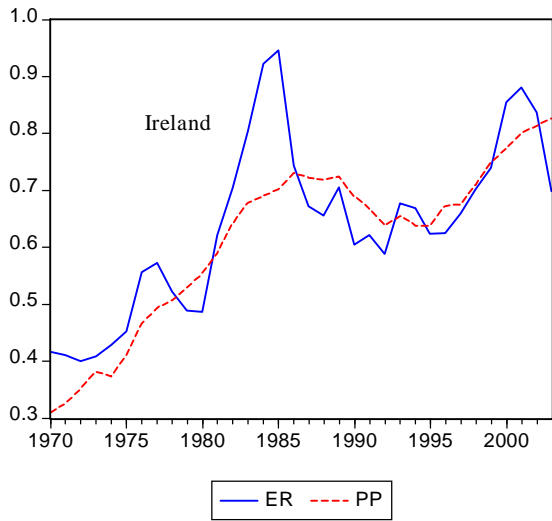
² Information available at: <http://www.usc.es/economet/ea.htm>

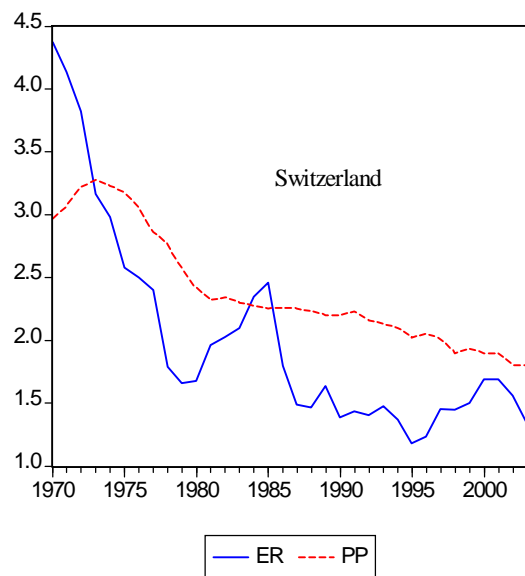
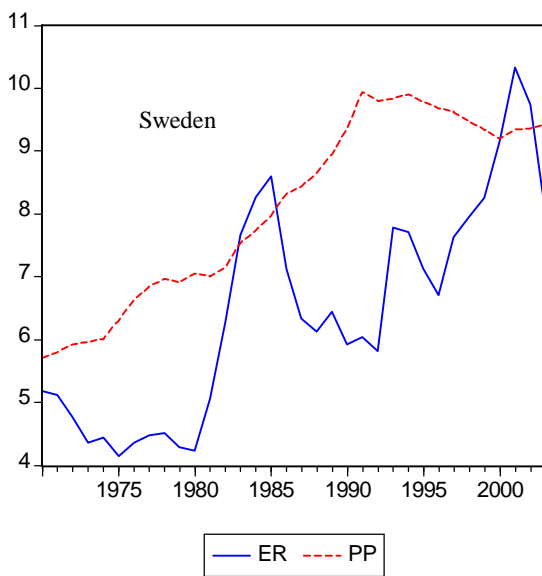
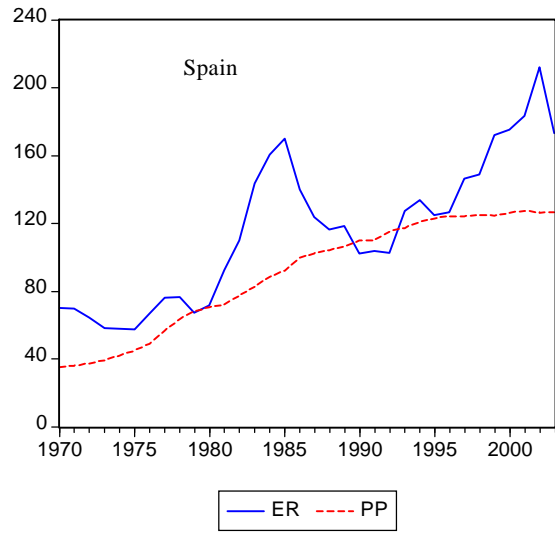
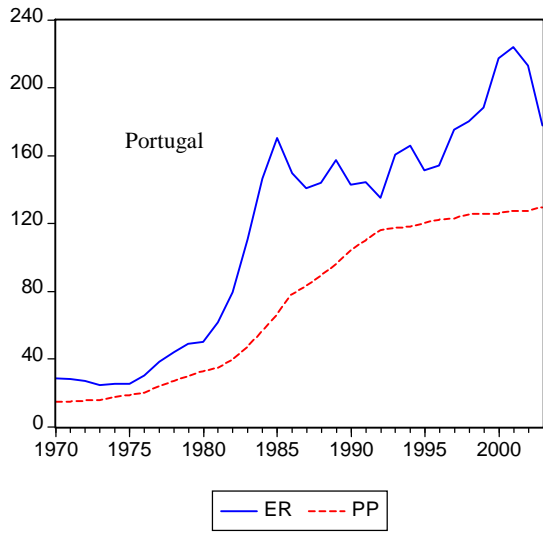
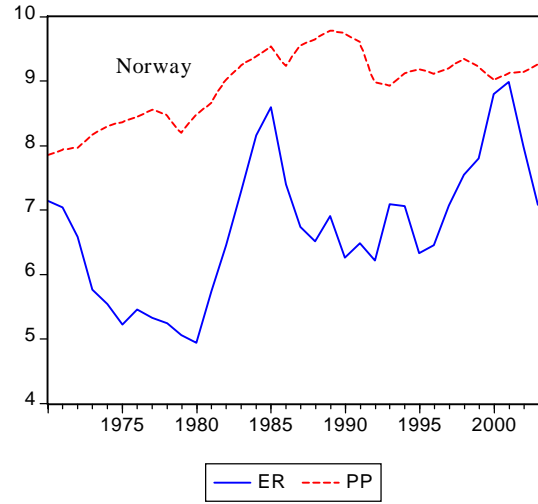
