The Quality of Greek Exports across Time and Destinations

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Abstract: Product quality is identified as an important determinant of bilateral trade flows in international trade literature. In this paper, the quality of Greek exports between 1998 and 2012 is identified empirically following Khandelwal's (2010) approach. Using disaggregated data from Greek manufacturing I find that there is substantial heterogeneity in SITC1 industries and that a quality drop is observed in exports to middle income countries.

Athens, June 2015

Master Thesis

ATHENS UNIVERSITY OF ECONOMICS AND BUSINESS

DEPARTMENT OF INTERNATIONAL AND EUROPEAN ECONOMIC STUDIES

1. Introduction

Many recent studies highlight the significant role of quality of goods in international trade. Hummels and Skiba (2004), Hallack (2006) and also Baldwin and Harrigan (2011) find evidence that differences in product quality are an important determinant of the pattern of international trade flows.

The related literature attempts to exploit the available disaggregated data to reveal how the components of trade flows, such as varieties, quantities and unit values are linked to the quality of exported goods. The greatest challenge is the fact that quality of goods is unobservable. A large body of the relevant literature uses as a proxy of product quality the unit values of exports. According to Kravis and Lipsey (1974) the unit values of internationally traded goods are heavily influenced by quality. Yet, unit values as a quality measure are subject to shortcomings due to trade costs, pricing strategies across markets, and composition, production and transport costs. Moreover they might be affected by standard demand and supply shocks that have implications for the prices of goods, but they do not affect quality. The aforementioned problems are encountered by recent papers that use explicit microeconomic foundations on macroeconomics (Khandelwal (2010), Hallak and Schott (2011), Henn et al. (2013), Feenstra and Romalis (2014), Vandenbussche (2014)).

In this study I proxy the quality of Greek exports between 1998 and 2012 following the idea provided by Khandelwal (2010), who estimates quality using a variety-fixed effect to capture the time-invariant part of quality combined with a time-fixed effect to account for the variation of quality over time, combining information for quantities and prices. To this end, I estimate regressions for 21 SITC5 categories of manufacture products. Next, I construct quality indices, which depict the Greek export quality progress in the period 1998-2012. Finally, I study the dispersion of Greek exports quality with respect to the destination countries' size in order to reveal the average quality identity of Greek exports across destinations in the same period.

2. Literature review

2.1 Theoretical Studies

There are many theoretical studies on quality measurement in the current literature following several different approaches. The first dominant approach in the literature is based on Constant Elasticity of Substitution utility functions. The quality measurement using a CES-type utility function is very popular as such type of functions offers a simple estimation procedure with tangible and elegant mathematics. Many existing trade models that adopt the CES approach, formulate consumer demand in a representative consumer (per country) framework, whose main characteristic is the love-for-variety suggested by Dixit and Stiglitz (1977).

From a monopolistic point of view, Dixit and Stiglitz (1977) develop a model in which the price remains the same despite the differences in distance or destination size, due to the fact that constant markup pricing and identical producers do exist. This way, the consumers[1] buy a specific amount of every single variety in a fixed price. Their monopolistic competition model is based on the assumption that consumers prefer the existence of variety in addition to the assumption that there is no asymmetry in the substitutability of products and that firms have finite requirements for limited productive resources. This love of variety explained by a CES utility function is symmetric in a bundle of differentiated products.

Melitz (2003) adopts the Dixit-Stiglitz setup and connects the value of sales to the operating profits and high-competitive exports. According to his work, exposing a product to trade involves two selection processes, namely the productive firms are able to enter into the export market, while the less productive ones exit the domestic market due to the high competition. Trade liberalization increases the market share and the foreign demand of most productive firms resulting in the increase of the labor factor demand as well. Thus, the marginal cost increases while the less productive firms exit the domestic market since they cannot afford to cover the fixed costs of the manufacturing process. Both selection processes lead to a reallocation towards more productive firms and a raise of country's average productivity occurs. Being influenced by Melitz's (2003) work, recent models based on heterogeneous firms adopt this framework. In these models, due to the Dixit-Stiglitz constant markup pricing, prices at the company level are undistinguishable no matter the destination, while no correspondence between prices and distance has ever been noted. For a distant market, only firms with considerably low marginal cost can afford to export, while less competitive ones export in neighbor markets.

