Costs, Knowledge and Market Structure: Understanding the Puzzle of International Competitiveness with Greek Export Data

Abstract:
The current study examines the determinants of international competitiveness using export data from for thirteen Greek manufacturing industries over the period 1987-2005. The analysis expands the current empirical trade literature focusing on export drivers other than those of pure cost competitiveness. The paper investigates whether knowledge accumulation and knowledge spillovers can generate export gains. The findings contradict the usual expectations indicating that Greek exports are more sensitive to domestic R&D stock and foreign R&D spillovers. The most effective channel of knowledge transfer is via imports of raw and other materials from more technologically advanced countries. Regarding the measure of cost competitiveness, our decomposition analysis shows that what really matters is productivity and not labour cost reductions. The key policy implication is that Greece's international competitiveness is associated with product quality rather than simply cost of production.

KEYWORDS: Exports, Competitiveness, Unit Labour Costs, Knowledge Stock, Knowledge Spillovers, Manufacturing Industries, Greece

1. Introduction

European integration has offered the benefit of exploiting a larger market without the uncertainties induced by exchange rate fluctuations and trade barriers. The existence of a new economic environment has driven trade analysis and policy focus away from measures of protectionism towards other factors that affect trade performance. For many European countries increasing exports have been set as a key policy objective recognizing that an export orientation is a very effective recipe for escaping recession traps. Stimulating exports as an antidote to economic downturn is also applicable to European countries with severe national debt where government borrowing and spending is an obsolete policy instrument. In this case, the alternative way to stimulate demand for domestic products is through exporting. The crucial question is what are the main export drivers? Despite its apparent ease, economic policy makers find the answer to this question rather complicated because it is not so obvious what boosts the competitiveness of domestic products. To understand the complication concerning the issue of European manufacturing exports, one needs to take into consideration two facts. First, countries have lost their monetary autonomy, so currency devaluation as a means to improve price competitiveness is out of the policy-making tool kit and second, the intensive use of production offshoring towards South-East Asian countries substantially lowers costs leading to a rapid process of de-industrialisation in many EU countries.

These two facts are complicating the strategy of improving international competitiveness in the EU area. The importance of designing a successful export strategy is even greater for the European periphery such as Greece, Spain, Portugal and Italy, where the source of comparative advantage is no longer obvious. Greece has been in the centre of attention over the last two years as the first European country that requested a trilateral bailout to fund its public sector. The implementation of a bailout program has dictated austerity policies that inevitably trap the whole economy in recession. Other peripheral countries have been close to appealing to the same bailout mechanism (e.g. Portugal and Ireland already did so) facing the same consequences as Greece. Despite certain differences in the causes of the current debt crisis, all peripheral countries face deep recession requiring an export orientation. The paper focuses on Greece's export performance but the findings are likely to apply mutatis mutandis to other peripheral countries.

Cost competitiveness is always a vital issue in exporting but this cannot be achieved any longer by nominal currency devaluation. The recent tendency to reduced rigidity in the labour market leads only to temporary gains as far as labour costs are concerned, without a real impact on substantial export activity. The current economic and borrowing crisis of many European countries indicates the need for a new export paradigm where the source of comparative advantage is product differentiation and not solely cost reduction. This is also consistent with the Lisbon Treaty (2007) and subsequent directives that emphasized the importance of developing a knowledge-driven economy in the EU area. Export success for the European periphery no longer lies in cost compression but in its ability to produce differentiated products with high technological content.

The paper asks what are the determinants of exports in thirteen Greek manufacturing industries between 1987 and 2005. The answer to this question addresses the issue of the sensitivity of Greek exports in international markets. In other words, the drivers of export performance explain the factors fuelling international competitiveness.

Our main contribution is to extend the analysis beyond the traditional measures of cost competitiveness considering the link of exports to knowledge accumulation and knowledge transfer. Knowledge accumulation is a key indicator of a country's ability to offer differentiated products in international markets. However, for technologically laggard countries like Greece the stock of knowledge accumulated by domestic sources might be insufficient to generate substantial gains. Laggard countries can improve their technological capacity by transferring knowledge already produced abroad. In such a scenario, export success is inseparable from the absorptive capacity of the laggard country. While the empirical trade literature considers the effect of various national proxies of knowledge stock on exports, there is limited evidence about the impact of foreign knowledge spillovers on boosting domestic exports. Ledesma (2005) estimates the elasticities of foreign R&D stock on exports of OECD countries with country level data. We believe that industry level data avoid aggregation bias making easier to observe the effects of knowledge transfer. As already mentioned, the prevailing view of competitiveness from a policy maker point of view is to reduce costs regardless the fact that competitiveness is also likely to be stimulated by the degree of rivalry in the domestic market (Porter 1990). According to Melitz and Ottaviano (2008) small and less integrated markets tend to have lower productivity and set on average higher mark-ups. This distortion has been documented in the Greek manufacturing sector by recent research (Rezitis and Kalantzi (2011) posing the question whether these non-competitive conditions played a negative role on exports. Taking into account the above considerations the puzzle of international competiveness cannot be restrained to costs per unit of output but we need a more systematic analysis of the so called non-price competitiveness factors that suggested by theoretical trade models. The goal of this paper is to contribute to this direction specifying an empirical export function that includes costs, knowledge accumulation, knowledge transfer and domestic market conditions.

The paper is structured as follows: section 2 discusses some conceptual issues mainly related to the formulation of export functions and the definition of export determinants, section 3 controls for various econometric problems that are associated with the estimation of the export functions, section 4 discusses the results and section 5 concludes.

2. Conceptual Framework

Unit Labour Costs

The traditional macroeconomics approach is to model exports (X) as a function of relative prices and foreign income (Krugman (1989)). Relative prices represent relative cost (C) per unit of output and foreign income (Y^F) is an indicator of trading partners' purchasing power. This is widely considered a demand side approach for understating export behaviour:

$$X = F(C, Y^F) \tag{2.1}$$

The long tradition of empirical trade analysis employs an index of Unit Labour Costs (ULC) to measure cost competitiveness (Carlin et al. (2001)). ULC is an attractive index as it offers a decomposition of cost into: (a) cost per unit of labour input and (b) an index of labour productivity. We define ULC as follows:

$$ULC = \frac{\left(W/H\right)}{\left(Y/N\right)} \tag{2.2}$$

The upper ratio $\left(W/H\right)$ represents wages per worker measured as labour compensation per working hour while the lower ratio $\left(Y/N\right)$ indicates labour productivity defined as value added per hour worked.[1] Function (2.1) implies that exports are a function of relative prices between the home and foreign countries. In the current context, *ULC* should be measured in a fashion that reflects cost competiveness in Greece relative to cost in the major destination countries. For that purpose, we weight *ULC* with a reference point, which is the average *ULC* of Greece's eight major export partners.[2] Therefore, the Relative Unit Labour Costs (*RULC*) in industry *i* at year *t* is defined as:

$$RULC_{i,t} = \frac{ULC_{i,t}}{\overline{ULC_{i,t}}} \tag{2.3}$$

To make *ULC* comparisons meaningful across countries, values in (2.2) must be expressed in a common currency. Contrary to the standard approach followed in many empirical trade studies, we do not adopt a common Purchasing Power Parity (ppp)-exchange rate for all industries. Instead, we convert labour productivity in 1997 USD using Unit Value Ratios (*UVR*). The latter are industry specific exchange rates that capture more accurately the differences in output prices across industries. The UVRs are taken from the International Comparison of Output and Productivity (ICOP) industrial database and are only available for 1997. We extrapolate data for the remaining years of the sample using industry-specific output price deflators. Labour compensation per worker (*W/H*) is expressed in current USD. Therefore, the reference point of unit labour cost is computed as:

$$\overline{ULC_{i,t}} = \frac{1}{c}\sum_{c=8}^{\left(W/H\right)} \Big/ \frac{1}{c}\sum_{c=8} uvr\left(Y/N\right) \tag{2.4}$$

where *c* denotes the export partners currently considered to be eight.

Market Structure

Although (2.1) is an export demand function, it is relevant that the elasticity of export supply, especially in a small economy like Greece is finite. Under conditions of perfect competition in the domestic market, producers must be indifferent whether to serve domestic or foreign consumers. Nonetheless, it is widely accepted that the state of competition in Greek manufacturing (Anagnostaki and Louri (1995), Voulgaris et al. (2004))[3] diverges from the perfect competitive paradigm, which calls for further investigation for the link between domestic market structure and export behaviour. Although the nature of this relationship has already been addressed in an early study of Magee (1975), there is a weak focus on this in

[1] The difference between *H* and *N* is that the former refers to total number of hours including self-employed while *N* refers only to total hours worked by employees.

[2] The selection of Greece's major export partners is based on average values of export shares over the period of our study. On average during this period, the amount of exports shipped to these countries accounts for about 43% of total Greece's exports. The group of trading partners include Belgium, Germany, France, Italy, the Netherlands, Spain, UK and USA. There is a small number of countries that are systematic export partners (i.e. Cyprus and neighbouring Balkan countries) of Greece but are excluded due to heavy data omissions in variables used to construct *ULC*.

[3] This situation was subject to change after Greece's accession to European Union. The integrated European market helped reduce the degree of concentration in Greek manufacturing but the gloomy prospect of increased concentration has been always present since many small and medium sized enterprises could not cope in such a competitive environment and thus were forced to exit.

current research. Here we elaborate the effect of domestic market conditions by augmenting (2.1) with a measure of market concentration. This measure is based on the Lerner index:

$$L = \frac{p - MC}{P} \tag{2.5}$$

where p is price and MC is marginal cost. The Lerner index ranges between zero and one, with values close to zero representing perfect competition and values close to one representing monopoly. By re-arranging (2.5), the following expression is derived:

$$p = \frac{1}{1 - L} MC \tag{2.6}$$

where $\frac{1}{1-L}$ is the price mark-up (PM) imposed upon marginal cost. In a perfectly competitive, market the mark-up value is equal to one, while values above one indicate that the market diverges from the perfectly competitive outcome, suggesting the existence of monopolistic power. Industries with a mark-up very close to one view exports as a way to expand market size and thus a positive sign is expected. However, export behaviour in industries with monopolistic power is not *a priori* given. There are two competing scenarios, one that views monopolistic power as a disincentive for export involvement (Riedel *et al.* (1984)) and one that favours a positive link considering that monopolistic power ensures profitability, which is necessary for the development of substantial export involvement (Kumar and Siddharthan (1994)).

Home and Foreign Knowledge Stock

As mentioned above, cost competitiveness is not the only factor in export success. The ability of domestic industries to offer a variety of differentiated products is also vital. The importance of product differentiation in international trade has been noted since Posner's (1961) pioneering study. A similar proposition can be found in the so called "Kaldor paradox" (1978), which reveals that growth in exports moves alongside unit labour costs. The novel element in these studies is that product quality rather than cost of production is the international competitive edge. These findings have opened a new perspective in empirical export studies turning the interest from price competitiveness to factors such as R&D, patents and FDI (Krugman (1979) and Brander and Krugman (1983) and Grossman and Helpman (1991)).[4] In our analysis, we do not restrict our focus to the innovative activity that takes place within national borders but we also account for the existence of international knowledge spillovers that are derived from the R&D activity of foreign competitors. Generally, R&D is regarded as the ability to offer new varieties or products placed high in the quality ladder leading to a positive correlation between R&D and exports. Nonetheless, the technological sophistication embodied in exported goods can be derived either from national or foreign R&D. The impact of knowledge spillovers on exports essentially tests the absorptive capacity of Greek manufacturers to convert knowledge initially generated abroad into export gains. It should be noted that foreign knowledge is even more important for laggard countries whose distance from the international technological frontier is large. Greece is a representative economy of this type, with an increasing inability to devote sufficient domestic resources to R&D [5]. The next vital issue is to identify effective channels through which foreign knowledge can be diffused into the home economy.

[4] Empirical validity for the importance of technological factors on export activity can be found in Soete (1987), Dosi (1988), Amendola *et al.* (1992) and Verspagen (1992).

[5] See Komninos and Tsamis (2008) for a review of the difficulties and uncertainties existing in the Greek innovation system that largely explain the low R&D performance in Greece.

We consider that trade and especially imports of intermediate materials and capital goods are important conduits of the research effort conducted abroad. Such imports embody knowledge spillovers that can be disseminated in the domestic economy, improving in turn the quality of exporting commodities. Additionally, we also consider FDI as a means through which knowledge flows between countries increasing the technological capabilities of the recipient economy[6]. We define home knowledge as Greece's R&D stock in industry *i* at year *t*:

$$K_{i,t}^{H} = R\&D_{i,t} \tag{2.7}$$

Foreign knowledge is defined as the sum of R&D stocks of the eight major partners *j* in industry *i* at year *t*.

$$K_{i,t}^{F} = \sum_{j=8} R\&D_{i,j,t} \tag{2.8}$$

We construct R&D stock using the perpetual inventory method: $K_{i,t} = (1-\delta)K_{i,t-1} + RDI_{i,t-1}$, where δ is a physical depreciation rate currently assumed to be 12%[7] and *RDI* is R&D investment. All R&D data are expressed in constant 2000 USD ppp-exchange rate prices.

3. Data and Econometric Modeling

In this section, we review our empirical specifications and use them for our econometric investigation. We build our models gradually starting from a benchmark specification that includes unit labour costs, foreign income, domestic market concentration and home knowledge stock. We then augment the benchmark specification with foreign knowledge stock along with the different channels of knowledge diffusion in the home market. The set of specifications is:

$$X_{i,t} = \alpha_i + \beta RULC_{i,t} + \gamma Y_{i,t}^{F} + \delta PM_{i,t} + \varepsilon K_{i,t}^{H} + u_{i,t} \tag{3.1}$$

$$X_{i,t} = \alpha_i + \beta RULC_{i,t} + \gamma Y_{i,t}^{F} + \delta PM_{i,t} + \varepsilon K_{i,t}^{H} + \phi K_{i,t}^{F} + u_{i,t} \tag{3.2}$$

$$X_{i,t} = \alpha_i + \beta RULC_{i,t} + \gamma Y_{i,t}^{F} + \delta PM_{i,t} + \varepsilon K_{i,t}^{H} + \phi K_{i,t}^{F} + \lambda(m_{i,t} \times K_{i,t}^{F}) + u_{i,t} \tag{3.3}$$

$$X_{i,t} = \alpha_i + \beta RULC_{i,t} + \gamma Y_{i,t}^{F} + \delta PM_{i,t} + \varepsilon K_{i,t}^{H} + \phi K_{i,t}^{F} + \mu(fdi_{i,t} \times K_{i,t}^{F}) + u_{i,t} \tag{3.4}$$

Where *X* stands for real exports, Y^F denotes foreign income, *m* is the share of imports to output and *fdi* is the share of inward FDI flows to output. Foreign income refers to GDP per capita of Greece's eight major partners. To make this variable industry variant, we weight foreign income with the share of imports from Greece to total imports in each industry at the destination country. This adjustment might cause feedback effects between exports and the

[6] More recently, other entry modes to international markets such as joint ventures can be important channels of technology transfer. Nonetheless, it would be very difficult to construct a quantitative measure for this channel at the industry level. We leave this option as a possible path for future research where the application of firm level data is more suitable.

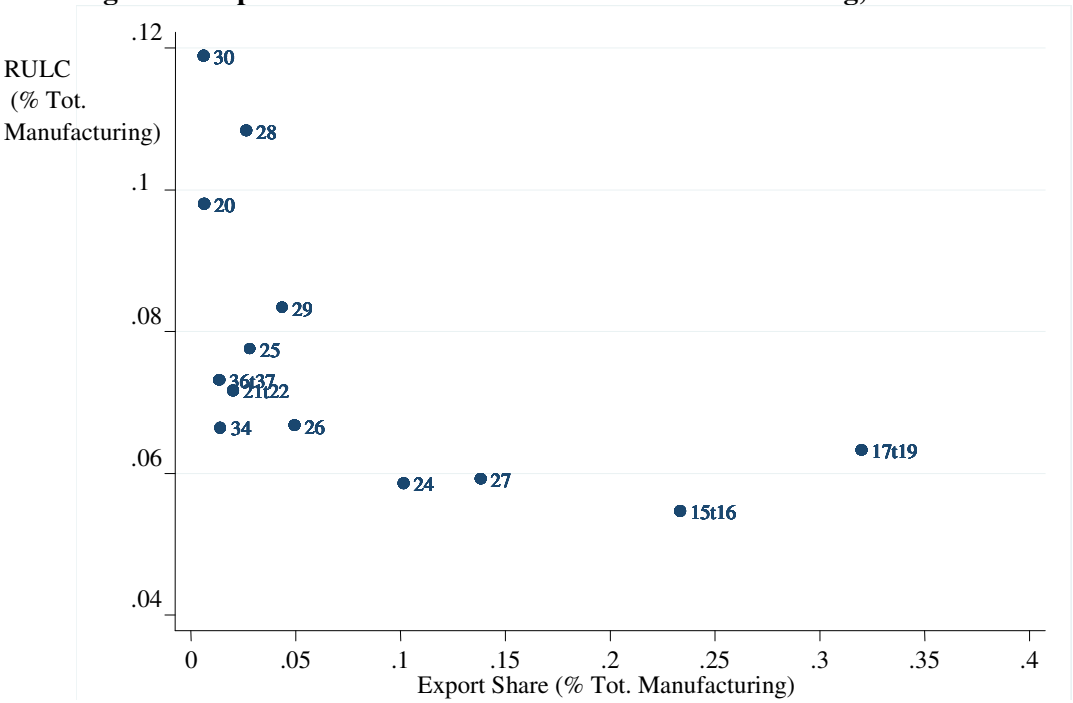
[7] We have experimented with different values of δ=0.05, δ=0.1 and δ=0.15. There are no qualitative differences in the values of R&D stock as well as in the econometric results produced. These estimates are available from the authors upon request.

adjusted foreign income. However, this potential endogeneity issue is very minor with regard to generating causality problems given that the proportion of Greek imports in the total imports of these countries is very small. All variables in specifications (2.1)-(2.4) are in logs. Following the previous discussion, K^H and K^F denotes domestic and foreign R&D stock, respectively.

The main data providers are EUKLEMS (2007) and OECD. Both databases are ideal for industry level analysis, reporting data for a long series, with industrial disaggregation. We use them in a complementary fashion as both databases are constructed in a fully compatible manner from Supply and Use Tables (SUTs) derived from the National Accounts System. Export and R&D data are taken from OECD while *RULC* and *PM* are constructed from EUKLEMS. FDI flows are taken from OECD and then we construct estimates of FDI stock following the methodology of Lane and Milesi-Ferretti (2001). Finally, GDP per capita in the major partners is obtained from the World Bank Development Indicators (WDI).

Before proceeding to the econometric analysis, it will be useful to provide some preliminary identification concerning exports and the behaviour of some key variables used in the study. Figure 1 presents a scatter plot of sample mean values of export shares and *RULC* over the period 1987-2005. Looking first at exports (horizontal axis), we observe the common pattern with food and tobacco industries dominating the exports of the whole manufacturing sector. This picture is consistent with the notion that Greece's main areas of specialisation relate to manufacturing and processing of food and textiles (Arghyrou (2000)). This can be regarded as a stylised fact that aligns with the neoclassical proposition of comparative advantage linking *RULC* to export intensity. Figure 1 indicates a skewed pattern of Greek manufacturing exports since many industries make only a minor contribution to total exports.

Figure 1: Export Shares and RULC in Greek Manufacturing, 1987-2005



Note: The reader can find the description of each industry code in Table 1

A further perspective on Greek manufacturing industry is offered in Table 1, where mean sample values are displayed for the remaining empirical variables. It is interesting that Food and Textile industries have relatively high R&D intensity. Although this is only descriptive evidence, it implies that export orientation in these industries is due not only to relatively low labour costs but might be also associated with intensive innovative effort. An

interesting correlation that can be derived from Table 1 is between export intensity and labour productivity in Food, Textiles and Basic Metals. By contrast, laggard industries in productivity such as Fabricated Metals and Computing Machinery have both low levels of export shares and R&D intensity. Finally, the price mark-up column shows that in many industries the value of mark-up is higher than 1, implying the existence of monopolistic power. The interesting correlation here is that in export oriented industries such as Food and Basic Metals the price mark-up is quite high (1.499 and 1.631) suggesting that the pricing policy fails to meet efficiency criteria. Nonetheless, we avoid drawing any further implications at this stage as our econometric analysis will draw a more rigorous correlation between price mark-up and exports.

Table 1: Exports and Other Performance Characteristics in Greek Manufacturing: 1987-2005

Code	Industry	*X*	*Relative Labour Cost*	*Relative Labour Productivity*	*PM*	*R&D*
15t16	Food and Beverages	0.233	29.704	33.504	1.499	0.114
17t19	Textiles	0.320	42.068	37.002	1.342	0.330
20	Wood	0.006	43.718	24.099	1.148	0.006
21t22	Pulp and Paper	0.020	31.394	25.879	1.255	0.012
24	Chemicals	0.101	25.310	25.932	1.410	0.104
25	Rubber and Plastics	0.028	26.351	20.242	1.403	0.097
26	Non-Metallic	0.049	32.332	27.762	1.488	0.078
27	Basic Metals	0.138	36.348	37.505	1.631	0.032
28	Fabricated Metals	0.026	32.094	15.584	1.040	0.029
29	Machinery	0.044	35.604	24.935	0.954	0.163
30	Office Machinery	0.006	39.182	10.006	0.962	0.009
34	Motor Vehicles	0.014	36.001	31.812	1.149	0.025
36t37	Manufacturing and Recycling	0.013	54.121	40.387	1.264	0.000

Notes: Exports(*X*) and R&D are expressed in % of total manufacturing. Relative Labour cost and Relative Labour productivity are expressed in USD (1997=100) using industry specific exchange rates (Unit Value Ratios). See the text for further information for full definition of these variables.

The export equations specified above pose some difficulties concerning the stationarity of the time series component in the panel. Estimating a model with stationary variables is very likely to produce spurious results. One possibility for mitigating this problem is to run separate regressions for each unit of our panel. Such an approach entails the obvious problem of a small number of years in each cross-section making it difficult to support firm inferences. For example, estimating a small sample can lead us to mistakenly accept the null of a unit root whilst the alternative is true. Instead, we use recent techniques of panel unit roots that elaborate both the cross-section and the time series dimension increasing the degrees of freedom as well as the power of cointegration tests being used. Certainly, the use of panel unit roots is at the expense of partially ignoring the heterogeneity that always exists in a panel. We try to address this problem by using versions of Augmented Dickey Fuller (ADF) tests that allow for some degree of panel heterogeneity.

Our econometric methodology is implemented in three stages. First, we test for the existence of a unit root in the variables appeared in models (3.1)-(3.4). Second, we seek to unveil whether there are long-run cointegrating relationships between our variables. Third, we estimate the cointegrating vector.

Concerning the panel unit root tests, we first display the structure of an ADF regression:

$$\Delta x_{i,t} = a_i + \rho_i x_{i,t-1} + \sum_{j=1}^{\rho_i} \lambda_{i,t-m} + \xi_{i,t}$$

ADF panel unit roots tests are involved in testing the hypothesis $\rho = 0$. Levin et al. (2002) (LLC hereafter) propose a test that allows for individual specific time trends and short-run dynamics. The LLC test is also consistent with a heteroscedastic structure in the error terms. The null hypothesis specified in the LLC test is $H_0 : \rho = 0$ against $H_1 : \rho_i = \rho < 0$. For testing this hypothesis a transformed t-statistic is used whose asymptotic properties are $N(0,1)$. We also use the Im et al. (2003) (IPS hereafter) panel unit root test that specifies a null hypothesis of the following form: $H_0 : \rho_i < 0, \ \forall i$ against the alternative $H_1 : \rho_i < 0$. In contrast with the LLC test, the IPS test does not assume that all cross-section units converge towards the same value of ρ, hence offering the flexibility to account for heterogeneity across sections of the panel. The IPS test is based on a standardised t-statistic that carries the same asymptotic properties as the LLC test.

Table 2: Panel Unit Roots (1)

Variables	LLC(2)	IPS
X	1.517	2.420
	(0.935)	(0.992)
RULC	**-3.614**	**-6.701**
	(0.000)	(0.000)
Relative Labour Cost	**-2.572**	**-7.479**
	(0.005)	(0.000)
Relative Labour Productivity	1.975	0.655
	(0.976)	(0.744)
Y^F	-0.438	0.581
	(0.331)	(0.720)
PM	3.069	0.125
	(0.999)	(0.550)
K^H	17.189	-0.241
	(0.771)	(0.405)
K^F	**-7.969**	**-5.298**
	(0.000)	(0.000)
$imp \times K^H$	-0.942	0.073
	(0.173)	(0.529)
$fdi \times K^F$	19.931	2.185
	(0.921)	(0.986)

Notes: (1) Numbers in parentheses represent p-values. Characters in bold indicate rejection of the null hypothesis that all panels have unit roots. The number of lags is selected by the Akaike criterion, specified here at 4 for both tests.
(2)The LLC test is run specifying the inclusion of a time trend.

Results from the unit root tests are shown in Table 2. There are no particular differences between the estimates of LLC and IPS. It is easy to ascertain that the majority of the variables included in the exports equations are non-stationary. Interestingly, one of the variables that appears to be stationary is *RULC* but this is only due to stationarity in the labour cost component since labour productivity, as expected, is highly persistent with strong I(1) behaviour. Given the evidence in Table 2, there is a need for a co-integration analysis in order

to establish whether variables included in equations (3.1)-(3.4) represent long-run equilibrium relationships.

We use the panel cointegration test developed by Westerlund (2007). Westerlund (2007) suggests four cointegration tests that rely mostly on the structural characteristics of the data rather than on the residual dynamics like the test that can be found in Im et al. (2002). Initially, all the variables are assumed to be I(1). The first pair of the statistics pool information regarding error correction along the cross-section dimension of the panel. The second pair does not follow the same procedure and reports group means statistics. For the panel statistics, the null hypothesis is formulated as: $H_0 : \alpha_i = 0$ for all *i*, against the alternative $H_1 : \alpha_i = \alpha < 0$ for all *i*, which indicates the existence of cointegration for the whole panel. For the group mean statistics, the alternative is $H_1 : \alpha_i < 0$ for all *i* indicating that a rejection should be regarded as evidence of cointegration of at least one unit of the cross-sectional dimension. For the implementation of these tests, we specify two lags and a Barlett Kernel window of 3.[8] Table 3 reports the values of the Westerlund statistics. Foreign income is the only variable that does not have a co-integrating relationship with exports. This means that while panel unit root indicates stochastic trends in the series of this variable these trends cancel each other out, leading to stationary residuals. For the remaining variables of our specifications there is robust evidence that justifies the existence of cointegration between exports and the independent control variables.

Table 3: Panel Cointegration Tests

	X-RULC	*X-RLP*	*X-RLC*	*X-Y^F*	*X-PM*	*X-K^H*	*X-K^F*	*X-($m \times K^F$)*	*X-($fdi \times K^F$)*
Gt	-3.30***	-3.35***	-3.23***	-2.80**	-3.47***	-2.87***	-4.00***	-3.45***	-2.35
Ga	-18.13***	-21.64***	-19.44***	-7.37	-19.97***	-15.28***	-14.03**	-17.48**	-14.65**
Pt	-8.78*	-7.51	-10.44***	-6.77	-10.38***	-8.63***	-9.27	-7.939	-7
Pa	-11.27*	-16.53***	-18.24***	-4.96	-19.45***	-13.21***	-11.46***	-12.99***	-14.28***

Notes: *RLP* and *RLC* denote relative labour productivity and relative labour cost as defined in equation (1.4). *Gt*, *Ga*, *Pt* and *Pa* denote group mean and panel tests following the formulation of the tests suggested by Westerlund (2007). The null hypothesis always refers to no cointegration. Three asterisks represent significance at the 1%, two asterisks at the 5% and one asterisk at the 10% level.

Based on the evidence presented in Tables 2 and 3, our models constitute long run cointegrating relations indicating that OLS will generate spurious results. Our specifications require the use of an estimator that ensures efficiency while allows us to accommodate the needs of a non-stationary heterogeneous panel. A number of estimators have been suggested in the econometrics literature for these purposes, among which the most appropriate for our case is that suggested by Pesaran et al. (1999). This is a pool mean group (PMG) estimator based on maximum-likelihood. The appropriateness of this estimator against other alternatives is usually dictated by two factors: (a) the structure of the panel, this is the number of cross-sections (N) relative to the number of years (T) and (b) the degree of heterogeneity in the data. In our case, T>N so the PMG is preferred to a GMM estimator which is more suitable for a short time span with a large number of cross-sections. Additionally, traditional dynamic fixed effects (DFE) (Pesaran and Smith (1995)) and dynamic OLS (DOLS) (Kao and Chiang (2000)) do not allow for different short-run dynamics across units, which make them less attractive for a heterogeneous panel.

The PMG fits an autoregressive distributed lag (ADL), allowing both for short-run and long-run dynamics. The general formulation of an ADL (*p,q*) model is:

[8] Westerlund (2007) provides further discussion regarding the asymptotic properties of the above statistics.

$$\Delta y_{i,t} = \varphi_i y_{i,t-1} + a_i \mathrm{X}_{i,t-1} + \sum_{j=1}^{p-1} \varphi'_{i,j} \Delta y_{i,t-1} + \sum_{j=0}^{p-1} a'_i \mathrm{X}_{i,t-1} + \omega_i + u_{i,t}$$

Where X is a vector of explanatory variables, a_i represents the long-run elasticities, φ_i is the error correction term while a'_i and φ'_i represent coefficients of short-run dynamics. The PMG is obtained by estimating N individual regressions and then averaging the estimated coefficients by restricting $a_i = a$ for all i while allowing the short-run coefficients to vary across industries.

4. Results

Table 4 shows the long-run estimates of the coefficients for the specifications presented in (3.1)-(3.4). The pattern of foreign income is significant at the five percent level and above with a high income elasticity exceeding unity in three out of four specifications. The impact of domestic market structure appears to be highly negative indicating that monopolistic practices in the domestic market are strong disincentives for export performance.

Turning to the impact of knowledge stock on exports, the accumulation of domestic stock is consistently positive and significant. The magnitude of this estimate ranges between 1,5% and 3,4%. Such a finding indicates a much smaller elasticity than Ledesma (2005) has found for OECD countries. The impact of autonomous foreign knowledge in Greek exports appears to be insignificant in two out of three specifications. In column (3) foreign knowledge appears to have a highly negative coefficient suggesting that trading partners' knowledge accumulation enforces their ability to export new varieties of product hindering at the same time Greece's export capacity. However, once we control for specific conduits of knowledge transfer this estimate exhibits a clearer pattern. In column (3), we include the import-output ratio (specification (3.3)), and then the interacted term has a positive and significant coefficient. Interestingly, the estimated parameter of foreign R&D stock interacted with import share is much higher than the estimated parameter of domestic R&D stock. This indicates that when using the right paths of knowledge transfer, foreign knowledge stock can be a more important source of export gains. This result can be viewed compatible with Greece's position in the international technology ladder. While advanced economies rely more on their R&D efforts in developing new products for export markets, Greece's backwardness in the technological sector makes it weak in producing new varieties attractive to international markets. Therefore, according to the estimates in Table 4, the nature and the scale of domestic R&D although significant in other aspects[9] cannot generate massive export gains. Column (4) tests whether FDI can be a channel of knowledge transfer. This interaction term produces weak results on export performance contrary to the channel of trade openness. Although FDI is widely regarded as a more appropriate path of technology transfer across countries, the result of our study is not surprising given that Greece has been unable to attract substantial FDI flows over the period under study.

[9] Domestic R&D has a dual role. The first role is to stimulate the rates of innovation increasing the number of product varieties. In empirical studies, the estimated coefficient of R&D stock is known as the social return to R&D. The second role of R&D is to improve absorptive capacity even though it has little contribution to generating new product varieties. The second role of domestic R&D is rather important for laggard countries as it ensures that the absorption of foreign knowledge can take place faster. This is the aspect that calls for continuous investment in R&D even if there are not always export benefits. For a further discussion of this topic see Griffith et al. (2004) and Bournakis (2012), among others.

Table 4: Determinants of Exports, Estimates from a Pooled Mean Group Estimator (PMG)

	Exports (3.1)	*Exports* (3.2)	*Exports* (3.3)	*Exports* (3.4)
	Long Run Estimates			
RULC	0.091	0.228***	0.099	-0.089
	[0.80]	[2.65]	[0.97]	[0.83]
Y^F	1.672***	1.579***	0.789*	2.072***
	[5.34]	[4.34]	[1.93]	[4.21]
PM	-0.317*	-0.272	-1.031***	-0.644***
	[1.76]	[-1.49]	[4.19]	[2.84]
K^H	0.034***	0.027***	0.015**	0.024**
	[4.04]	[2.70]	[2.07]	[2.20]
K^F		0.11	-0.598**	-0.101
		[0.99]	[2.30]	[0.68]
$imp \times K^H$			0.356***	
			[3.51]	
$fdi \times K^F$				-0.02
				[0.96]
Observations	230	230	230	219
Number of Industries	13	13	13	13
Log-Likelihood	154.061	177.179	206.633	192.988

Notes: Each column shows the results of specifications (2.1)-(2.4).The estimates presented in the table refer to the long run elasticities of the pool mean group estimator (PMG). The t-ratios are reported in square brackets. Asterisks denote significance as follows: *** 1%, ** 5%, * 10%. The full definition of variables can be found in section 2.

Estimates in Table 4 fail to produce a clear pattern concerning the unit cost elasticity of Greek exports. This finding is in contrast with other studies that point out the importance of cost measures on exports such as Goldar (1989), Anderton (1992), Wolff (1995) and Montobbio (2003).[10] In all specifications but (3.2) relative unit labour costs are insignificant and with an ambiguous sign. As discussed above the measure of *RULC* comprises of two different components, labour cost and labour productivity. There is a presumption (Bank of England (1982)) that either a change in relative wages or a change in relative productivity has the same impact on *RULC*. However, a change in wage originates a change in productivity in a perfectly competitive labour market and if these changes are proportionally equal (i.e. as they are supposed to be in a frictionless labour market) then they cancel each other out leaving *RULC* unaffected. In a distorted labour market, the movements in wages and productivity are very likely not to coincide, which implies that one cannot have *a priori* expectations about the effect of relative unit labour costs on exports. These considerations explain why the estimates of *RULC* in Table 4 are not surprising. If we want to obtain a more insightful picture of the cost sensitivity of exports we need to disentangle these effects estimating separate specifications for each of these cost components.

[10] Not all these studies use the same definition of Unit Labour Cost (ULC) and do not use the same dependent variable. For instance, Goldar (1989) and Wolff (1995) measure cost with a growth index of total factor productivity (TFP). In the studies of Carlin et al. (2001) and Montobbio (2003) the dependent variable is specified as the export share of industry *i* in total world exports. Our focus here is the level of exports in an individual industry and not export shares. This suggests that the reader must be cautious when comparing our results with findings in other studies.

The results of this robustness test are shown in Table 5 where we replicate specifications (3.1)–(3.4) by replacing the measure of relative unit labour costs with its individual components. Only relative labour productivity has the expected sign in the long-run while the estimate of relative labour cost remains ambiguous confirming in two specifications the "Kaldor paradox", mentioned earlier. The Wald test shown in the last row confirms that one should reject the hypothesis that the long-run effects of relative labour cost and relative labour productivity are identical at conventional levels. According to this, unit labour costs and thus exports are more sensitive to productivity performance than anything else.

Two main implications may be derived from these results. First, our earlier claim that there are divergences from the competitive paradigm is confirmed, implying further that wages and productivity do not move analogously. Second, the view that successful export activity in Greece depends entirely on the ability to lower costs is not supported in this instance. This is also consistent with the fact that relative wages in Greece are already quite low so there is no margin for further reduction. What really matters for improving cost competitiveness is to find ways to stimulate efficiency and productivity. Our measure of cost competitiveness in the paper does not allow us to pick up potential forces that drive productivity, this remains a path for future research including a more integrated measure of productivity that incorporates not only labour but the whole set of production factors.

Table 5: Determinants of Exports: Decomposition of RULC

	Exports (3.1)	*Exports* (3.2)	*Exports* (3.3)	*Exports* (3.4)
Long Run Estimates				
Relative Labour Cost	-0.069	0.132	0.072	-0.314**
	[-0.69]	[1.41]	[0.78]	[-2.35]
Relative Labour Productivity	0.698***	0.523***	0.341**	0.09
	[2.89]	[2.64]	[2.31]	[0.48]
Y^F	2.223***	1.487***	0.909**	0.073
	[6.80]	[3.40]	[2.09]	[0.10]
PM	-0.889***	-0.765***	-0.893***	-0.724***
	[-3.76]	[-3.47]	[-4.20]	[-2.76]
K^H	0.057***	-0.047	0.026**	0.073**
	[4.99]	[-0.77]	[2.56]	[2.37]
K^F		-0.122	-0.688***	-0.842***
		[-0.76]	[-2.70]	[-3.04]
$imp \times K^H$			0.377***	
			[4.23]	
$fdi \times K^F$				0.001
				[0.02]
Observations	230	230	230	219
Number of Industries	13	13	13	13
Log-Likelihood	177.918	209.644	239.587	216.4327
Wald Test-Chi2(2)	8.56 (0.01)	12.30 (0.00)	7.86 (0.01)	6.02 (0.04)

Notes: Each column shows the results of specifications (2.1)-(2.4).The estimates presented in the table refer to the long run elasticities of the pool mean group estimator (PMG). The t-ratios are reported in square brackets. Asterisks denote significance as follows: *** 1%, ** 5%, * 10%. Wald test and the associated p-values in parentheses refers to the hypothesis that the coefficients of *Relative Labour Cost* and *Relative Labour Productivity* are jointly significantly different from zero. The critical value for the Chi2 distribution at the conventional level of 5% is 5.91. This leads us to reject the hull hypothesis in all four specifications.

5. Conclusions

Given that the integrated European environment offers great opportunities for market expansion, it is of special importance to have a clear guide concerning the drivers of exports. The current paper investigates the determinants of exports over the period 1987-2005 for Greek manufacturing industries shedding light on factors other than cost competitiveness. Given the radical changes happening in Europe, we revisit the puzzle of export performance seeking to identify the importance of non-price competiveness on exports. The rapid spread of outsourcing towards East Asia makes it virtually impossible for the European Manufacturing sector to compete by lowering costs. Outsourcing intensifies the need for European countries to invest more in R&D as this shapes the source of comparative advantage, and also brakes the de-industrialisation process. Innovative activity is also the key for peripheral European countries even if the area of export specialization remains the low technology manufacturing.

The study highlights the notion that for a peripheral European country boosting exports is a matter of either domestic knowledge accumulation or effective absorption of foreign knowledge. There appear to be three key findings that can be used to guide future policy. First, the closer the domestic market to monopoly the lower the amount of output sold in foreign markets. This type of conduct in the domestic market is a strong disincentive for international commitment as producers rely exclusively on the exploitation of domestic welfare in order to increase profitability. Second, Greek exports are less cost sensitive compared to other determinants used in the empirical estimation. Even if Greece's main areas of export specialisation are in low-technology industries, cost reduction does not necessarily increase export capacity. The important element is the amount of knowledge embodied in exporting commodities. The ability to differentiate production appears to be a more important factor for successful international competitiveness than cost reduction. The main source of knowledge is through transfer from countries placed higher on the international technology ladder. The most effective channel of knowledge transfer is via imports in materials and capital goods (Bournakis 2012). The elasticity of exports with respect to home knowledge stock is between 1.5% and 7.5% while the elasticity of exports with respect to foreign knowledge stock transmitted via imports is much higher, 35,6% and 37,7%. To understand this pattern better one needs to consider that Greece is a member of a strong currency union that leaves little margin to affect price competitiveness via exchange rate adjustments, especially when the main exporting partners are other members of the common currency area. Third, the decomposition of *RULC* indicates that if one focuses only on the cost competitiveness aspect of exports then the issue is how to improve productivity as exports proved to be insensitive to labour cost reductions. To conclude, the export paradigm supported by our study implies skills intensity and training rather than a flexible labour market. Such a transformation process will lead peripheral countries to converge towards the German export paradigm thus contributing to a more unified EU area.

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