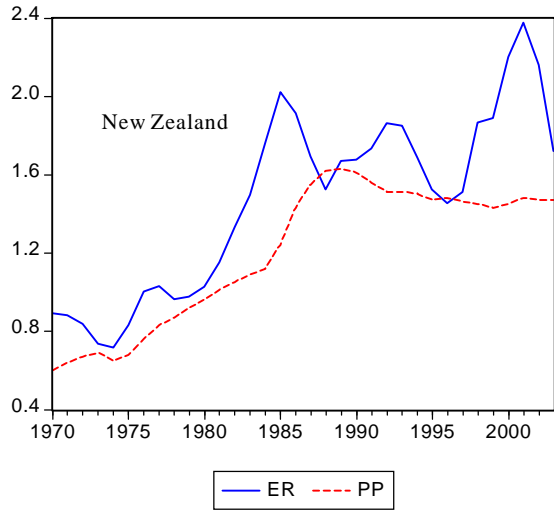
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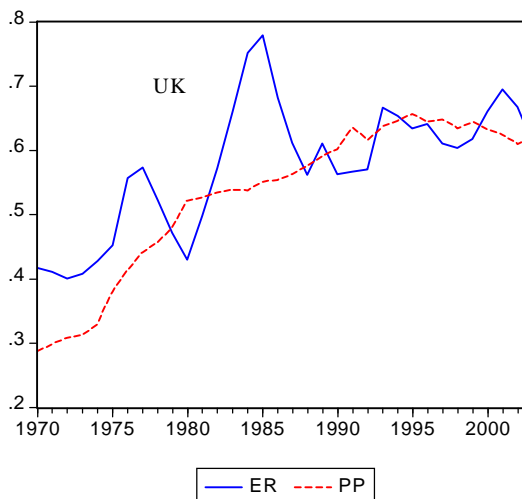
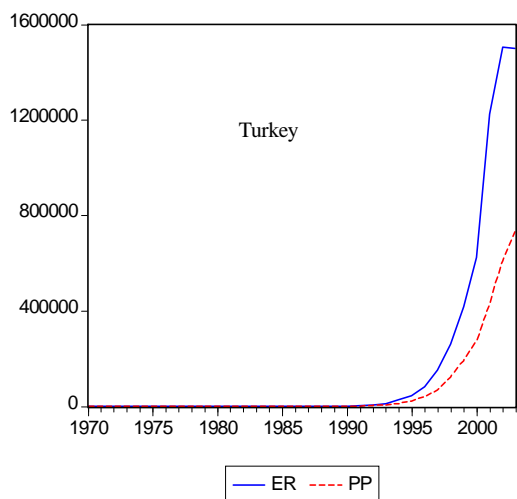
A1. Exchange Rates (ER) and Purchasing Power Parities (PPPs) in OECD countries, 1970-2003: units of local currency per 1 US \$