Baldwin and Harrigan (2007) develop a heterogeneous firm trade model with CES demand and quality competition in which consumers appreciate quality. Higher quality is identified as having higher marginal costs. While in the original Melitz model (2003) price is the sole

[1] Consumers are identical in order not to appear heterogeneity in taste.

determinant of competition, meaning that market entry thresholds can be expressed in terms of the maximum price, in Baldwin and Harrigan (2007), competitiveness depends on quality-adjusted prices. Lower quality-adjusted prices, which are unobserved, are related to higher unadjusted observed prices. Hence, only the most expensive and high quality products can be exported to the most distant markets. Empirically implementing their model, Baldwin and Harrigan (2007) establish that most potential export flows are not present and also that unit values are positively correlated with distance, rejecting every well known multi-good general equilibrium trade model. At the product level, Baldwin and Harrigan (2007) find positive associations between US export unit values and destinations' distance.

Melitz and Ottaviano (2008) present a model where firm heterogeneity is introduced based on Melitz (2003), while instead of a CES demand they assume a linear demand system with horizontal product differentiation, incorporating endogenous mark-ups. This linear demand system is developed by Ottaviano et al. (2002)[2]. Melitz and Ottaviano (2008) introduce an alternative structure that incorporates predictions on the distribution of four different performance measures (both average and variance), meaning the size, productivity, markup and price. Their monopolistically competitive model of trade is proposed in order to predict the way in which an average set of industry performance measures would react to a possible change in world trade. They display how the market's size prompts significant changes in industry and also how the costly trade does not completely consolidate markets. Particularly, they indicate that for firms with linear demand functions, markups will vary depending on export destinations and that the possibility of price discrimination across markets may result to lower markups and prices on markets which are characterized by higher competition. In such models two ramifications occur in terms of the average price. Firstly, there is the price discrimination effect which applies in cases of strong competition. Secondly, there is the selection effect according to which the most productive firms survive and set higher markups. Here trade operates through an increase of product market competition instead of an increase in the labor market competition. This tougher product market competition results in a lower markup charged by firms outweighing the selection effect.

Di Comitè, Thisse and Vandenbussche (2014) extend this approach of quality measurement allowing a separation of quality from consumer taste effects in trade, 'the verti-zontal model

[2] Ottaviano, Tabuchi and Thisse develop a monopolistic competition model (different than that of Dixit and Stiglitz) adopting an alternative specification of the consumer preference for variety, the quadratic utility model.

of trade'. They assume productivity differentiation between firms exactly as Melitz (2003) and linear demand stemming from a quadratic utility function as Melitz and Ottaviano (2008), but they innovate by allowing consumer preferences (and the resulting demand) to vary across countries and products instead of considering symmetric demand for all products. They claim that conditional on prices, products may have a larger market share because they either appeal more to consumer taste or have a quality advantage. Their model is characterized by parallel and slope demand shifters; while parallel shifters correspond to quality, slope shifters represent horizontal differentiation of varieties. More specifically, di Comitè, Thisse and Vandenbussche (2014) imply that differences in market shares between varieties of the same product are decomposed into market share shifts due to quality and shifts due to taste (i.e. a vertical demand shifter accounts for the quality differences between varieties).

This claim is argued by Khandelwal (2010) who insists that conditioning on price, products with a larger market share, must have a higher quality; with no need for a distinction by separating quality from cost and taste effects. Khandelwal (2010) presents his approach to quality measurement incorporating in his model price and market share information. He derives the quality measures from a nested logit demand system that embeds preferences for both vertical (quality) and horizontal features, based on Berry (1994), not disentangling quality from marginal cost since both always move in the same direction. Assuming that in equilibrium all firms produce horizontally distinct varieties[3] and that a Ricardian-type comparative advantage drives the vertical component, he claims that *holding prices fixed, all consumers would prefer higher quality goods.* As a consequence, he infers quality using a variety-fixed effect to capture the time-invariant part of quality combined with a time-fixed effect to account for the variation of quality over time. Furthermore, Khandelwal (2010) introduces the notion of quality ladders as the differences between the highest and lowest quality of each market.

2.2 Empirical Work

The empirical work on this field adopts mostly theoretical extensions of the previous models. Hummels and Skiba (2004) provide evidence that the quality composition of exports increases with the distance between trading partners[4]. They claim that international transportation costs

[3] According to Krugman (1980) and Melitz (2003).

[4] Alchian and Allen (1964) claim that the presence of a per unit transaction cost lowers the relative price of high quality goods

lead firms to ship high quality goods abroad, while keeping for domestic consumption the low-quality goods. Hummels and Skiba (2004) employ in their model an augmented CES utility function to include quality differences. In this framework, they show that the presence of bilateral variation in per unit shipping costs will change the relative price of high- and low-quality goods across bilateral pairs. Shipping costs affect the quality composition of trade both across exporters and importers for a given pair.

