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Analysing the pattern and determinants of Portugal's trade in manufactured goods: a time-series approach (1971-98)

Paper presented at the Sixth Annual Conference of the ETSG,
European Trade Study Group,
Nottingham,
United Kingdom,

9-11 September 2004

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September 2004

Analysing the pattern and determinants of Portugal's trade in manufactured goods: a time-series approach (1971-98) [1]

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Abstract

The main purpose of this paper was to investigate the pattern and determinants of Portugal's trade in manufactured goods across the period 1971-98. The econometric investigation analysed a set of hypotheses in the context of Portugal's preferential access to the EU market and subsequently membership of the EU. The particular objective of this paper was to investigate whether manufacturing related FDI had a positive or a negative impact on net exports and whether the nature of the relation between the two could be better understood if dynamic-specific characteristics were considered in the econometric investigation. An important requirement was the collecting of suitable statistics given the difficulty in obtaining time series data. Evidence for cointegration was found by means of the Johansen (1988) maximum likelihood approach. The econometric analysis produced statistically significant elasticity's on human capital and FDI relating the principal variables in the long run trade function to net exports, human capital, GDP, real exchange rate and FDI inflows. The impact of FDI on trade was negative. The dynamic model of net exports was not statistically significant suggesting that net exports alone were not an equilibrating mechanism of the system.

Keywords: trade, multinational activities, time series econometrics

JEL-Classification: F14, F21

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(Revised version: September 2004)

Comments are welcome.

[1] Sponsored by *Fundação de Ciência e Tecnologia* (Praxis XXI/ BD/ 21219/ 99). The author would like to thank *Instituto Nacional de Estatística* and *Banco de Portugal*.

1. Introduction

The Portuguese economy has witnessed important inflows of FDI during the second half of the eighties coinciding with the first years of integration into the EU and the prospect of the completion of the Single European Market. Portugal was among the smallest recipients of FDI in the EU but the percentage of FDI inflows in GDP was one of the highest among EU countries (table A.2). The manufacturing industry has been a traditional major receiver of FDI inflows from the OECD and EU area. Despite the shrinking position of the traditional sectors (textiles, clothing and footwear), which are the largest sectors in Portugal, the Portuguese manufacturing industry adapted towards EU demand, that is, in skill intensive mainstream industries (automotive, car components and electrical machinery).

The general purpose of this paper is to assess the effects of Portugal's economic relationships with the EU on foreign trade. The econometric investigation analyses a set of hypotheses in the context of Portugal's preferential access to the EU market and subsequently membership of the EU. The study's main focus is an empirical investigation at the aggregated level on the patterns and determinants of Portugal's trade in manufactured goods over the period 1971-98. The particular objective of this paper is to investigate whether manufacturing related FDI has a positive or a negative impact on trade in manufactured goods and whether the nature of the relation between the two can be better understood if dynamic-specific characteristics in econometric modelling are taken into account.

The existing theoretical and empirical literature on the determinants of trade flows largely neglects the role of FDI. Most studies on trade in Portugal seek to explain the determinants of trade flows within cross-section models. Given the difficulty in obtaining time series data, an important requirement was the collecting of suitable statistics, hence substantial work and time have been spent on this matter. This study seeks to contribute to knowledge in the field by incorporating FDI into models of the determinants of trade flows in manufactured goods within a dynamic framework. The analysis is of trade patterns and as part of this, admittedly an important part, but only part, looks at the role of FDI.

The paper investigates whether there are cointegration relationships by means of the Johansen (1988) maximum likelihood approach. The estimation procedure is jointly capable to determine the short-run dynamics in the evaluation of the long-run model structure. The econometric analysis is able to quantify elasticity's from the principal variables of the long-run trade function (i.e. net exports function).

This paper is organized in the following way. Section 2 presents the theoretical background. Section 3 reviews different empirical studies on the pattern and determinants of Portugal's trade in manufactured goods. Section 4 discusses the empirical studies on the effects of FDI in Portugal. Section 5 presents the broad characteristics of the data set. Section 6 incorporates the econometric modelling and the research results. Section 7 contains the main conclusions of this empirical investigation.

2. Theoretical background

The principle of comparative advantage in trade theory explains the trade performance of countries by location-bound advantages which are differences in technology between countries in the Ricardian tradition and differences in factor endowments between countries in the Heckscher-Ohlin-Vanek (HOV) framework respectively. Technology models of trade focus on differences in innovation between countries (Posner, 1961). These are often combined in product life-cycle models with differences in demand conditions across countries (Vernon, 1966) and in the HOV model with international technological differences (Trefler, 1995; Harrigan, 1997).

New trade and new economic geography theories stressed the role of scale economies, product differentiation and location-bound advantages (Krugman, 1980 and 1991; Tybout, 1993). Davis and Weinstein (1996, 1998 and 1999) and Trionfetti (1998) demonstrated the importance of traditional as well as new trade theory in explaining countries' trade performances. These theories were challenged by the incidence of multinational activities. Model assumptions of immobile production factors and technology were questioned due to the distinctive nature of multinational firm competitive advantages. Empirical work often ignored the impact of multinational activities on the trade structure of countries. The theoretical modelling of multinational activities within trade models gained only due attention with models showing that multinational firms have a non-neutral effect on the

volume and direction of trade of host countries dependent on trade costs, market size and relative factor endowments.

Other trade models explain the behaviour of multinational activity within the ownership-location-internalisation framework advanced by Dunning (1979, 1981, 1988, 1993 and 1998), which states that, in addition to location advantages there are ownership and internalisation advantages to induce FDI. These models show that horizontal multinationals arise when countries are identical in endowments and in market size, while vertical multinationals emerge to exploit relative endowment differences between countries.

Theoretical imperfect competition models predict a complementary relationship between FDI and trade flows for vertical MNEs which separate geographically each stage of the production process according to relative cost advantages (Helpman, 1984, 1985, 1998 and 1999; Helpman and Krugman, 1985; Markusen, 1983, 1984, 1995, 1998 and 2000). FDI and trade might be substitutes rather than complements in the case of horizontal MNEs, which produce roughly the same product in different locations in order to gain an easier access to the host market (Brainard, 1993; Markusen and Venables, 1996 and 1998).

There is no clear assertion on the trade and FDI relationship. Baldwin (1979) showed that inward FDI explained the trade performance of developing countries. Empirical evidence is mostly available on the complementarily relation of trade and FDI while different studies found substitutive relationships (Lipsey and Weiss, 1981 and 1984; Abd-el-Rahman, 1991; Blomstroem and Kokko, 1994; Pfaffermayr, 1994 and 1996; Svensson, 1996; Belderbos and Sleuwaegen, 1998; Brenton, DiMauro and Luecke, 1999; Mello and Fukasaku, 2000; Bajo & Muñoz, 2001; Egger, 2001; Sleuwaegen and Backer, 2001).

3. Empirical studies on the pattern and determinants of Portugal's trade in manufactured goods

Courakis and Roque (1984) investigated the pattern and determinants of Portugal's net exports across the period 1972-79. The econometric model relied upon the Heckscher-Ohlin-Samuelson model of international trade and its neo-factorial and neo-technological extensions. Portugal displayed a comparative advantage in unskilled labour intensive

products and a comparative disadvantage in physical capital and skilled labour ones[2]. These findings were in accordance with Courakis and Roque (1989). Courakis and Roque (1984) highlighted Portugal's comparative advantage in natural endowed industries.

Courakis and Roque (1992) extended the inquiry into the pattern and determinants of Portugal's trade in manufactured goods across the period 1972-85. The econometric analysis reported that the Portuguese pattern of trade exhibited comparative advantage in products of industries that were intensive in unskilled labour and comparative disadvantage in products of industries that were intensive in skilled labour (i.e. human capital). The results suggested that the comparative disadvantage in skilled labour products was more pronounced in products that were intensive in low quality skilled labour than in products that were intensive in high quality skilled ones[3]. Physical capital was not an important determinant of net exports.

Fontoura (1995) investigated the determinants of Portugal's export intensity across the period 1991-92. The investigation adopted a simultaneous equation approach for exports and FDI respectively. The results did not confirm the two-way relationships between the two variables. The results for the export intensity equation were similar to those obtained in earlier studies (i.e. studies mentioned above). The results displayed a comparative advantage in products that were intensive in unskilled labour. Products that were intensive in skilled labour had a comparative disadvantage. Labour costs were not significant since FDI was located in industries including high labour costs and economies of scale and were intensive in human capital (labour) and technology.

Crespo and Fontoura (2001) explored the industry and country characteristics associated with intra-industry trade within a cross-country and cross-industry analysis using only data for the year 1997[4]. Intra-industry trade was determined by vertical differentiation suggesting a specialisation along the quality spectrum. Portugal's trade pattern changed without a significant alteration of the trade determinants traditionally associated to the factor proportions model. The econometric analysis confirmed that the comparative advantage explanation stands for the vertical case. But the results for the skilled labour variable suggested a tendency towards a more intensive use of the skilled labour.

[2] The results queried the cross-section results for the year 1979 by Roque (1983).
[3] Similar results were reported by Roque, Fontoura and Barros (1990) and Fontoura (1991).

4. Empirical studies on the effects of FDI in Portugal

Taveira (1984) found that the size and growth of the domestic market were important determinants of export oriented FDI in Portugal. Simões (1985) reported that foreign affiliates present higher productivity levels and display a greater orientation towards high-technology and skill demanding industries than their domestic counterparts. FDI contributed positively to the restructuring of the Portuguese industry by developing export orientated activities. Cabral (1995) showed that wages paid by foreign firms in Portugal were substantially higher than those paid by domestic firms. The subsidiaries with the less qualified and cheaper labour force were more export intensive. Export-oriented FDI tend to be located in traditional Portuguese export sectors, rather than in sectors where intra-industry trade was preponderant.

Farinha and Mata (1996) reported productivity spillovers effects across the period 1986-92. Foreign firms had higher labour productivity than domestic firms with the same characteristics. Foreign presence in a sector increased the probability of R&D activities by domestic firms due to the increased competition in the domestic industry. Flores, Fontoura and Santos (2000) found mixed evidence regarding spillovers. The technological gap seemed to be a condition for spillovers but only within a certain range favouring modern sectors with large scale gains which did not exist before in the economy.

Castro (2000) found that labour costs, labour skills, characteristics of the local market, economic and political stability were important location determinants of FDI. Geographic and cultural proximity was a country related determinant of FDI including market seeking FDI rather than efficiency seeking FDI[5]. These findings were supported by Tavares (2001) who reported that lower costs of production and competitiveness improvements in relevant foreign markets were among important motivations for establishing a subsidiary in Portugal. The availability of natural resources and local scientific competencies were viewed as the least important factors for the majority of the firms surveyed. The level of qualification and expertise of the local workforce played an important role in textiles, clothing and footwear industries but also in the car equipment sector.

[4] Faustino, Silva and Carvalho (2001) studied the determinants of horizontal and vertical intra-industry trade at the product level between Portugal and Spain across the period 1990-99.

Mata and Portugal (2002) investigated the determinants associated with the survival of new foreign and new domestic firms (1983-89) and argued that survival was determined by firm characteristics, such as, ownership advantages, size and growth strategies, internal organization of the firms, but also by industry characteristics (i.e. economies of scale, industry entry and growth). Domestic and foreign firms did not exhibit different chances of survival. They responded in similar fashions to the determinants of survival and display identical time patterns of exit.

Barbosa and Louri (2002) showed that foreign ownership choice in Portugal was found to be significantly affected by firm characteristics, such as, firm size and firm labour costs, while it did not interact with industry profitability and growth. Manufacturing multinational firms established in Portugal were export oriented and able to ignore prominent domestic market features. The effect of R&D intensity was significant and favoured full ownership.

5. Data set

The lack of limited statistics and the inadequacy of existing statistics have often discouraged researchers in performing quantitative studies on the Portuguese manufacturing industry. Analysing the pattern and determinants of Portugal's trade in manufactured goods in a time series perspective has proved to be an important task because of the complications that arise in compiling a suitable data set.

All time series incorporated annual observations which were transformed in natural logarithms. The time series were valued in real terms (i.e. constant prices) with the GDP deflator. Data was collected from *Instituto Nacional de Estatística* and *Banco de Portugal*. Different surveys have been carried out by *Instituto Nacional de Estatística* on the Portuguese manufacturing industry since the beginning of the seventies (table 1). The same statistical structure in the publications remained essentially in force until 1989, although some cosmetic alterations have been made in to the manner of publication in the years 1983, 1984 and 1985. The data was published together in just one volume. Important changes in concepts and definitions occurred in 1990 (i.e. data changeover 1989-90). Since then the manner of publication changed radically in order to fulfil the requirements of the European

[5] Castro and Buckley (2000) showed that despite the apparent positive evolution of Portugal's Investment Development Path position in the second half of the 1990s, Portugal's competitive position remained weak.

System of Accounts. The *industrial statistics* (*Estatísticas Industriais*) were replaced by the *industrial production and firm statistics* (*Estatísticas da Produção e das Empresas - Indústria Portuguesa*).

Table 1: Surveys on the Portuguese manufacturing industry (1971-98)

Name of survey	**Annual manufacturing industrial survey**	**Company harmonized survey**	**Company harmonized survey**
Time period covered	1971-89	1990-95	1996-98
Name of inquired unit	Industrial establishment	Industrial company	Industrial company
Number of units surveyed	11500	26400	26400
Number of questionnaires	1	3	2
Type and name of questionnaires	*Questionnaire* sent to industrial establishments	*Minimum Questionnaire* Sent to companies with less than 100 employees. *Simplified Questionnaire* Sent to companies with 19 to 99 employees. *General Questionnaire* Sent to companies with 100 and more employees.	*Model A* Sent to companies with less than 20 employees. *Model B* Sent to companies with more than 20 employees
Representativeness	11500 establishments	65000 companies	65000 companies
Sectors covered	Manufacturing industries	Extracting industries, Manufacturing industries, electricity, gas and water	Mining and quarrying, Manufacturing industry, electricity, gas and water supply
Activities covered	154	328	328

Broadly speaking, the preliminary analysis of the data set for the time series investigation included necessary data adjustments to overcome the 1989-90 data changeover. Therefore, conversion factors have been calculated to allow for consistent estimates of the data to be constructed for the entire period 1971-98. Three methods have been employed depending on the series concerned to make the necessary adjustments in the industrial data series in this manner:

a) Conversion factors were known.
b) Conversion factors were calculated as a ratio of two series when they overlapped. The conversion factors were worked out when an overlap existed.
c) Where no overlap existed, an overlap was generated by forecasting (whether with linear or quadratic trend depending on the results). Then it was possible to calculate the conversion factors.

The data was matched with the United Nations International Standard Industrial Classification System - ISIC Rev. 2 (table A.1). Different correspondence tables have been used to match the series altogether. For instance, trade data was collected at the four-digit level in the Combined Nomenclature (CN) and converted to the ISIC three-digit level classification. Trade data accounted for 80 per cent of Portugal's total trade in manufactured goods, that is, trade with the EU-15.

Data on real GDP and exchange rate was taken from the IMF - Annual Statistics Yearbook. But, the real exchange rate for Portugal was backwards extended (figure 1). A Fund working paper provided background on the concepts and methodology for the real exchange rate computation[6]. A re-basement of the data was completed on a sub-set of top partners that accounted for 80 per cent of Portugal's total trade which is consistent with the trade data manipulations.

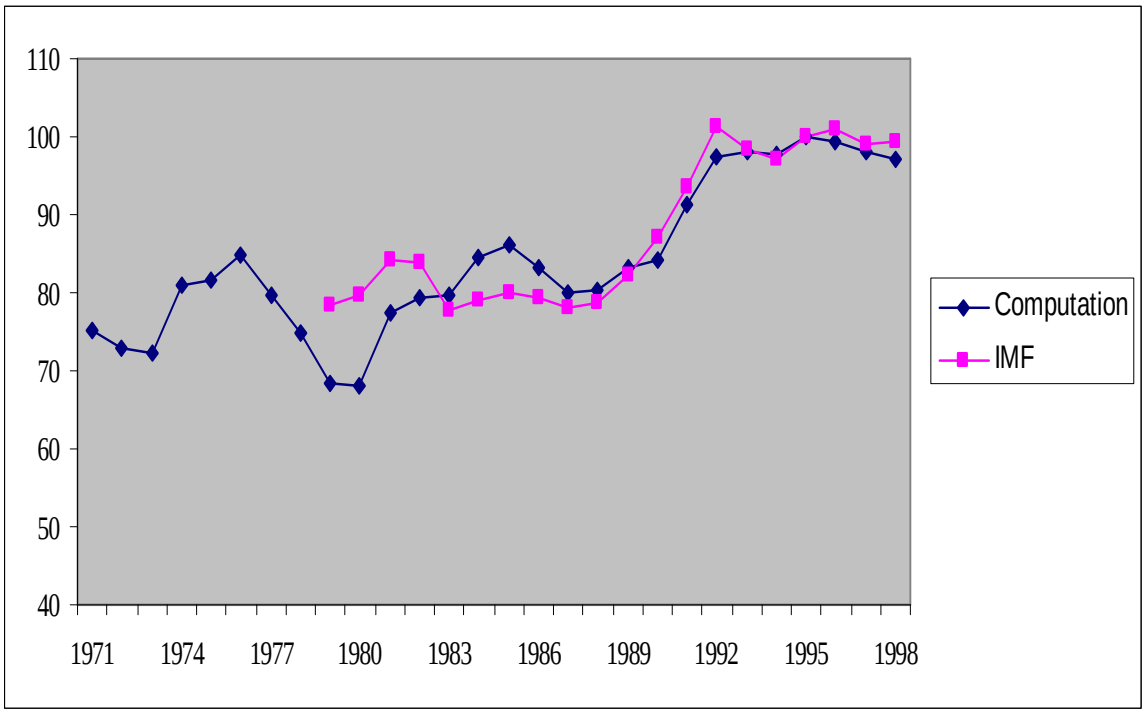
The real exchange rate is a consumer price index CPI-based real exchange rate and it was computed as a weighted geometric average of the level of consumer prices in the home country relative to that in its trade partners given by the following formula:

$$Ei = \prod_{j \neq i} \left[\frac{PiRi}{PjRj} \right]^{Wij}$$

where *j* is an index that runs over country *i*'s trade partners, *wij* is the competitiveness weight put by country *i* on country *j*, *pi* and *pj* are consumer price indices in countries *i* and *j*, and *ri* and *rj* represent the nominal exchange rates of countries *i* and *j*'s currencies expressed in US dollars. An increase in the index reflects an appreciation.

[6] *"A Primer on the IMF´s Information System", IMF Working Paper WP/97/71.*

Figure 1: Real exchange rate computation (1971-98)



6. Econometric modelling

6.1. Econometric model

The econometric analysis on the pattern and determinants of Portugal's trade in manufactured goods at the aggregate level followed the path of earlier empirical studies on trade flows that used the net export index (section 3).

Net exports are the natural logarithm of the ratio of exports to imports. This trade variable is expressed in the following manner:

$$NetX_{it} = \ln X_{it} - \ln M_{it} = \ln\left(\frac{X_{it}}{M_{it}}\right).$$

X_{it} and M_{it} are aggregate exports and imports of industry i in time t and valued at constant 1990 prices respectively. If $X_{it} > M_{it}$ then $\ln\left(\frac{X_{it}}{M_{it}}\right) > 0$ and if $X_{it} < M_{it}$ then $\ln\left(\frac{X_{it}}{M_{it}}\right) < 0$. If $X_{it} = M_{it}$ then $\ln\left(\frac{X_{it}}{M_{it}}\right) = 0$, so the slope is the same on $X_{it} - M_{it}$.

A first range of variables relates to the traditional location-bound sources of traditional trade theory and the neoclassical H-O model. The variable *physical capital (PHYS)* is defined as the value of industry's fixed assets, proxied by the gross fixed capital formation in the industry. The variable *human capital (HUM)* reflects the factor endowment explanation of trade performance. This variable is computed as a white collar (skilled labour) to blue collar (unskilled labour) ratio. The sign of physical capital is hypothesised to be positive. The sign of human capital is positively related to net exports.

Since Portugal exhibits relative abundance in labour, the econometric analysis studies the effect of *labour costs (COST)* on the pattern and determinants of Portugal's trade in manufactured goods. This variable is a cost per firm ratio (i.e. labour costs divided by the number of firms in the industry). According to the traditional factor endowment theory, an industry should export goods which are produced using the relatively abundant resources of the country, while import goods which are produced using relatively scarce resources of the home country. But, the lower the labour costs the better the export performance (for instance in labour intensive sectors). Therefore, a positive and a negative sign are hypothesised.

Economies of scale (SCALE) measure the scale intensity of the industry. This variable is proxied by a capital to output ratio in the industry. It is computed as the value of industry's gross fixed capital formation over the value of the industry's gross value added. It aims to measure the efficiency of investment that is how investment generates output in the industry. The hypothesised sign of this variable is positive and negative. Theory predicts a non-continuous relationship between trade and economies of scale. But Portugal being a small market within the EU, the open-up of the Portuguese market may have lead to a progressive reduction of costs in production.

Multinational firms through their technology transfer affect the pattern of trade. *Multinational activities* are proxied by the following FDI variables:

1) The *FNET* variable stands for net FDI flows (outflows minus inflows).
2) The *FINF* variable represents FDI inflows.

3) The *DFNET* variable is the rate of growth of *FNET* . It is the first differences of *FNET* , that is, the subtraction of one lagged period *FNET*(−1) and *FNET* .
4) The *DFINF* variable is the rate of growth of *FINF* . It is the first differences of *FINF* , that is, the subtraction of one lagged period *FINF*(−1) and *FINF* .

The rate of growth of *FNET* and *FINF* , *DFNET* and *DFINF* respectively, are differences in the logs. Multinational activities have a positive impact on net exports. A positive sign is hypothesized.

The pattern of demand is determined by the level of income. Theory predicts a positive relationship between imports and GDP. Imports are induced (imports are determined by GDP) whereas exports depend on what is going on in the rest of the world. A negative relationship between *domestic income (GDP)* and net exports is hypothesized. Net exports are a function of the real exchange rate. If the real exchange rate depreciates, domestic goods become cheaper relative to foreign goods. The sign of the *real exchange rate (RER)*[7] is expected to be negative.

6.2. Johansen method

Developments in time series econometrics, especially in the field of testing for non-stationarity and cointegration between time series, have provided new insights in applied economics through Granger (1986), Engle and Granger (1987 and 1991), Johansen and Juselius (1990 and 1992), Johansen (1988 and 1995). Cointegration is essentially based on the idea that there may be a long run co-movement between trended economic time series so that there is a common equilibrium relation, which the time series have a tendency to revert to. Thus, even if certain time series themselves are non-stationary, a linear combination of them may exist that is stationary.

The commonly applied method in testing for cointegration is the two-step estimation procedure by Engle and Granger (1987) where Error correction modelling is inherently based on the idea of incorporating both the long-run and short-run effects in the

[7] Courakis and Roque (1984) argued that the behaviour of the residuals could be related to the connection that exists between net exports and the real exchange rate.

empirical model structure. This single-equation method for estimation cointegration relations is based upon a restrictive assumption of a single cointegration relationship, which can be estimated with ordinary least squares[8]. Hall (1986) has given an illustration of how the single equation method can lead to confusion about the cointegrating vector. If there are more than two variables, there might also be more than one equilibrium relationship. This leads to the problem of determining the number of cointegration relationships between variables and the identification of these relationships within the theoretical model structure.

In this circumstance, the maximum likelihood estimation procedure proposed by Johansen (1988 and 1995) was used to estimate long-run equilibrium relationships. In contrast to single-equation methods, the procedure efficiently includes the short-run dynamics in the estimation of the long-run model structure. The main advantage of the Johansen's vector autoregressive estimation procedure is in the testing and estimation of the multiple long-run equilibrium relationships.

The hypotheses of the econometric model were tested with the Johansen's maximum likelihood approach. Standard methods of estimation were not applicable. The econometric model was specified in log linear form and therefore the coefficients of the estimated equations were the elasticity's. The first stage of the extended specification search (cointegration analysis) involved determining the order of integration of all time series present in the econometric model. To determine the order of integration of individual variables the top-down Dickey and Pantula (1987) procedure was used (table A.3). The Akaike information criterion (AIC) was used to determine the augmentation order of the test regression (maximized) in the unit root tests.

6.3. Long-run net exports function

When considering the (maximized) SBC (151.09) in table 2 there is a long run net exports function with HUM, RER, GDP and FINF. A drop is noticeable between the former result and the second best (maximized) SBC (149.95), which points out a long run net exports function with HUM, RER, GDP and FNET. The maximal Eigenvalue and trace tests, both, allowed rejecting the null hypotheses of $r = 0$ (no cointegration) at the 5%

[8] The results obtained when experimenting with the Engle and Granger method have been rejected due to

and 10% level of significance. Both tests were able to reject the null hypotheses that r is at most 1 at the 5% and even at the 10% level of significance. Hence, it was concluded that there was at least a single cointegrating vector. The model selection criteria allowed to conclude that there was 1 cointegrating vector by (max) SBC and 3 cointegrating vectors by (max) AIC and HQC. The AIC, SBC and HQC favoured $r = 1$ and $r = 3$. Therefore the choice of the number of cointegrating vector was $r = 2$.

A cointegrating VAR with unrestricted intercepts and no trends was estimated. Sensible results were obtained when imposing identifying restrictions on the cointegrating vectors (homogeneity restriction). In the second cointegrating vector the coefficients on HUM, RER and GDP sum up to one. In the first cointegrating vector the coefficient on FINF equals zero. The coefficient on NETX took the value –1 because the cointegrating vectors were normalized on it. The coefficients of the variables were taken from the second cointegrating vector.

Table 2: Testing and selection criteria for VAR 1 in 5 variable models for net exports in rank order (best to worse)

				NUMBER OF COINTEGRATING VECTORS USING			
Ranking	*Possible combinations among best of the best models*	*VAR order*	*SBC*	*Max Eigenvalue*	*Trace*	*SBC*	*AIC and HQC*
1	**NETX HUM RER GDP FINF**	**1**	**151.09**	**1**	**1**	**1**	**3**
2	NETX HUM RER GDP FNET	1	149.95	1	1	1	2
3	NETX COST RER GDP FNET	1	149.86	2	1	2	3
4	NETX COST RER GDP FINF	1	149.82	1	1	1	2
5	NETX COST RER GDP DFINF	1	145.87	1	2	3	3
6	NETX HUM RER GDP DFINF	1	142.90	2	1	2	3
7	NETX COST RER GDP DFNET	1	137.01	1	1	3	3
8	NETX HUM RER GDP DFNET	1	136.32	2	1	2	3
9	NETX HUM COST GDP FINF	1	133.97	1	0	1	2
10	NETX HUM COST GDP DFINF	1	132.09	1	2	3	4
11	NETX HUM COST GDP FNET	1	131.49	1	0	1	2
12	NETX HUM COST GDP DFNET	1	126.44	1	1	2	3

the presence of more than one cointegration relationship in the time series concerned.

The cointegration tests are performed on VAR 1 models. From a total of 16 models with the FDI variants, only 12 were considered. Table 2 shows that among the 4 best VAR models the first and the second best VAR models have the same combinations of variables. The following qualitative findings across models are reported:

a) The best models have all RER and GDP. The models are better with RER. The worst models don't have RER.
b) Poorer models include both HUM and COST, while better ones do not.
c) Amongst the good models, levels of FDI are preferred to changes. FINF is preferred to FNET. The favoured NETX model has FINF not FNET[9].
d) The combination of HUM and COST seems undesirable (i.e. do not have HUM and COST together)

The long run model for net exports adopts the form:

$$NETX = \underset{(0.25)}{1.81HUM} - \underset{(0.42)}{0.52RER} - \underset{(0.47)}{0.29GDP} - \underset{(0.03)}{0.19FINF}$$

The standard errors are indicted in parentheses and numbers are rounded to 2 decimal places. The intercept is excluded but appears in the VAR. This model was not unique. This function was obtained under the identifying restriction that the coefficients in the second cointegrating vector on HUM and RER and GDP sum up to 1 (HUM+RER+GDP=1) allowing one of the coefficients to be negative. An alternative restriction would be to force the coefficients to sum to zero, but this would force them to have oppositely signed coefficients and did not seem sensible from an economic point of view. This is arbitrary. The homogeneity restriction is more sensible assuming constant returns to scale.

[9] This is important since such regularities suggest which variables are or are not important without turning to significance tests as part of an (unavailable in this case) general to specific procedure.

6.3.1. Elasticity's

Elasticity's are quantified in the following manner:

a) With respect to human capital (HUM): 1.81 meaning a 1% increase in wages will lead to a 1.81% increase in net exports.

b) With respect to the real exchange rate (RER): -0.52 meaning a 1% increase in human capital will lead to a 0.52% fall in net exports.

c) With respect to GDP: -0.29 meaning a 1% increase in GDP will lead to a 0.29% fall in net exports.

d) With respect to FINF: -0.19 meaning a 1% increase in GDP will lead to a 0.19% fall in net exports.

Contrary to HUM and FINF, both GDP and RER are not statistically significant. Further over-identifying restrictions can be tested on GDP and RER. This means forcing a particular structure, which is imposing an over-identifying restriction on some of the model coefficients separately or in groups. For instance, imposing individually $RER=0$ and $GDP=0$ together with $HUM=1$ does lead to the rejection of these restrictions suggesting that the model is not supported by the data. Relaxing the homogeneity restriction, that is not allowing FINF to be freely estimated in the second cointegrating vector, did not change the earlier results. Therefore, the long run net exports function effectively includes a combination of NETX, HUM, RER, GDP and FINF variables.

6.4. Dynamic model

The residuals from the cointegration equation (long-run solution) were incorporated into a dynamic model taking the form of an error correction model to investigate the short run movements around equilibrium of net exports. The estimated VECM takes the following form:

$$DNETX = 1.99 + 0.01ECM1(-1) + 0.17ECM2(-1)$$

$$DNETX_t = 1.99 + 0.01(-1.00 * NETX + 1.57HUM - 3.79RER + 0.63GDP - 0.00FINF)_{t-1} + 0.17(-1.00NETX + 1.81HUM - 0.52RER - 0.29GDP - 0.19FINF)_{t-1} + \varepsilon_t$$

In the VAR(1) there is no short-run feedback. There are no lagged differences of variables. It only changes because of the equilibrium of ECM1 and ECM2. The only dynamics comes from the equilibrium correction terms. The coefficient on ECM1 in the equation for DNETX was positive and between 0 and 1. This is consistent given the coefficient of -1 attached to NETX in the definition of ECM1. The coefficient on ECM2 in the equation for DNETX was positive and between 0 and 1. This result is sensible given the coefficient of -1 attached to NETX in the definition of ECM2. The second ECM (ECM2) is the candidate of the net exports function equilibrium error. This is the supposed NETX des-equilibrium.

The estimates for ECM1 suggested that almost 1.1% of the disequilibrium in one period is corrected in the next but the *t*-ratio of ECM1 is not large and it is not significant. The estimates for the supposed NETX disequilibrium for ECM2 suggested that almost 17.1% of the disequilibrium in one period is corrected in the next and the *t*-ratio of ECM2 is more significant. Thus ECM1 and ECM2 were not statistically significant. The general insignificance of the error correction terms is an issue although the diagnostic tests were all passed at the 5% level. The serial correlation tests were passed, although a larger *p*-value value would have been preferred, and the remaining full range of diagnostic tests were all largely and successfully passed for the test of size 5%.

The dynamic model of net exports was not significant given the result of the *F*-statistic F (2,24) = 0.4884[0.62]. R^2 was low. Net exports individually were not a powerful economic equilibrating mechanism amongst the set of variables. Indeed, when calculated, the corresponding error correction models normalized on HUM, RER, GDP and FINF gave better results. Net exports were not a powerful economic equilibrating mechanism amongst these variables. The results suggested that the net exports function being an equilibrium mechanism in the system is rather weak. The net exports function was not the driving dynamics of the system.

6.5. Econometric results

The net exports results query Courakis and Roque (1984), that is, the comparative disadvantage in products of industries that are intensive in skilled labour. The results for the human capital variable, which is statistically significant in the long-run net exports function, might be interpreted as a tendency towards a more intensive use of skilled labour. This finding is in accordance with Crespo and Fontoura (2001). The empirical analysis provides evidence that specialization in skilled-labour-intensive products may contribute to an increase in net exports. It indicates the contribution of specific factor inputs to trade performance in the manufacturing sector. The aggregate econometric analysis indicated that Portugal has a comparative advantage in goods that are intensive in skilled labour and a comparative disadvantage in goods that are intensive in unskilled labour. However, further work is needed especially at the sectoral level to complement this finding obtained with aggregated data. Indeed, it is not excluded that a rise of the factor abundance of low skilled labour may have a positive impact on net exports in particular manufacturing sectors and a negative impact on net exports in others.

An increase in GDP was associated with a reduction of net exports. An increase in the level of GDP affected the propensity to get in imports faster than exports suggesting a shift in consumer demand for foreign goods because of closer integration with the EU. The real exchange rate result indicated that real exchange rate appreciations had a negative effect on net export. The earlier variables were not statistically significant in the long-run model. Scale economies and physical capital were not an important determinant of net exports.

The results for FINF suggested that FDI (FDI inflows) substitutes for trade (net exports) at the aggregate level. It is statistically significant in the long-run net exports function. The negative sign on FINF might be interpreted in the following way: either FDI has slowly contributed to an alteration of the traditional pattern of specialization of Portuguese industries, including the birth of new importing sectors. FDI has not used Portugal mainly as an export platform to EU markets.

7. Conclusions

The majority of different empirical studies for Portugal used cross-sectional data rather then a time series approach. Static analyses are easily biased and the results can be different from those obtained with time series techniques. This econometric investigation is a systematic attempt to use time series techniques rather then cross-section evidence to study the pattern and determinants of Portugal's trade in manufactured goods. Theoretical hypotheses were confirmed by the estimations. The following qualitative findings are relevant:

- Evidence for cointegration and hence long run equilibrium was found by imposing so called just-identifying restrictions on the coefficients of variables in the system of net exports.

- Net exports alone are not an equilibrating mechanism of the system. For this reason, aggregated exports and imports should be separated to try and understand why the function involving the composite net exports did not seem to work well. Broadly speaking, empirical studies should focus on other trade variables rather than net exports (exports functions are a better equilibrating mechanism of the system but the results are not reported in this paper) when studying the pattern and determinants of Portugal's trade in manufactured goods. What equilibrium relationships drive this problem is a subject for investigation.

- FDI inflows were significant and negatively related to net exports, so that the substitutability hypothesis was one supported by the evidence. The aggregation of the data might have distorted the picture and further empirical investigations are needed to complement the present finding (experimentations with imports and exports functions lead to a statistically significant complementarity's relationship between these variables and FDI but the results are not reported in this paper)

8. References

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9. Appendixes

Table A.1: Classification of industries (ISIC Rev.2)

3-digit level ISIC codes	*Industries*
311	Food products I
312	Food products II
313	Beverages
314	Tobacco
321	Textiles
322	Clothing
323	Leather products
324	Footwear
331	Wood products
332	Furniture/ Fixtures
341	Paper products
342	Printing, publishing
356	Plastic products
361	Pottery, china
362	Glass and glass products
351	Industrial chemicals
352	Pharmaceuticals and other chemicals
353	Petroleum refineries
354	Petroleum, coal products
355	Rubber products
369	Non-metallic mineral products
371	Iron and steel
372	Non-ferrous metal
381	Metal products
382	Non-electrical machinery
383	Electrical machinery
384	Transport equipment
385	Professional, scientific equipment
390	Other industries

Table A.2: FDI inflows in the EU (1986-92)

Countries	***Yearly growth rates***	***% over total***	***% of GDP***
Austria	31.60	0.80	0.35
Belgium-Luxembourg	60.93	8.33	3.16
Denmark	35.92	1.07	0.65
Finland	3.00	0.67	0.36
France	36.60	16.06	1.01
Germany	15.20	4.49	0.20
Greece	15.94	1.46	1.21
Ireland	69.33	0.52	0.89
Italy	-4.98	5.49	0.38
Netherlands	16.43	10.07	2.55
Portugal	**41.25**	**2.02**	**2.31**

Table A.3: Unit root tests on second, first differences and levels of variables

VARIABLES	*TEST (CRITICAL VALUE)*		
	I(3) versus I(2) (-3.03)	**I(2) versus I(1)** (-3.02)	**I(1) versus I(0)** (-3.01)
NETX	-5.55	-4.19	-2.01
PHYS	-4.45	-5.56	-1.95
HUM	-6.68	-3.55	-0.36
COST	-4.71	-3.66	-0.24
SCALE	-5.63	-6.32	-0.32
RER	-5.39	-3.32	-1.23
GDP	-4.75	-3.77	0.43
FNET	-3.69	-3.06	-2.26
FINF	-4.57	-3.48	1.82