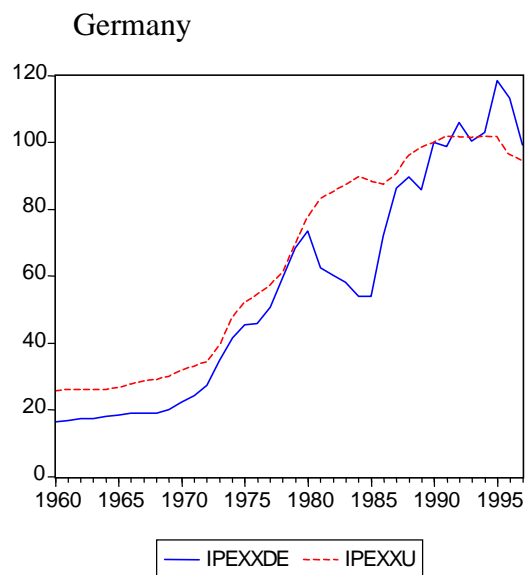
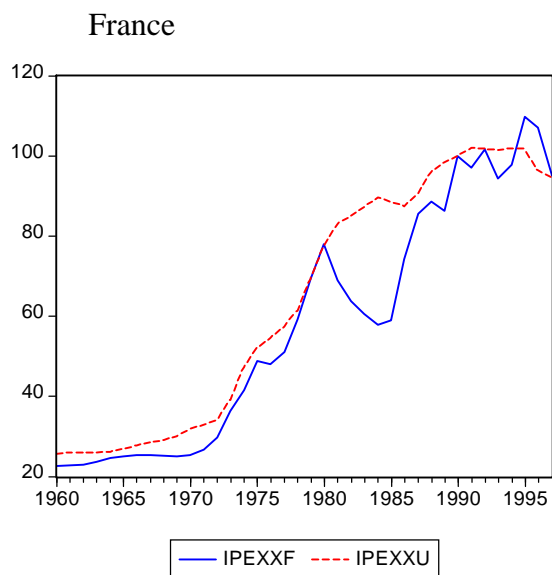






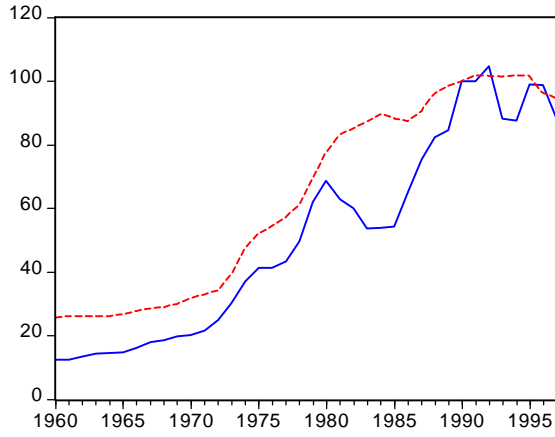


A2. Index of external Prices of Exports of 8 OECD countries in comparison with the USA



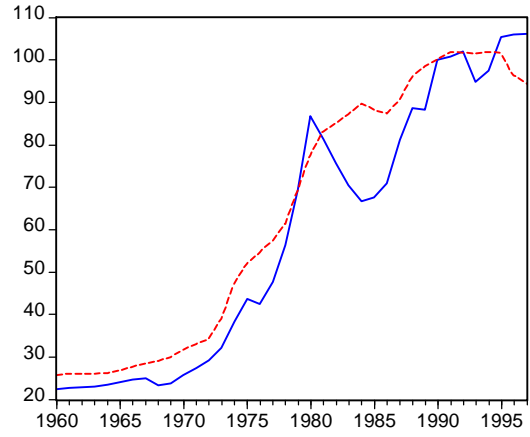
Spain

United Kingdom



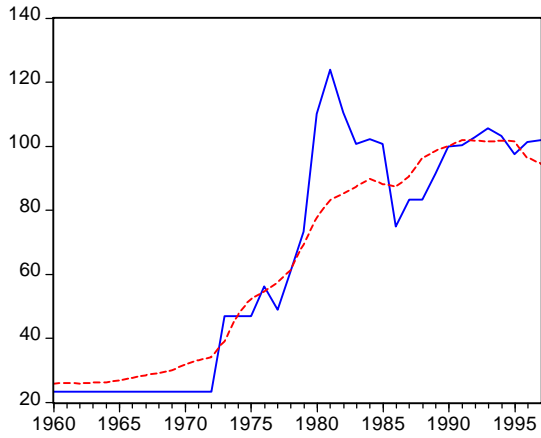
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Mexico



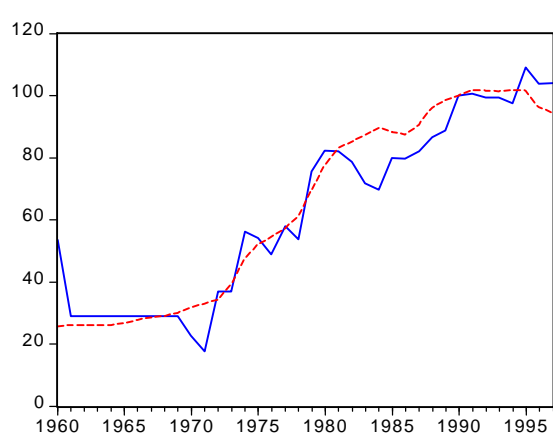
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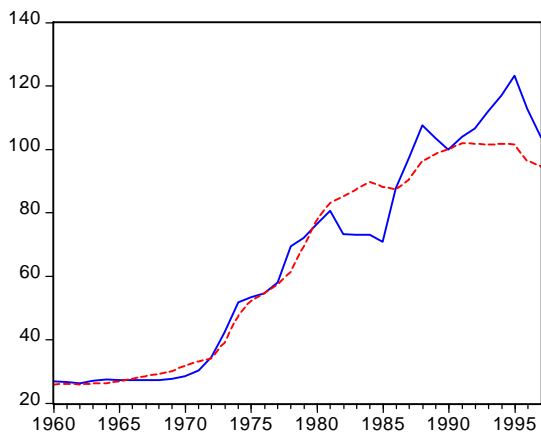
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Japan

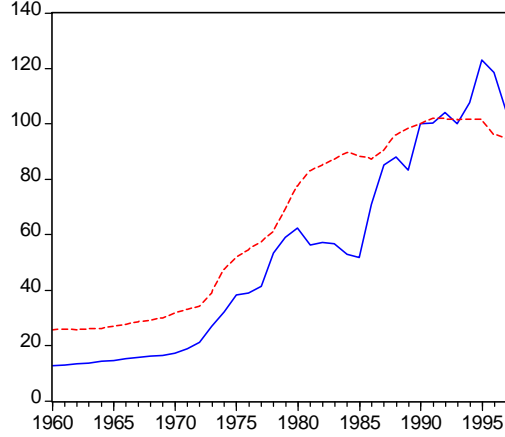


— IPEXXTR - - - IPEXXU

Switzerland

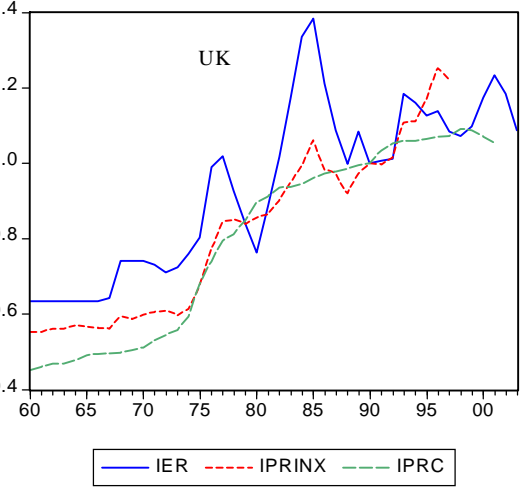
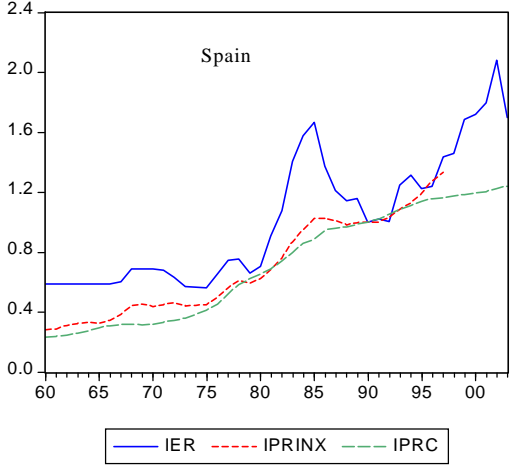
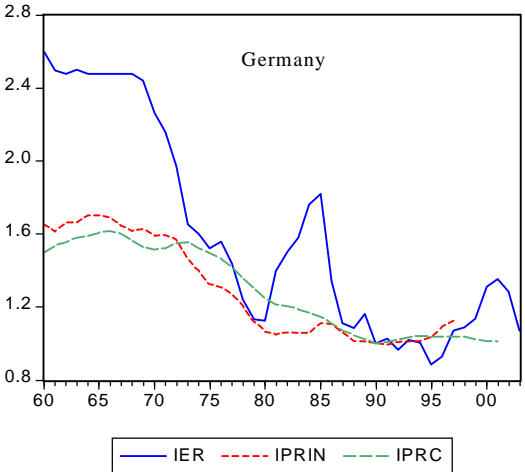
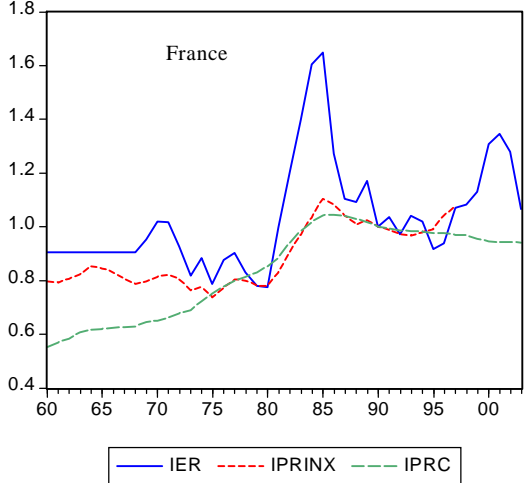


— IPEXXJ - - - IPEXXU



— IPEXXSI - - - IPEXXU

A3. Evolution of IER, IPRINX and IPRC in 4 OECD countries



A4. Short term interest rates

Rates of Interest Short term: RS