Hallak (2006) provides an empirical framework to estimate the impact of quality on the direction of trade. The subutility functions used are an augmented version of Dixit-Stiglitz preferences, while quality enters as a utility shifter attaching a horizontal dimension to product differentiation. He works with bilateral trade flows at the 3-digit product level to construct export price indices and interprets them as quality indices. These indices are based on cross-country differences in unit values of US imports. He captures differences across countries in quality demand which stems from the cross-country variation of income. In his empirical work, Hallak (2006) confirms that rich countries have the tendency to record more import flows from countries that produce goods of higher quality. He shows that this applies not only to the manufacturing sector, but also to the homogeneous and reference priced products.

Kneller and Yu (2008) use Chinese data and find evidence against the dominant trade models based on Melitz (2003) and Baldwin and Harrigan (2007). They adopt a different heterogeneous firm trade model, based on Melitz and Ottaviano (2008), which incorporates quality differences and spatial price discrimination[5]. In this model, the relationship of export unit values with distance and market size of export destinations is ambiguous as existing selection and price discrimination effects work in opposite directions.

Bastos and Silva (2010) indicate that free-on-board unit values within product categories increase consistently with distance and also tend to be higher for shipments traded to richer destinations. They utilize highly disaggregated firm-level data to estimate models with firm fixed-effects in order to investigate whether the positive effect of distance on export unit values is merely explained by the self-selection of heterogeneous firms across markets or occurs within each firm. The results show that firm size heterogeneity does not play a key role in explaining the positive effect of distance on export unit values and also that unit values

[5] The optimal firm level f.o.b. export price varies across export destinations with different distances and market size.

within products heighten with the income per worker at the importing country, indicating that demand side factors constitute a significant driver of export quality.

Schott and Hallak (2011) claim that export unit prices are an unsatisfactory measure of quality as they may vary for reasons like production costs or over/undervalued exchange rates that are not related to product quality. They develop a method that extracts observed export prices from a country's products combination and their world demand, decomposing export prices into quality versus quality-adjusted-price components and accounting for unobserved horizontal differentiation.

Martin (2012) focuses on how within-export prices vary with distance. Using a Melitz-type model with Melitz-Ottaviano-type demand functions and assuming a monopolistic competition framework, he examines bilateral trade firm-level data of French exporters. He shows that firms set higher markups or even sell quality upgraded products when they face higher transportation costs. Martin (2012) claims that previous models like that of Hummels and Skiba (2004), fail to explain why this happens and he provides a strong argument in favor of per unit transport cost. To explain the positive correlation between export prices and distance, he assumes unit transport costs instead of iceberg trade costs. Under CES demand, firms increase the quality exported when per unit transport costs increase while under quasi-linear demand, firms reduce their markups to sell goods in more distant markets independently of transport costs.

Johnson (2012) examines whether quality is homogeneous (meaning that quality is identical for all products and thus firms compete only in terms of price) or heterogeneous (meaning that there is a wide range of quality and thus firms compete on quality-adjusted price terms) at the Standard International Trade Classification (SITC) 4-digit level[6]. He indicates that prices that rise with the threshold for export dominate the data. This pattern is consistent with models of quality heterogeneity, in which the most capable firms within a sector choose to produce high quality goods and charge high quality unit prices.

In Hallak and Sivadasan (2013) firms choose both the price and the quality of the products, in an attempt to maximize their profits. The optimal quality depends on the export status of the firm. They employ a model where trade costs are a decreasing function of quality captured by a monopolistic competition setup with an augmented constant-elasticity of substitution demand. Hallak and Sivadasan (2013) claim that it would be significantly more likely for

[6] Johnson (2012) assumes a Dixit-Stiglitz form with a monopolistic competition framework.

exporters to acquire ISO 9000 certifications conditional on size, meaning that they could possibly charge higher prices than non-exporters. Based on their result that conditional on size quality is higher for exporters than non-exporters, is presumed that conditional on size exporters pay higher input prices than non –exporters. Furthermore, it is established that exporters would pay higher average wages than non-exporters, while exporters would use physical capital more intensively.

Henn, Papageorgiou and Spatafora (2013) claim that observing unit value ratios may lead to an inaccurate approach for export quality. The model they employ is an adjusted version of Hallak (2006) who suggests that wealthier countries import higher quality, discarding data limitations in order to succeed in acquiring maximum country and time coverage (178 countries, 1962-2010). Henn, Papageorgiou and Spatafora design a set of quality indicators based on unit values, evaluated within a sector – specific gravity – equation framework. Their findings show that high product prices do not necessarily suggest high quality. Nevertheless, this may be an indicator of other supply side consideration, such as high production costs. They reach the conclusion that the average quality at the country-level moves in parallel to the income per capita. Finally, they deduce that quality upgrading is best encouraged through horizontal rather than sector-specific policies.

Feenstra and Romalis (2014) feature an extended monopolistic setup where firms choose both prices and product quality, while they allow countries to have non-homothetic quality demand. They treat bilateral trade data over 25 years embedding a quality decision into a Melitz-type model. Their target is to adjust observed trade unit values for quality to estimate quality-adjusted prices in trade. They require detailed data on importer- and exporter-reported prices (CIF and FOB prices respectively) in order to construct a ratio-type measure of quality that incorporates consumers' non-homothetic preferences for quality.

Recently, Vandenbussche (2014) following the methodology proposed by di Comitè, Thisse and Vandenbussche (2014), develops a new *Quality Indicator* based on a structural model with an identifiable quality parameter in order to assess the position and its dynamics, of each Member State of EU in terms of market shares. Studying the quality distributions constructed for each Member State and the corresponding quality ladders over time (2007-2011), he shows that products with the largest market shares is possible not to have the highest quality.

3. Data Description

Our empirical analysis utilizes data on Greek exports from 1998 to 2012 from the Eurostat's Extra-EU trade statistics basis and Eurostat's Intra-EU trade statistics. Extrastat is the system that produces statistics on trade in goods of European Union (EU) Member States with non-EU Member States, while correspondingly, Intrastat produces statistics on trade in goods between countries of the European Union (EU). Export values in these data bases are free-on-board. We also enrich our data set with various fundamental characteristics of the destination country such as its distance from Greece and its size, in constant GDP and population terms, from the World Development Indicators of the World Bank[7].

When goods are declared to the EU-statistics, they have to be classified according to the 8-digit Combined Nomenclature or CN8. This is the most detailed product classification system for keeping foreign trade statistics in the European Union. The structure of the CN8 code is standardized. The first two digits of the CN8 code symbolize the sector where each product is classified; as CN8 digits ascend (until reaching the 8-digit level) we get a more detailed description of the recorded product. By defining products at a highly disaggregated level, the 8-digit level of the Combined Nomenclature, one can minimize the scope for product quality differences determining price variations within firms. In our case this can be convenient as firm-level data are not available for analysis and it is a fact that we do not have the information required to limit within-firms' price variations.

Furthermore, in order to facilitate the international comparison of trade data, products are classified according to the Standard International Trade Classification, SITC as an abbreviation, which is the classification of the commodities entering external trade developed by the United Nations for multi-dimensional purposes of economic analysis. According to the UN definition the groupings of SITC reflect the production materials, the stage of processing, the commercial practices and uses of traded products, the weight of goods in world trade, and also technological changes. The hierarchical structure of the classification comprises; the one-digit code stating the sections traded commodities, two-digit codes which declare goods' divisions, three-digit codes categorizing products into groups, four-digit codes for the products' subgroups and finally five-digit codes showing the specific traded item[8].

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[7] Following Manova and Zhang (2012).

[8] Currently applies revised fourth edition of SITC (SITC Revision 4), which was approved in 2006 by the 37th session of the Statistical Commission of the United Nations.

Our sample consists only of goods from the manufacturing sector[9] excluding the homogeneous goods as they exhibit no quality differentiation following Rauch's (1999) liberal classification. We use the liberal standard because it is more stringent in the classification of goods as differentiated[10]. In our original data set, flows are recorded as monthly exports. Before we transform them into annual recordings, we harvest them and keep only varieties (defined as CN8 classifications) that are exported for more than 6 months and also those that are exported for more than 3 months to one single destination. Next, we calculate unit values as ratios of export value to quantity and we exclude CN8 codes with unit values that are 10 times larger or lower than the median product (per SITC) price in order to deal with the existence of a considerable measurement error. Finally, we remove products with less than three CN8 classifications per SITC allowing for variation across nested shares (CN8) within a product category (SITC). As a result, we focus only on a subset of all exported products based on the three previous restrictions.

In the meantime, the EU-statistics do not report zero flows. It is important to be clear on how "zeroes" are treated[11]. In our estimations we include only products (SITC5) that are exported every single year no matter their destination; "zeroes" are dropped out. Finally, we end up with 21 SITC5 codes (see table A1) which include 179 different product varieties and are exported to 94 different destinations in total, carefully harvested from the initial data set after all these trims.

4. Empirical Analysis

4.1 The Model

To obtain a proxy for the quality of Greek exports I estimate two separate models following Khandelwal (2010). His model is characterized by parallel demand shifters, with high quality goods identified by their market shares. