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Foreing Trade Functions in the Countries of the Economic and Monetary Union

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Foreign Trade Functions in the Countries of the Economic and Monetary Union

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ABSTRACT

In this paper we focus on the major determinants of exports and imports in the member states of EU-15, giving a special emphasis on those belonging to the Economic and Monetary Union. For this reason we drive a general picture on the evolution of exports and imports. We analyse also the evolution of export and import prices, as well as the average labour productivity. Finally we estimate foreign trade equations both for imports and exports using the Johansen methodology. Among the major findings we can mention that we can reject the no cointegration among the import and export variables in the EU countries.

1. INTRODUCTION

Standard international trade theories state that countries have two main reasons to trade: the specialisation in those activities they do the best and the exploitation of scale economies. On the one hand, theories based on comparative advantages foresee the specialization of nations in those activities in which they have comparative advantages, mainly due to the lower price of production factors. However, the hypothesis in which these theories are based -perfect competition and constant returns to scale- have been considered rather unrealistic. On the other hand, Krugman (1979), Brander y Krugman (1983) and Helpman & Krugman (1985), presented other trade theory which consider imperfect competition, increasing returns to scale and differentiated goods.

As far as we have observed in some previous pieces of research such as Frías & Iglesias (2003), the expectations of some qualified economists of a deeper specialisation of northern European countries in human capital-intensive industries and in labour-intensive industries in the southern countries were not totally correct. However, the development of intra industrial trade in the last decades can be used to provide evidence of the fact that the benefits of scale economies were bigger in the south, where they were less exploited in the seventies. Both theories altogether may partially explain international trade flows in the EU. Foreign direct investment has also played a role in the reinforcement of specialisation patterns across Europe.

Being a member state of a monetary union, such as the EMU (European Monetary Union), forces nations to control inflation even more tightly than in other circumstances, in which other instruments of trade policy (exchange rate, import taxes or export subsidies) could be used to keep the external equilibrium.

The inflation gap can be defined as the amount in which inflation rate in a country is over the inflation rate of others. For an EMU state, the only way to recover a nominal competitiveness lost (due to inflation gap) is to have lower inflation rates in the future. This implies that having an inflation differential at present will force the country to go over a hard adjustment in the future.

As far as monetary policy cannot be used to correct nominal competitiveness losses, the only way to fight against this is controlling (or cutting) the costs and improving the productivity. Cutting costs will require the implementation of fiscal policies directed to control the demand. Alternatively, other competition strategies, based in increments of productivity and produces differentiation, may be followed.

Therefore, apart from those most desirable policies aimed to foster increases in productivity it is extremely important, when belonging to a monetary union, cautiously manage supply side, (flexible labour and product markets, increasing competition on the services sector,...). Besides, as these policies take time to produce effects, inflation gap must be closely surveyed.

In the present paper we will study the effects that international trade prices and national economic growth may have in the internal trade balance of the EU member states. Firstly, in next sections, we revise the evolution of import and export quantities, prices and average labour productivity in the countries of the EU-15 between 1970 and 2002. Then, we estimate export and import functions using Johansen methodology.

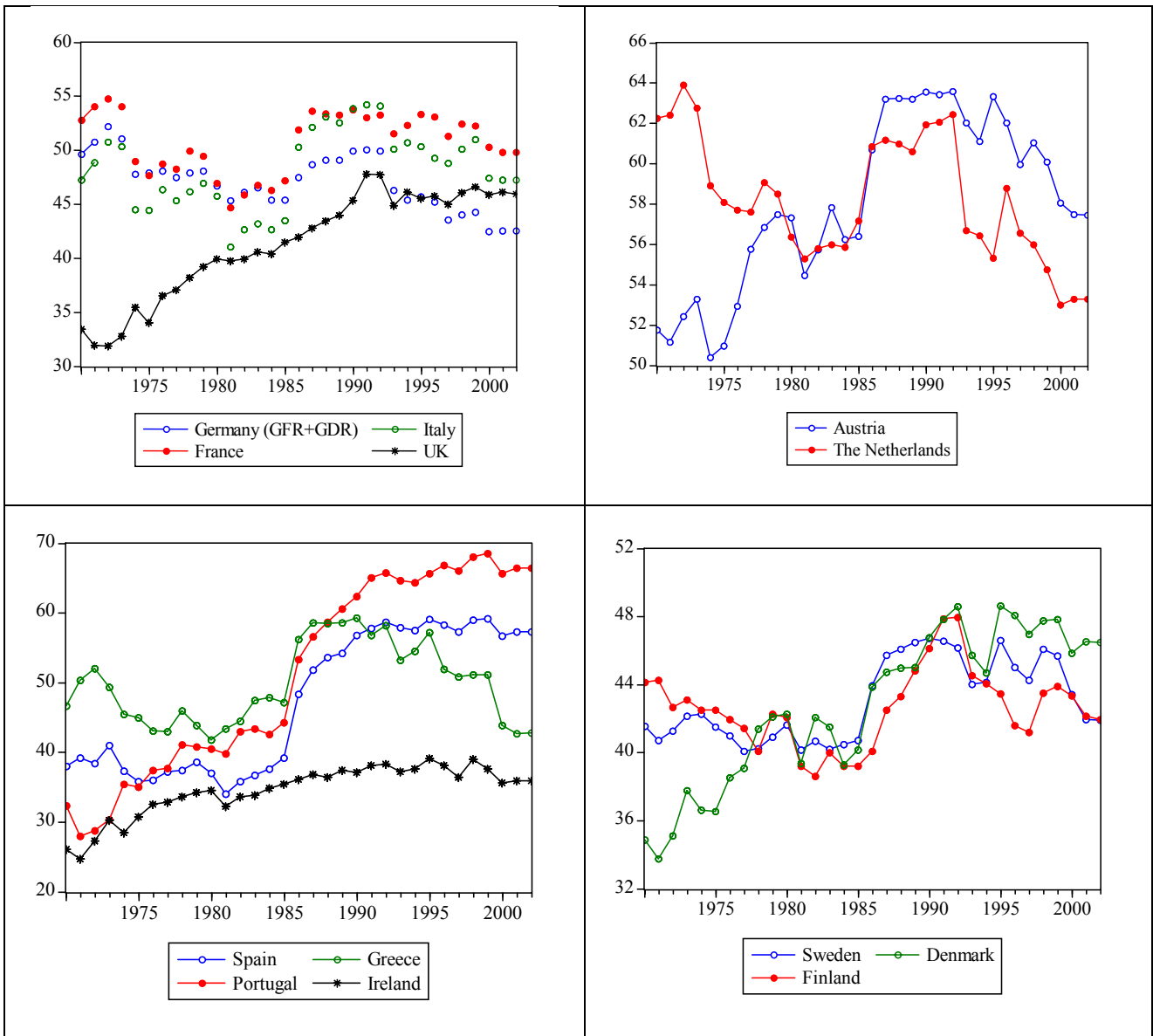
2. IMPORTS AND EXPORTS OF GOODS AND SERVICES IN THE PERIOD 1970-2002.

In this section, we address the evolution of the trade flows destined and originated in the Economic and Monetary Union (EMU) from 1970 to 2002.

The following graphs present, for the former 15 EU nations, the percentage of foreign trade directed to the EMU¹.

¹ Sometimes we have dropped Belgium and Luxembourg from our analysis because of a lack of consistency in the data published by OECD.

Graph 1. Foreign trade with the EMU as a percentage of total trade 1970-2002



Source: Author's calculations with OECD data.

Table 1. Foreign trade with the EMU, average for the thirteen countries

YEAR	Average (percentage)
1970	43.15
1980	44.08
1990	52.59
2000	48.60
2002	48.40

Source: Author's calculations with OECD data.

As it can be seen on the graphics and the table above, it seems that on average the percentage of foreign trade directed towards the EMU increased in the period studied. However, this evolution was not so clear if we observe the data in detail, as this percentage was higher in 1990 than in 2002.

Besides, we can also see that trade patterns are quite different when analysing the countries individually. The following three groups can be established:

- Countries which have clearly increased their trade with the EMU: the United Kingdom, Austria, Spain, Portugal, Ireland, and Denmark.
- Countries which have decreased their trade with the EMU: Germany and The Netherlands.
- Other countries: France, Greece, Italy, Finland and Sweden.

Then, we checked the degree of trade openness of the different countries with the EMU, measured as indicated below:

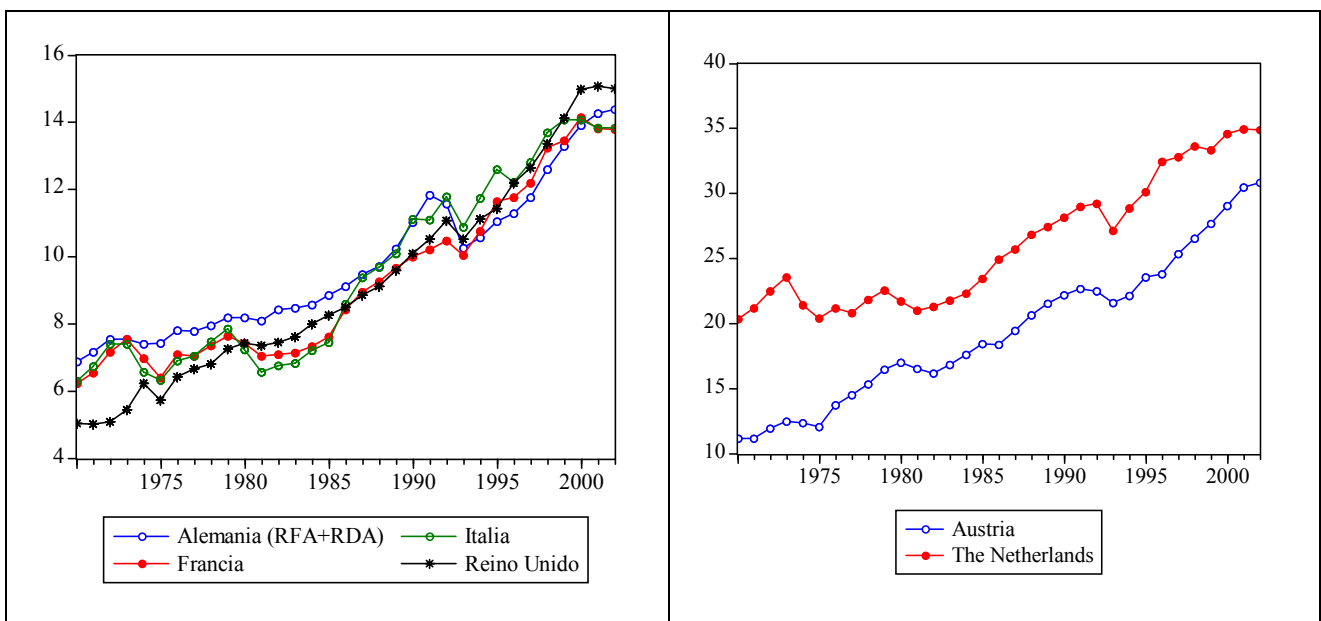
- Degree of openness with the EMU: $\frac{(X_{EMU} + M_{EMU})}{GDP} \times 100$, where

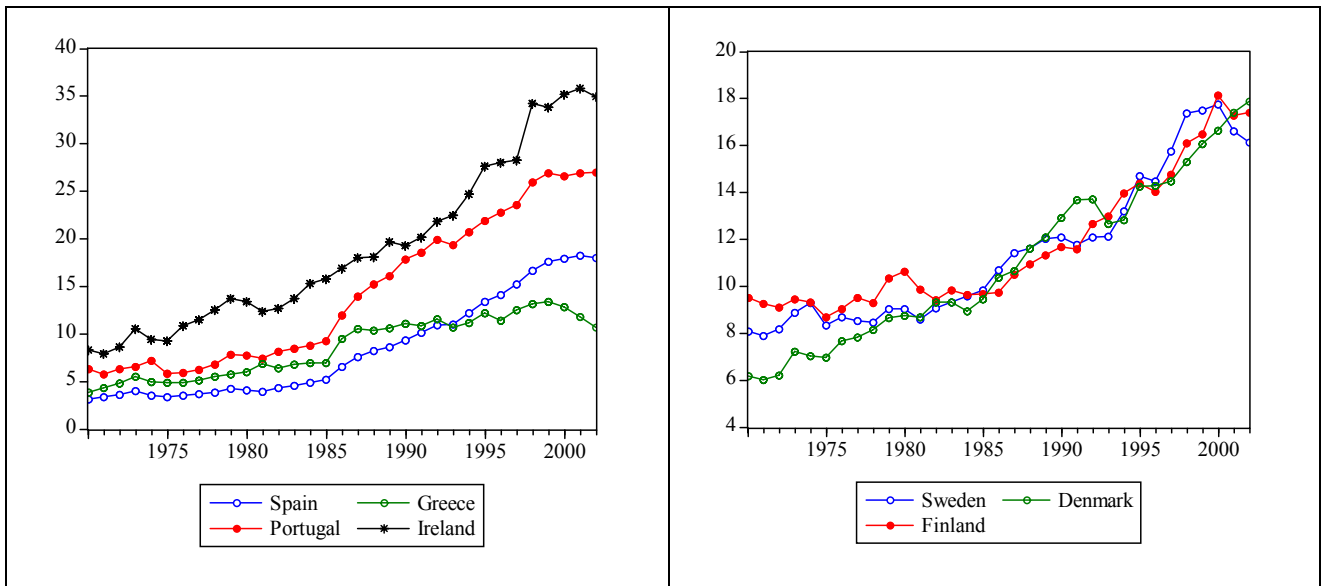
X_{EMU} : exports to the EMU MN € de 1995.

M_{EMU} : imports from the EMU MN € de 1995.

GDP: Gross Domestic Product MN € de 1995.

Graph 2. Trade openness with the EMU (in %), 1970-2002





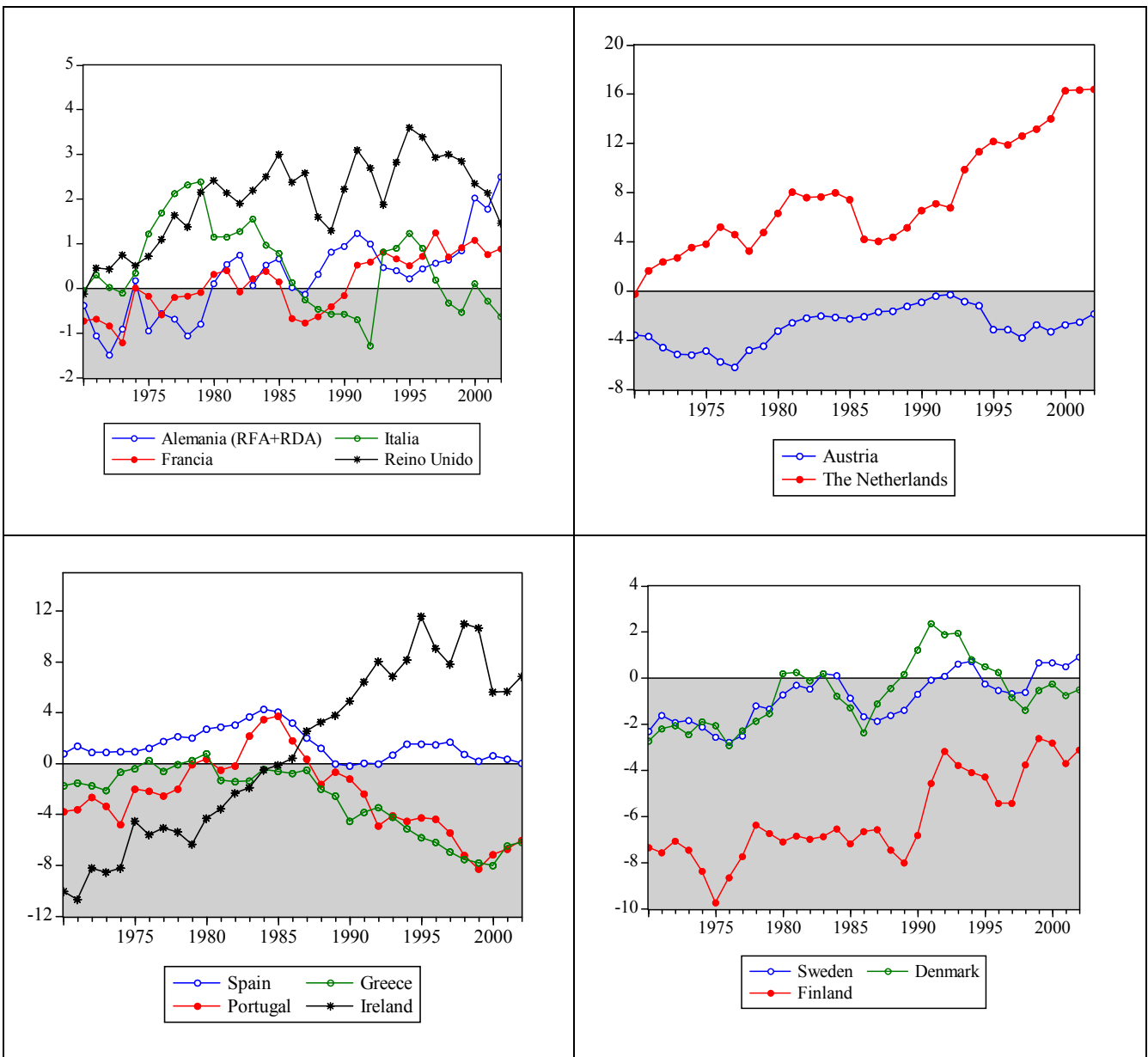
Source: Author's calculations with OECD data.

As we see in the graphs presented above, the evolution of trade is clearer: all the 13 nations considered have increased their trade openness with the EMU. However, we should remark that the degree of openness varies considerably among them. In 2002, the economies less opened with the EMU were Greece, Germany, the United Kingdom, Italy and France. In a similar position, although with a higher degree of openness, were Spain, Sweden, Finland and Denmark. Finally, among the more opened economies towards the EMU we find Austria, the Netherlands and two countries which, coming from a backward position, have achieved a high degree of openness with the EMU: Ireland and Portugal. As a rule of thumb, it seems as if bigger economies were less opened than the smaller ones. In fact, this is as expected as far as bigger economies have more possibilities of economic diversification. On the other hand, Greece has a singular geographical position, slightly isolated from the rest of its economic partners, and it is a fact that most countries trade mostly with their neighbour nations.

Next graphs show the trade balance of the thirteen countries with the EMU, which has been measured as follows:

- Trade balance with the EMU as a percentage of GDP: $\frac{(X_{EMU} - M_{EMU})}{GDP} \times 100$, where the variables are those considered previously.

Graph 3. Trade balance with the EMU as a percentage of GDP, 1970-2002



Source: Author's calculations with OECD data.

Apart from the more common situations of those countries which alternate trade deficits with trade surpluses, there are some striking cases. Ireland is the more shocking one, as it has changed its position from a huge trade deficit with the EMU in the 70s to an important trade surplus in 2002. Thus, the Irish miracle is reflected quite well in this indicator. Finland, in spite of the fact that still has a trade deficit with the EMU, has undergone a positive evolution since 1970. The Netherlands are another special case, as they have kept a regular and increasing trade surplus with the EMU for the whole period. In 2002, it has reached almost the 16% of GDP. It can also be seen that both, the UK and Germany, have been able to increase their trade surplus with the EMU, while other countries such as Greece or Portugal have gone in the opposite way.

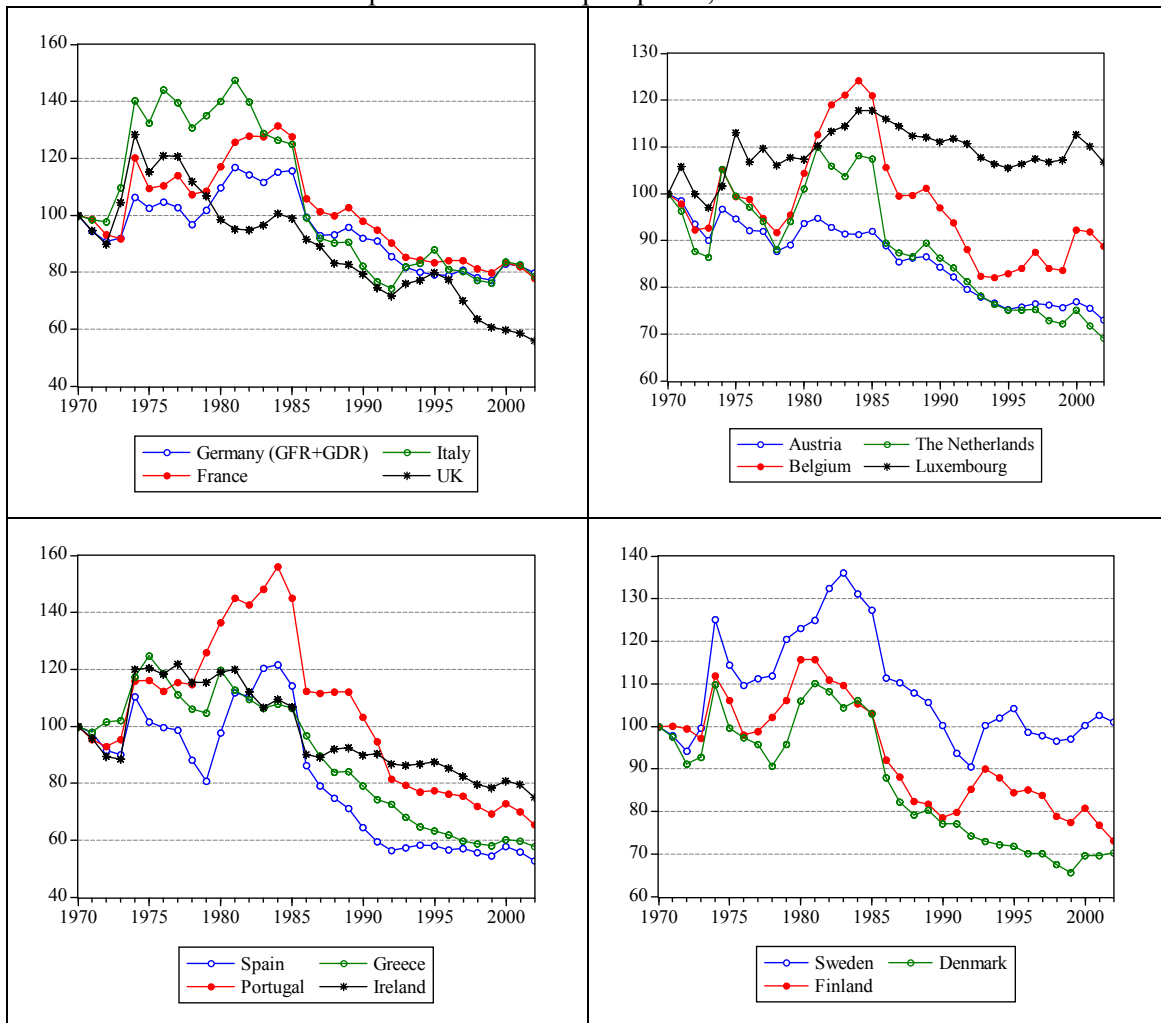
3. THE EVOLUTION OF IMPORT AND EXPORT RELATIVE PRICES

In this section we will come over the evolution of export and import prices in the EU-15. Price variables are widely used in foreign trade models. Empirical works using price variables can be seen in *Houthakker & Magee (1969)*, *OECD Econometric Model (Adams et al., 1969)*, Faini, Prichett & Clavijo (1992), Bahmani-Oskooee & Nimroomand (1998), Fernández and Sebastian (1991), Buisan and Gordo (1994), Montañes and Sansó (1996), or Straub (2002), among many other studies.

In the next graphs, we will see the evolution of relative import prices for the EU-15, as well as the evolution of the two variables used to construct the relative prices, defined as follow:

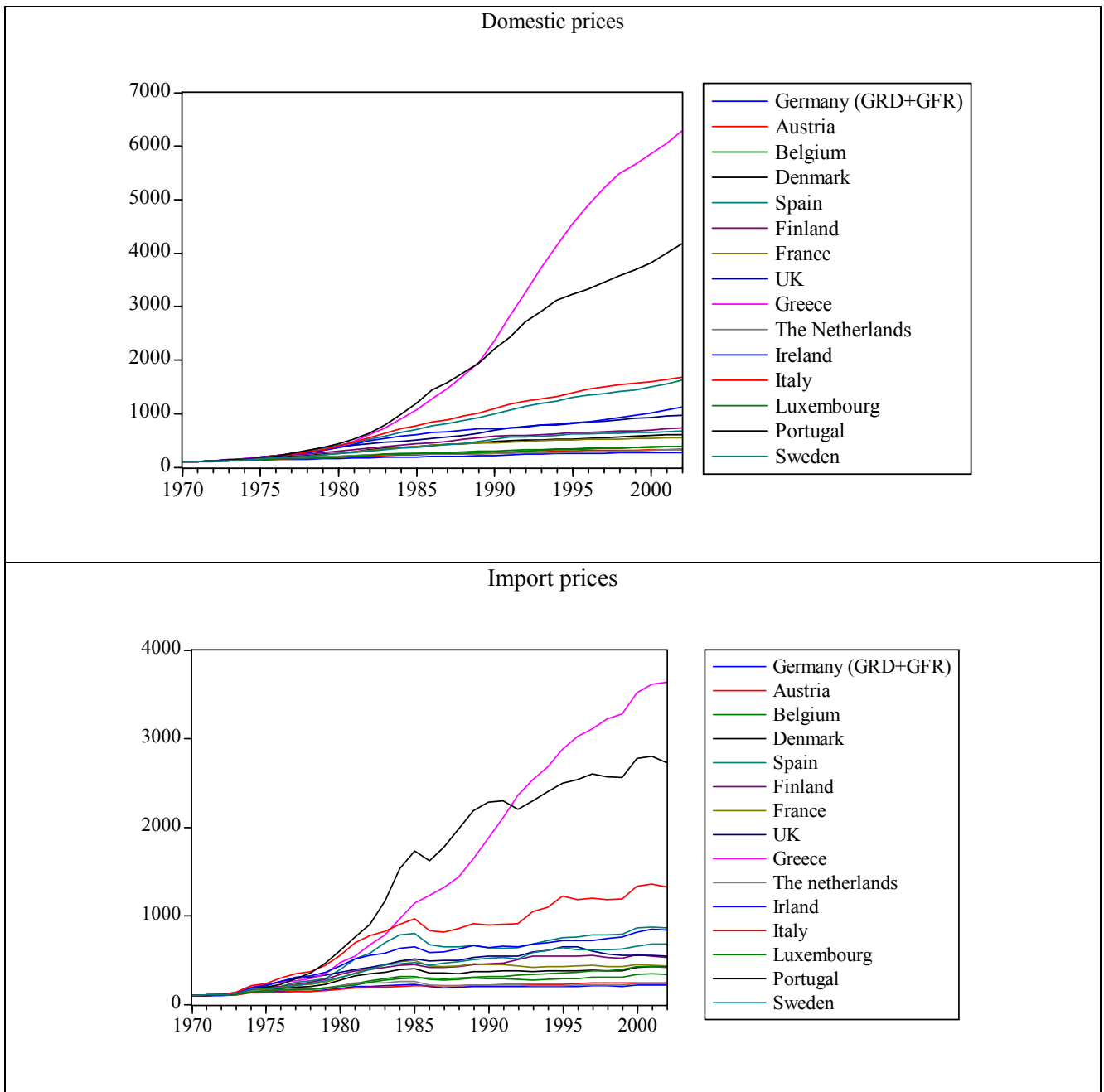
- Relative import prices = $\frac{P_M}{P_D} \times 100$, where
 P_M index of import prices (1970 = 100)
 P_D index of domestic prices (1970 = 100)

Graphs 4. Relative import prices, 1970-2002



Source: Author's calculations with OECD data.

Graphs 5. Domestic and import prices, 1970-2002



Source: Author's calculations with OECD data.

As can be clearly seen in the graphs, the relative import prices of the EU-15 states have decreased over the period under study. This general tendency can be splitted in two sub periods. The first one would comprise the years from the first oil crisis in 1973 until the middle 80s, when import prices rose at a higher rate than domestic prices. After 1985, import prices moderated their growth while domestic prices continued to increase. Due to this differential, relative prices started to decline constantly in this second interval.

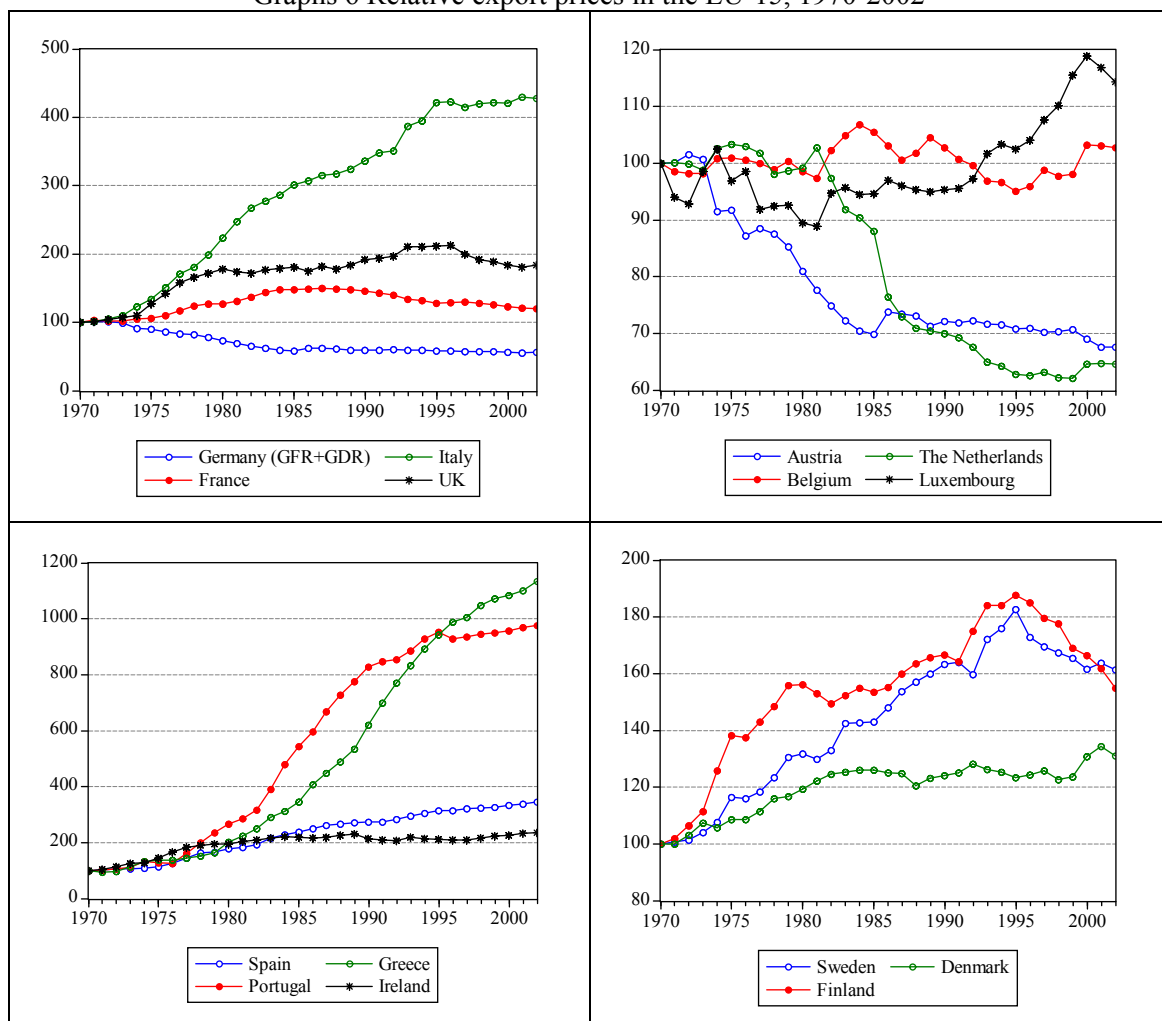
Of course, there are some differences, Luxembourg is one of them, but there is no doubt about the existence of a similar pattern among the EU-15 countries.

Apparently, the evolution of import prices reflects quite closely that of the energy imports prices, apart from some other factors as the reduction of intra EU import tariffs. This is a severe drawback for the estimation of our import equations as far as we will employ import prices which include some systematic errors and that will necessarily be correlated with import quantities. In next revisions of this paper, we will have to address the estimation of import prices that more reliably reflect the prices of goods and services imported from the EMU area.

Next graphs show, for each country, the evolution of export prices in relation to the export prices of the rest of the EMU. This indexes attempt to reflect the differences in the evolution of both prices, in order to point to those countries whose export prices are growing faster than those of the rest of the EMU.

- Relative export prices = $\frac{P_{Xi}}{P_{XEMU-i}} \times 100$, where
 P_{Xi} are export prices of country i
 P_{XEMU-i} are export prices of the EMU area less country i

Graphs 6 Relative export prices in the EU-15, 1970-2002

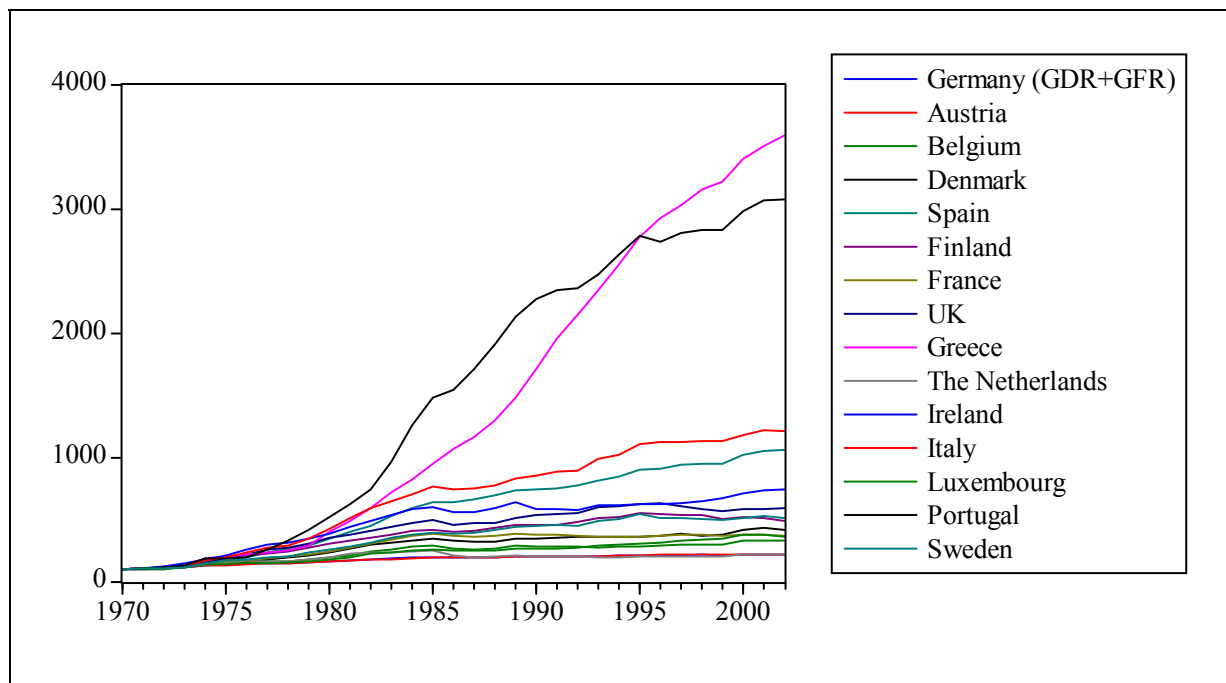


Source: Author's calculations with OECD data.

The graphs show that there is no common pattern in this case; the evolution of the export prices of EU-15 countries has been dissimilar. While the export prices of Italy, Portugal, or Greece experienced a huge increase since 1970, those of Austria or the Netherlands acknowledged an important decrease in the same period.

If we wanted to evaluate more accurately nominal price competitiveness, as well as its temporal evolution, it would be necessary to analyse the price level of several goods and services and their growth rates. Attention should not only be devoted to aggregated prices, but also to the prices of those sectors or products more linked to foreign trade activities. Nonetheless, this goes beyond the scope of this paper.

Graph 7. Export prices in the EU-15



Source: Author's calculations with OECD data.

We should bear in mind that export quantities, as well as import quantities, are surely not homogenous throughout a period of time as long as the one considered. Thus, we may wrongly take for a loss of competitiveness which really is an increase or in the amount of value added or in the quality of the produces exported. One possible way to overcome this problem is disaggregation, although Grundfeld & Griliches (1960) and Aigner & Goldfeld (1974) have disregarded this possibility as they have pointed out that disaggregated data are more unreliable and that disaggregated import equations are more likely to suffer from specification errors. In relation with forecasting, whether forecasting errors corresponding to the disaggregated equations cancelled out, there would be no problem. Otherwise, aggregated functions may have a better forecasting capability.

Next table presents domestic, import and export price indexes for the EU-15 nations in years 1980, 1990, 2000 and 2002.

Table 2. Price indexes: domestic (D); imports (M); and exports (X) (1970=100)

		GE	AU	BE	DE	SP	FI	FR	UK	GR	NE	IR	IT	LU	PO	SW
1970	D	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
	M	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
	X	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
1980	D	166	186	199	260	406	293	255	370	395	209	363	399	187	445	251
	M	182	174	208	276	397	339	299	364	474	211	432	558	201	608	309
	X	165	162	195	236	347	306	242	350	402	197	381	423	177	523	260
1990	D	220	262	302	477	999	578	459	687	2368	253	717	1093	280	2206	524
	M	202	221	294	367	645	454	450	546	1874	219	643	899	311	2279	525
	X	200	203	284	344	740	457	381	532	1714	205	586	853	264	2270	452
2000	D	267	321	370	596	1497	693	536	932	5845	314	1013	1597	377	3810	652
	M	222	247	342	415	866	560	447	556	3519	236	818	1335	425	2779	653
	X	219	222	326	414	1021	521	377	581	3404	218	707	1182	375	2983	510
2002	D	275	332	384	605	1630	726	557	973	6287	342	1119	1683	390	4171	677
	M	219	242	341	426	862	532	433	544	3638	236	840	1324	416	2730	684
	X	221	220	327	418	1060	491	372	587	3589	220	745	1209	364	3071	515

Note: GE, Germany; AU, Austria; BE, Belgium; DE, Denmark; SP, Spain; FI, Finland; FR, France; UK, United Kingdom; GR, Greece; NE, The Netherlands; IR, Ireland; IT, Italy; LU, Luxembourg; PO, Portugal; SW, Sweden.
Source: Author's calculations with OECD data.

It is clear that export prices have increased more in Greece and Portugal than in any other country of the EU-15 (Sweden also stood out, although on a lesser degree). Conversely, export prices did not increase too much in The Netherlands, Germany and France.

Import prices also grew more in Greece and Portugal and less in Germany, the Netherlands and France.

In relation to domestic prices, we can add that apart from Greece and Portugal where they increased intensely, in some other countries like Italy, Spain and Ireland they increased significantly.

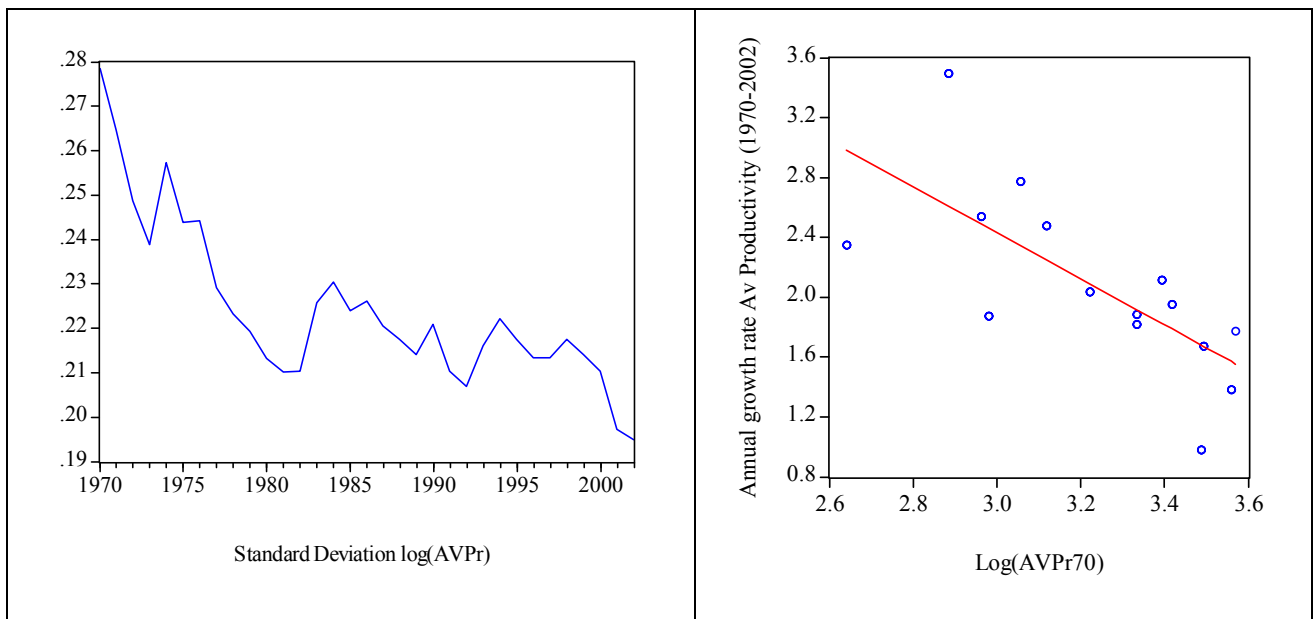
4. AVERAGE LABOUR PRODUCTIVITY IN THE EU-15

As it was previously stated, we should not forget that price indexes provided by the statistical offices find strong difficulties to account for just pure price variations, the reason is that products are changing their quality permanently and aggregated quantities may be hiding different goods and services mixes. Thus, if we take prices at aggregated level, we are not considering that the quality and the mix of the products traded may have also changed. Therefore, the country which is experiencing an increase in its export prices, let's say in relation to the EMU, may not be losing competitiveness but increasing their quality or their value added content.

In this section, we will make use of the commonly known concepts of σ -convergence and β -convergence² to check whether we can confirm, or not, the existence of convergence in the average labour productivity within the EU-15.

The graph on the left shows the standard deviation of the natural logarithm of average labour productivity for the EU-15. On the right, we plot the scatter with the regression line for the β -convergence equation.

Graphs 8. Average labour productivity in the EU-15: σ -convergence and β -convergence.



Source: Author's calculations with OECD data.

The graph on the left shows a strong decrease, almost 10 points, in the standard deviation of average labour productivity in EU-15. Thus, we confirm the existence of σ convergence.

The graph on the right clearly shows the presence of a negative relationship between the annual growth rate of average labour productivity during 1970-2002 and its value in 1970. β equals - 1.539518035 (with a t-statistic of -3.682562):

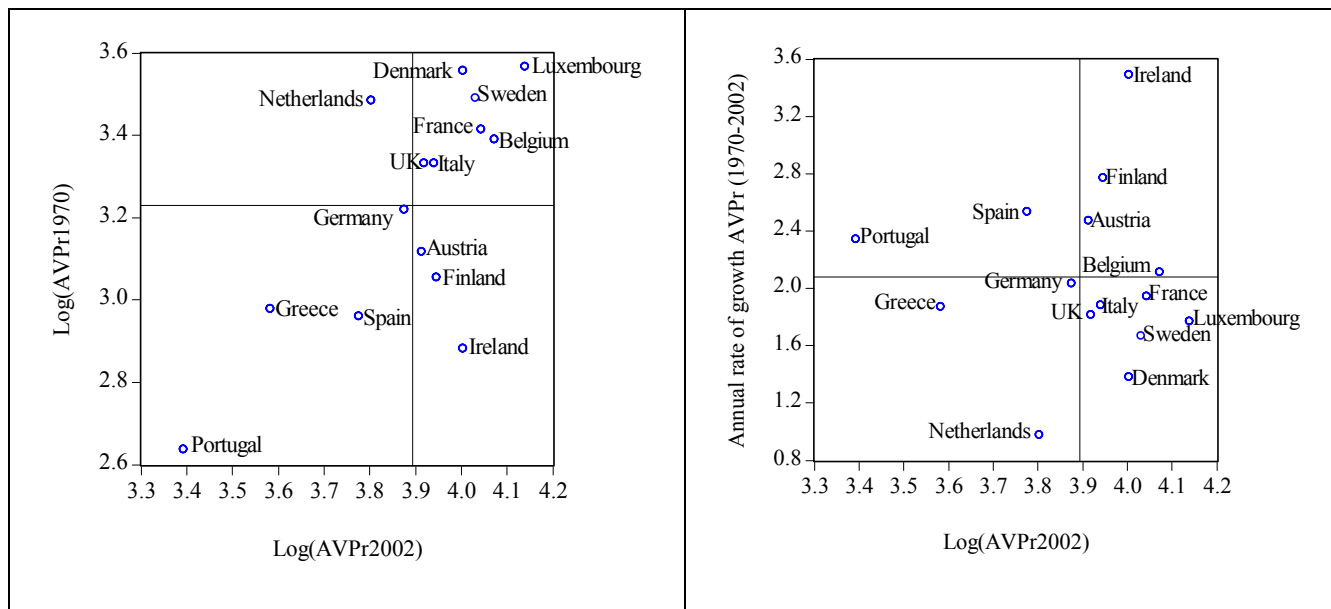
$$\gamma_{70-02} = 7.049620871 - 1.539518035 * \text{Log}(\text{PME70}) \quad R^2 = 0.51$$

As a conclusion, we can state that evidence supports the existence of both σ and β convergence in the evolution of average productivity in the EU-15.

² As they are profusely used in the literature and may be found in many publications such as Barro (1991) or Sala-i-Martin (2000).

With the next to graphs we will go deeper in the analysis of labour productivity in the EU-15, completing the information presented previously.

Graphs 9. Average labour productivity in the EU-15, past and present.



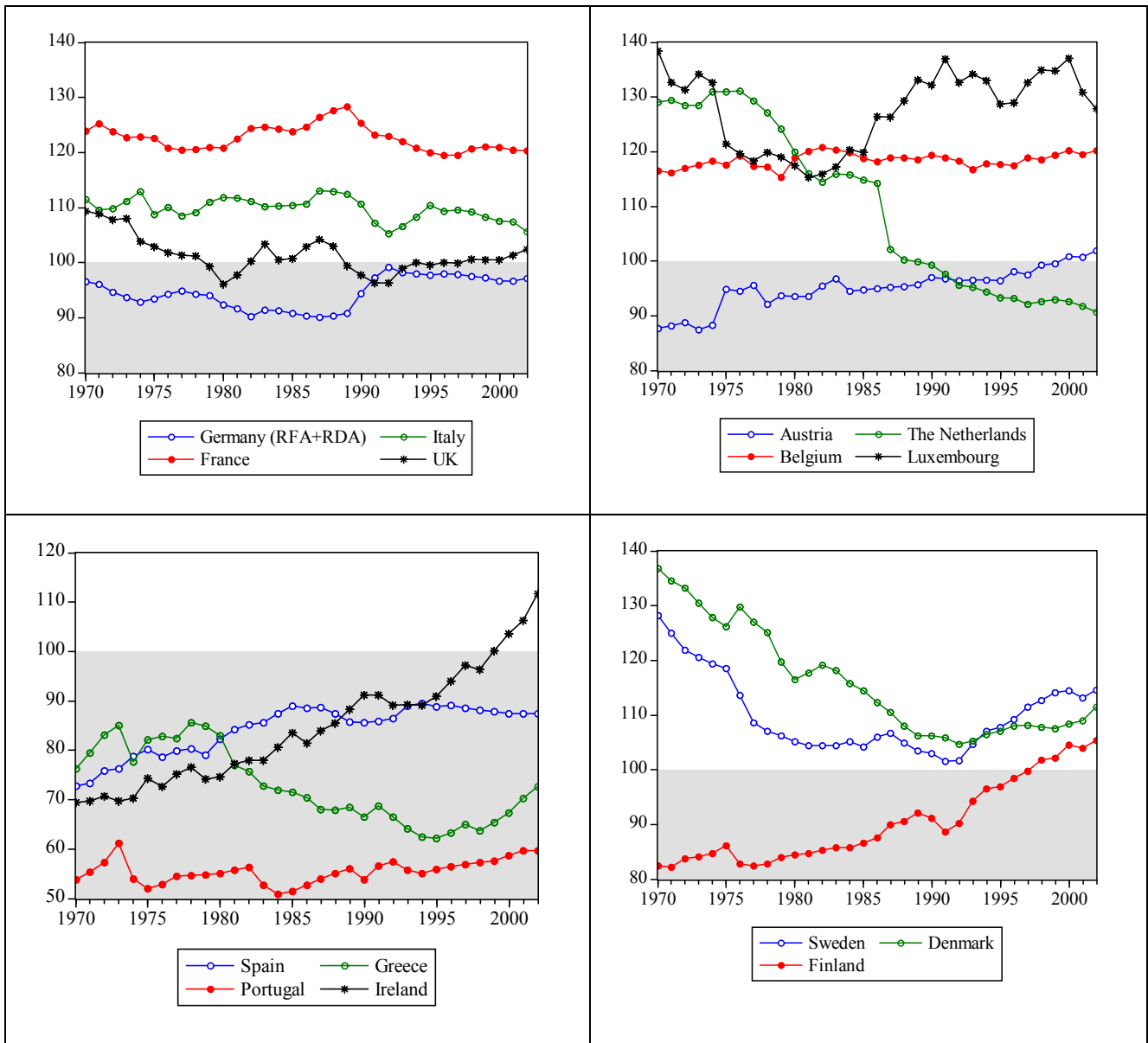
The graph on the left shows, that despite the existence of convergence (reflected on the reduction of the differential between countries with higher and lower productivity), the nations with higher average labour productivity are almost the same in 1970 than in 2002. Nevertheless, there are two significant cases that we would like to stress. Firstly, the Irish one, which coming from the second worse position in 1970 has well surpassed the EU-15 average in 2002, (as it happened with Austria and Finland though in a lower extent). Secondly, the case of Germany, which may be confusing due to the fact than we are considering the former GFR and the GDR altogether. If we had just considered the former GFR, average labour productivity would have obviously been higher³.

The graph on the right complements latter conclusions. We can see that some of those countries with higher labour productivity in 2002, such as Ireland, Finland or Austria, are those which grew faster during the period 1970-2002.

Graphs 10 present the average labour productivity per worker in every EU-15 country in relation with that of the rest of the EMU.

3 As Fuentes (2002) points the average labour productivity in the GDR was much lower than in the GFR.

Graph 10. Relative average labour productivity per worker in every EU-15 state. $\left(\frac{AV Pr_i}{AV Pr_{EMU-i}} \times 100 \right)$



Source: Author's calculations with OECD data.

Portugal and Greece are those countries with lower labour productivity amongst the EU-15 states, whereas the higher productivities can be seen in Luxembourg, France or Belgium.

Ireland increased enormously its average labour productivity achieving the level of the most privileged EU nations in this respect. On the contrary, Sweden, Denmark or the Netherlands, in spite of an important decrease, still keep a high position.

In order to shed some light about how much has changed the aggregated trade composition from 1970 to the present, next table presents national averages of the Grubel-Lloyd indexes⁴ (GLI) for the UE-15 in years 1986, 1992, 1998 and 2001. GL indexes have been computed as weighted averages over 23 industries⁵ of the trade indexes for every bilateral trade flow.

Table 3. Grubel-Lloyd Adjusted indexes (national averages).

	Austria	Belgium	Denmark	Finland	France	Germany	Greece	Netherlands	Ireland	Italy	Portugal	Spain	Sweden	U.K.
1986	0.65	0.7	0.59	0.49	0.68	0.66	0.36	0.66	0.58	0.57	0.44	0.59	0.55	0.67
1992	0.66	0.71	0.59	0.51	0.7	0.69	0.4	0.71	0.6	0.58	0.48	0.64	0.54	0.71
1996	0.68	0.7	0.6	0.48	0.71	0.7	0.43	0.69	0.57	0.61	0.48	0.65	0.56	0.72
1998	0.66	0.69	0.63	0.48	0.72	0.7	0.45	0.69	0.53	0.61	0.54	0.66	0.56	0.7
2001	0.68	0.68	0.61	0.45	0.73	0.71	0.45	0.65	0.5	0.61	0.58	0.68	0.57	0.68

Note: national averages have been weighted with the total amount of trade flows.

Source: OECD. Foreign Trade by Commodities. Several issues.

International trade patterns correspond to some varied influences. First of all, inter-industrial trade reflect the existence of comparative advantages between countries, so if inter-industrial trade is dominant GLI will have a value close to zero. Secondly, intra-industrial trade reveal the presence of scale economies, which prevent each country of producing the whole range of commodities it consumes. GLI will be equal to unity when trade between two countries is entirely intra-industry.

In general, both types of trade - inter and intra-industrial – will exist and their preponderance would depend upon the existence of similarities and differences among countries. If some economies are alike, intra-industrial trade will be pre-eminent. If they are not so similar, inter-industrial trade (based on comparative advantages) will flourish.

As can be seen on the table presented above, on the one hand, countries such as Ireland or Finland seem to have increased their inter-industrial trade making use of their comparative advantages to gain a better position on international trade. On the other hand, we may observe how countries like Greece, Portugal, or Spain have reinforced their intra-industrial trade.

$${}^4 \text{GLI} = 1 - \frac{\left| \frac{X_{ijk} - M_{ijk}}{X_{ij} - M_{ij}} \right|}{\frac{X_{ijk} + M_{ijk}}{X_{ij} + M_{ij}}}, \text{ where:}$$

X_{ijk} (M_{ijk}) are exports (imports) for the k sector and i country to (from) country j .

X_{ij} (M_{ij}) are total exports (imports) in country i to (from) country j .

⁵ Food and live animals, Feeding stuff for animals, Beverages, Tobacco, Textiles, Clothing, Leather-fur, Footwear, Wood, Wood furniture, Paper, Chemicals, Medical and pharmaceutical products, Petroleum and petroleum products,

As a conclusion, we should say that after fifteen years trade models in the EU did not change on a radical way. However, most of the countries increased their share of intra-industrial trade, which is probably related to the better ability of European companies to compete on a continental basis. This is partially reflected in the process of labour productivity convergence and reinforces the idea of the change in the trade composition. Thus, export prices must be registering the influence of an increasingly less differentiated trade between northern and southern states.

Ireland and Finland have increased their inter-industrial trade based on their comparative advantages in human capital and capital intensive industries, respectively. Therefore, some portion of their export prices increments should also be attributed to this reason.

5. ESTIMATION OF THE FOREIGN TRADE EQUATIONS

In this section, we will follow the analysis based on the consideration of elasticities, which has had significant contributions of such outstanding economist as Marshall, Lerner or Robinson. Its main drawback is that it is a partial equilibrium analysis and, therefore, it does not take into account the existing relations among exchange rates and some other fundamental economic variables as interest rate, inflation, money supply, etc

Econometric models of international trade explain individual trade flows through the estimation of time series functions in a little constrained manner. These models reflect a conception of international trade characterized by the existence of bi-lateral flows in almost every produce in a context in which the one-price law does not hold. The typical equations have the following specification:

$$M = a_1 Y^{a_2} (EP^*/P)^{a_3} \text{ (imports equation).} \quad X = b_1 WY^{b_2} (P/EP^*)^{b_3} \text{ (exports equation).}$$

where:

X are real exports

M are real imports

Y is the real income of the country

WY is the real income of the rest of the world

E is the nominal exchange rate

P are domestic prices

P* are foreign prices

The functional form usually employed is the log-linear. In this case, the estimators of the coefficients are the elasticities with respect to income and relative prices ($\xi_Y^M = \hat{a}_2$ and $\xi_p^M = \hat{a}_3$), respectively. These elasticities are constant along the sample.

First of all, we will address the determination of the dynamic behaviour of the series (M, X, Y, YW, P and P*) with the assistance of the most widely used unit root tests: Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP).

The deterministic components of the test equations (intercept and lineal trend) were included or not according to the observation of the graphical evolution of the series, which allows to determinate the most plausible rival hypothesis. The number of lags in the ADF test was selected according to the Schwartz Criteria up to a maximum of 9 lags. In the PP test, the New-West criteria was employed to capture serial correlation and to obtain a consistent estimation of the residual variance.

Secondly, the verification of the existence of cointegration and the estimation of export and import equations was made with the Johansen methodology.

Estimated price elasticities may be close to zero because of the simultaneity bias that may emerge due to the joint determination of quantities and prices, in which case, the elasticities estimated would be a weighted average of the supply and demand elasticities. Estimation procedures for equation systems must be used in this situation. In fact, Goldstein & Khan (1985) report that the researchers who made estimations under this assumption obtained higher price elasticities. Johansen procedure, besides of its better estimation properties, may also be used as an auxiliary tool in traditional econometrics: the existence of more than one cointegration equation will inform of the invalidity of single equation estimation techniques.

The results of the Johansen cointegration test are heavily reliant of the order of the VEC. Enders (1995) propose, as the most ordinary procedure, the estimation of a VAR model with the variables in levels and then select the number of lags according to the Likelihood Ratio test.

The VEC order in the cointegration test must be that of the VAR less one, as the variables in the VEC are first differentiated. We have decided to limit the maximum number of lags to 3 (in relation to economic principles and the number of observations) and select the VAR order according to the indication of most of the criteria incorporated in EViews 4.1 (SC, AIC, FPE, LR, HQ). In those cases in which there were rather ambiguities we have also used joint lag exclusion tests.

IMPORT EQUATIONS:

We must bear in mind that, as it was previously stated, aggregation of different categories of products may contribute to a downward bias in the estimation of price elasticity in the imports equation. If the effect of the explanatory variables were the same in the components and the aggregate or if the aggregate composition did not change it would be immaterial to estimate aggregated or disaggregated equations. Otherwise, aggregation may drive towards a bias in the coefficient estimation.⁶

Unit root tests:

Table 4. Unit Root tests: Mum95 = imports from the EMU (MN € 1995 (PPP))

Mum95 (1970-2002)	Augmented Dickey-Fuller		Phillip-Perron	
	Log(Mum95)	Δ log(Mum95)	Log(Mum95)	Δ log(Mum95)
Germany	-3.359520***	-5.838812*	-2.401190	-4.521207*
Austria	-3.523255***	-4.907286*	-2.763889	-4.855738*
Denmark	-2.772925	-6.548440*	-2.829652	-6.813876*
Spain	-3.498970**	-3.452887**	-1.758711	-3.530200**
Finland	-2.952829	-4.532207*	-2.177145	-4.826168*
France	-2.369343	-5.180220*	-2.386781	-5.213459*
Greece	-1.641007	-0.212539	-2.808736	-6.704865*
The Netherlands	-2.706972	-4.147942*	-2.065785	-3.958555*
Ireland	-0.658278	-4.263377*	-0.658278	-4.250308*
Italy	-1.971563	-4.948406*	-2.095727	-4.945429*
Portugal	-2.110718	-4.510859*	-2.028025	-4.435882*
United Kingdom	-3.032850	-6.262338*	-2.213333	-6.262338*
Sweden	-3.747551**	-4.632595*	-2.251841	-4.697314*

*, **, *** denotes rejection at 1%, 5% and 10% levels

The natural logarithm of real imports from the EMU are –as revealed the UR tests- first order integrated.⁷

⁶ In fact, estimation of positive price elasticities may be related to the positive correlation between the value of the traded flows and the export/import prices when products incorporate an increasing amount of value added and are not being produced in the importing areas.

⁷ Only Spanish and Swedish imports from the EMU are trend stationary according to the ADF test.

Table 5. Unit Root tests: GDP95 = GDP (MN € 1995 (PPP)).

GDP95 (1970-2002)	Augmented Dickey-Fuller		Phillip-Perron	
	Log(GDP95)	$\Delta\log(\text{GDP95})$	Log(GDP95)	$\Delta\log(\text{GDP95})$
Germany	-2.683089	-3.705826*	-1.695553	-3.443902**
Austria	-3.796883**	-5.090654*	-2.075494	-5.084209*
Belgium	-3.453464***	-5.285306*	-3.455581***	-5.277824*
Denmark	-2.300974	-5.210215*	-2.463468	-5.236781*
Spain	-4.131094**	-2.631765***	-2.707303	-2.569643
Finland	-3.821228**	-2.826228***	-2.119200	-2.608095
France	-3.117074	-3.829435*	-3.158875	-3.730446*
Greece	-3.055028	-4.633636*	-3.061815	-4.592316*
Holland	-2.349608	-2.956318***	-1.911550	-3.431564**
Ireland	0.763654	-3.137404**	0.134029	-3.213671*
Italy	-1.979829	-3.642374**	-1.420705	-5.092813*
Luxembourg	-2.044833	-4.096808*	-1.342910	-4.089487*
Portugal	-3.302165***	-4.357857*	-3.083341	-3.467390**
United Kingdom	-2.554419	-4.301833*	-2.142404	-3.624826**
Sweden	-4.176782**	-3.512055**	-2.075494	-3.198907**

*, **, *** denotes rejection at 1%, 5% and 10% levels

GDP also is a first order integrated variable in most of the countries considered ($\alpha = 0.05$). Main uncertainties are related with the GDPs of Austria, Spain, Finland and Sweden.

EP*/P are relative import prices: the ratio between import and domestic prices (GDP deflator). Next table shows the ADF and PP UR tests with linear trend for the natural logarithm of relative import prices.

Table 6. Unit Root tests: (RMP = Pm/Pd (price indexes 1995 = 1)).

Relative prices (1970-2002)	Augmented Dickey-Fuller		Phillip-Perron	
	Log(RMP)	$\Delta\log(\text{RMP})$	Log(RMP)	$\Delta\log(\text{RMP})$
Germany	-2.352523	-4.732006*	-1.695928	-4.682626*
Austria	-2.352804	-3.234810*	-2.326358	-4.621009*
Belgium	-2.192246	-4.033176*	-1.742347	-3.997230*
Denmark	-2.256865	-4.860116*	-2.026516	-4.860116*
Spain	-2.036091	-4.195208*	-1.902966	-4.208568*
Finland	-2.382680	-4.460304*	-1.972747	-4.460304*
France	-1.998193	-5.661213*	-1.836585	-5.661534*
Greece	-1.394925	-1.532324	-2.435474	-3.935834*
The Netherlands	-2.055982	-5.194780*	-1.905628	-5.239996*
Ireland	-3.441609	-5.163018*	-1.896828	-5.146854*
Italy	-2.188738	-4.558910*	-2.222369	-4.558910*
Luxembourg	-2.360046	-6.576486*	-2.177687	-7.075083*
Portugal	-2.029602	-3.913193*	-1.444419	-3.891208*
United Kingdom	-2.259899	-4.270174*	-1.981979	-4.252131*
Sweden	-2.457460	-5.027317*	-1.967470	-5.002127*

*, **, *** denotes rejection at 1%, 5% and 10% levels

Relative prices are in every case first order integrated variables.⁸

The dynamics of relative average labour productivity $\text{RAVPr} = \left(\frac{\text{AV Pr}_i}{\text{AV Pr}_{\text{EMU}-i}} \times 100 \right)$ are analysed in the following table.

⁸ This result is independent of the inclusion or not of the linear trend in the test equation.

Table 7. Unit Root tests: $RAVPr = \left(\frac{AV Pr_i}{AV Pr_{EMU-i}} \times 100 \right)$, (AVPr in thousand € 1995(PPP)).

RAVPr (1970-2002)	Augmented Dickey-Fuller		Phillip-Perron	
	Log(RAVPr)	$\Delta \log(RAVPr)$	Log(RAVPr)	$\Delta \log(RAVPr)$
Germany	-2.540812	-3.044624**	-1.922416	-2.763438***
Austria	-3.128930	-6.540787*	-2.837171	-11.55141*
Belgium	-2.905780	-6.697612*	-2.840684	-7.699297*
Denmark	-0.023142	-3.329624**	1.185522	-3.318780**
Spain	-1.935167	-4.455248*	-1.545770	-4.520773*
Finland	-1.620716	-4.882361*	-1.264602	-4.853087*
France	-2.338974	-3.955364*	-1.611465	-3.592089**
Greece	-1.145716	-4.978449*	-1.593898	-4.988150*
Netherland	-1.897758	-4.514272*	-2.062632	-4.478701*
Ireland	-1.899812	-5.833683*	-1.782611	-5.835121*
Italy	-2.992025	-5.079626*	-2.383524	-5.617037*
Luxembourg	-2.425290	-2.425290	-2.437975	-5.063537*
Portugal	-2.587655	-5.296504*	-2.379808	-7.751077*
United Kingdom	-2.665846	-3.955364*	-1.377513	-3.900777*
Sweden	-1.555238	-2.719996***	-1.566258	-2.719996***
*, **, *** denotes rejection at 1%, 5% and 10% levels				

Relative average labour productivity series are integrated of first order.⁹

⁹ These results would be consistent with the inclusion of intercept and trend in all the test equations for the series in levels and only intercept for the differentiated series.

Table 8. Estimation of import equations

Imports (1970-2002)	Elasticities			N° of lags	N° of CE	Trace statistic	Max-eigen statistic
	Income	Relative prices	Productivity				
Germany	0.694346 (0.40813)	-5.231537 (0.99062)	-19.22572 (3.28047)	2	1	54.63315**	29.80018*
Austria	1.408525 (0.22576)	-0.218625 (0.37484)	4.361415 (0.81531)	2	0/1	44.67912	33.46694**
Denmark	2.590909 (0.10279)	-0.336560 (0.06222)	0.722031 (0.15091)	2	1/0	47.31634**	25.77833
Spain	1.571083 (0.33548)	-1.064515 (0.15810)	11.10858 (1.13999)	2	2	45.73477**	39.41869**
Finland	1.077340 (0.07552)	-0.550527 (0.09929)	0.909312 (0.26636)	2	1	56.42487**	31.86661*
France	1.900919 (0.05204)	-0.611931 (0.07202)	1.045763 (0.46006)	2	1	51.92248*	27.08546*
Greece	0.310716 (0.33795)	-1.942264 (0.31926)	0.488839 (0.70397)	0	1	48.29612*	27.61101*
Netherlands	1.088552 (0.11422)	-0.120416 (0.11314)	-0.619680 (0.16276)	2	1	61.03922**	35.39824**
Ireland	1.211843 (0.29300)	0.502049 (0.25243)	1.450732 (1.06810)	0	1	50.10167*	21.68802
Italy	1.765151 (0.07099)	-0.856221 (0.06988)	-1.411980 (0.76732)	0	1	54.98302**	29.56669*
Portugal	2.128698 (0.28464)	0.003508 (0.38580)	12.62157 (2.26774)	1	2/0	32.50657*	26.99976
U.K.	3.255038 (0.14854)	0.543986 (0.12506)	2.062297 (0.53296)	1	1	55.66559**	29.38184*
Sweden	4.002194 (0.61908)	-1.004284 (0.68664)	-4.101099 (1.38868)	2	2	34.69379*	21.48326*
Average	1.76963954	-1.193688 [#]	[#] Only includes negative elasticities				

*(**) denotes rejection of no cointegration at the 5% (1%) level. 26.79/18.60

Trace and maximum eigen-value statistics indicate the rejection of no cointegration among the import variables in all the countries analysed. In Spain, Portugal and Sweden, there are two cointegration equations showing the possibility of simultaneity in the determination of the set of variables considered.

In the one hand, income elasticities, with the exception of Greece, are positive and significantly different from zero in every equation. On the other, price elasticities were negative as expected in ten countries and positive but not significantly different from zero in one more.

EXPORT EQUATIONS:

Unit root tests:

Unit root tests in the export series and in the EMU GDP (excluding the country considered) incorporate intercept and trend, and in the differentiated series only intercept.

Table 9. Unit Root Tests: exports to the EMU (MN € 1995 (PPP)).

Xum (1970-2002)	Augmented Dickey-Fuller		Phillip-Perron	
	Log(Xum)	$\Delta\log(Xum)$	Log(Xum)	$\Delta\log(Xum)$
Germany	-3.268956	-5.020928*	-2.794604	-5.116758*
Austria	-2.445204	-4.067762*	-1.705526	-4.025658*
Denmark	-3.341169	-4.624659*	-2.554227	-4.541099*
Spain	-2.752850	-5.082128*	-2.254824	-5.223734*
Finland	-2.785683	-5.136956*	-2.553699	-5.840413*
France	-2.560454	-4.773360*	-2.162979	-4.878860*
Greece	-2.604684	-5.163483*	-2.600698	-5.162902*
Holland	-1.968742	-4.772701*	-1.622380	-4.764059*
Ireland	-3.116647	-7.630455*	-2.871989	-7.449922*
Italy	-2.891993	-4.393243*	-2.180842	-4.304132*
Portugal	-0.980276	-3.109599**	-1.464343	-5.173376*
United Kingdom	-3.607547**	-6.023367*	-3.233103	-6.621517*
Sweden	-2.933354	-4.561432*	-2.211079	-5.998903*
*, **, *** denotes rejection at 1%, 5% and 10% levels				

All series of export towards the EMU are first order integrated.¹⁰

¹⁰ Only the exports from the UK have an ambiguous result depending of the level of significance adopted.

Table 10. Unit Roots Tests: GDP of the EMU countries except the one considered (MN € 1995 (PPP)).

XGDP95 (1970-2002)	Augmented Dickey-Fuller		Phillip-Perron	
	Log(XGDP95)	Δ log(XGDP95)	Log(XGDP95)	Δ log(XGDP95)
Germany	-3.829297**	-3.315343**	-3.179002	-3.751410*
Austria	-3.551545	-3.949574*	-2.901024	-3.830709*
Belgium	-3.548102	-3.903880*	-2.895592	-3.779763*
Denmark	-3.568637**	-3.940688*	-2.922878	-3.819482*
Spain	-3.320929	-4.103783*	-2.791319	-3.990975*
Finland	-3.477861	-3.964827*	-2.883324	-3.847617*
France	-3.578373**	-3.956260*	-2.800668	-3.810487*
Greece	-3.486448	-3.994255*	-2.864523	-3.879627*
Holland	-3.502237	-3.947614*	-2.875055	-3.826996*
Ireland	-3.456274	-3.949881*	-2.866721	-3.829917*
Italy	-3.743483**	-3.650933*	-2.866132	-3.379115**
Luxembourg	-3.560017	-3.939994*	-2.921590	-3.818761*
Portugal	-3.556444	-3.956444*	-2.920314	-3.836441*
United Kingdom	-3.568637**	-3.940688*	-2.922878	-3.819482*
Sweden	-3.568637**	-3.940688*	-2.922878	-3.819482*

*, **, *** denotes rejection at 1%, 5% and 10% levels

All series of EMU GDP (excluding the county considered) are integrated of first order according the PP test. However, the results are less regular employing the ADF test.

Evolution of relative export prices has a clear trend in all the countries, though it was increasing in some of them and decreasing in others. Thus, we will include intercept and trend in the test equations (only intercept in the differentiated series). Relative export prices are constructed as the ratio of the export prices of each country and the export prices of the rest of the EMU countries.

Table 11. Unit Root tests: (RXP = PX/PXUM (price indexes 1995 = 1))

pr? (1970-2002)	Augmented Dickey-Fuller		Phillip-Perron	
	Log(PXR)	$\Delta\log(\text{PXR})$	Log(PXR)	$\Delta\log(\text{PXR})$
Germany	-1.280029	-3.203995**	-0.661117	-3.199909**
Austria	-1.221922	-5.006618*	-1.163768	-4.999099*
Belgium	-1.943730	-4.633357*	-1.943730	-4.577745*
Denmark	-2.336485	-4.968803*	-1.889712	-4.968803*
Spain	-0.903844	-1.013591	-0.290650	-2.845303***
Finland	-0.622585	-2.693928***	-0.622585	-2.690371***
France	-2.815950	-2.196962	-0.386298	-2.154204
Greece	-0.101500	-1.616759	-0.613335	-3.902449*
Holland	-1.336048	-3.925767*	-1.709901	-3.927207*
Ireland	-2.482747	-3.136778**	-2.418082	-3.101201**
Italy	0.220774	-1.433675	-0.110910	-2.663194***
Luxembourg	0.437175	-4.758869*	-2.073599	-5.438514*
Portugal	-3.012459	-1.059087	0.229654	-2.888385***
United Kingdom	-0.805041	-2.915551***	-1.021897	-2.981844**
Sweden	-0.086248	-4.652621*	2.511252	-4.649998*

*, **, *** denotes rejection at 1%, 5% and 10% levels

Relative export prices are in most countries first order integrated.¹¹

11 The most clear exception is France and there are certain ambiguity in Italy, Portugal, Spain, Finland and Greece where may exist a second unit root.

Table 12. Estimation of export equations:

Exports (1970-2002)	Elasticities			N° of lags	N° of CE	Trace statistic	Max-eigen statistic
	Income	Relative prices	Productivity				
Germany	1.747988 (1.00649)	-2.466766 (1.05193)	1.387541 (2.91580)	2	1	63.84911**	39.53341**
Austria	4.372767 (0.46459)	-1.582316 (0.73757)	-19.12217 (2.45759)	0	1	60.20000**	36.66733**
Denmark	1.962191 (0.12036)	1.007552 (0.26665)	-0.548584 (0.35368)	1	1	49.26233*	22.98579
Spain	6.201478 (0.34190)	-2.191530 (0.29247)	7.047993 (1.14953)	2	3	19.15886*	17.24473*
Finland	2.319167 (0.33296)	-0.849913 (0.25633)	1.636622 (0.64819)	2	1	48.42905*	28.23504*
France	2.323780 (0.02681)	-0.676143 (0.03993)	1.148760 (0.25594)	2	3	18.11495*	17.01244*
Greece	-8.094363 (3.55620)	4.118284 (1.26388)	12.55936 (3.34030)	1	2/1	31.95598*	30.04929*
Netherlands	2.082254 (0.44177)	-0.000434 (0.16879)	-0.061413 (0.64813)	0	2/0	31.31442*	23.01153
Ireland	7.956706 (2.67454)	4.114381 (0.46884)	-6.374799 (4.33968)	2	1	68.68619**	48.35711**
Italy	1.454057 (0.37882)	0.447530 (0.16299)	-4.892899 (1.60049)	0	2/1	34.31414*	29.92959*
Portugal	3.414066 (0.30070)	0.249556 (0.07247)	-2.233172 (0.66933)	2	2/3	42.52983**	14.50513*
U.K.	2.233360 (0.18880)	0.053792 (0.24612)	2.753696 (1.14242)	0	1/0	50.03184*	21.22981
Sweden	2.495653 (0.13567)	-0.721593 (0.19430)	0.230164 (0.21297)	2	2/1	31.42309*	29.87204*
Average	3.21362225	-1.21267071 [#]	# Only includes negative elasticities				
*(**) denotes rejection of no cointegration at the 5% (1%) level.							

As shown in the trace and maximum eigen-value statistics reported in table 13, the rejection of no cointegration among the export variables hold in all the countries analysed. In some instances, there are even more than one cointegration equations showing the presence of reciprocal relations among the variables considered.

Income elasticities are in every case positive and significantly different from zero. The export equation for Greece is the only exception. In relation to price elasticities, seven were negative as expected and two more positive but not significantly different from zero. The aforementioned bias caused by the positive correlation between the value of export and export prices, when products incorporate an increasing amount of value added, has not been eliminated in spite of the inclusion of an indicator of relative productivity.

6. MAIN CONCLUSIONS

Being a state member of the EMU forces nations to concentrate in cautiously manage supply side and foster the growth of productivity in order to keep international competitiveness and external equilibrium. As monetary policy cannot be used any more to correct nominal competitiveness losses, the only way to fight against this is improving the productivity and controlling costs.

Through this paper we have attempted to draw a general picture of the evolution of foreign trade in the EU, specially in those states integrated in the EMU, and to quantitatively asses the relevance of the main determinants of trade flows. Our main findings can be summarized as follows:

1. In most of the EU countries the percentage of foreign trade directed towards the EMU nations increased in the period studied. However, this evolution was unequal among countries and along the time. In the first 1990s this indicator reached its maximum.
2. Trade openness within the EMU has witnessed a clear increase during the period under study.
3. Analysing the trade balance with the EMU, apart from the common situation of those countries that alternate deficit and surpluses, there are some striking cases, such as Ireland and the Netherlands. Ireland changed its position from a huge trade deficit with the EMU in the 70s to an important trade surplus in 2002. The Netherlands kept a regular and increasing trade surplus with the EMU for the whole period.
4. The relative import prices of the EU-15 states have decreased over the period under study. This evolution can be divided in two periods. In the first, from 1973 until the middle 80s, import prices rose at a higher rate than domestic prices. In the second, after 1985, import prices moderated their growth while domestic prices continued to increase.
5. The evolution of relative export prices of EU-15 countries has been dissimilar. While the export prices of Italy, Portugal, or Greece experienced a huge increase since 1970, those of Austria or the Netherlands acknowledged an important decrease in the same period.
6. There exist σ -convergence and β -convergence in labour productivity in the EU-15. However, we should stress that the nations with higher average labour productivity are almost the same in 1970 than in 2002. Exceptionally, Ireland increased enormously its average labour productivity achieving the level of the most privileged EU nations. Grubel-Lloyd adjusted indexes indicate that, according with this fact, most of the EU countries (specially those of lower GDP per head as Greece, Portugal, or Spain) have reinforced their intra-industrial trade. Also, exceptionally, Ireland and Finland increased their inter-industrial trade, gaining positions in the export of high value added products.
7. Trace and maximum eigen-value statistics indicate the rejection of no cointegration among the import and export variables in the EU countries. Even more than one cointegration equation exists in some cases. Income elasticities, but for Greece, are positive and significantly different from zero. Price elasticities were negative as expected in most of the countries analysed but the positive bias caused by

the correlation between value and price, when products incorporate an increasing amount of value added, has not been eliminated in spite of the inclusion of the relative productivity.

8. First of all, on average, increments of exports are bigger when other economies increase their GDP than increments of imports when our GDP increases. However, this is not the case of Denmark, Italy, the UK and Sweden. Secondly, estimation of price elasticity stresses, especially in some nations, the previous stated need about the control of prices when the implementation of monetary and trade policies does not correspond to national authorities.

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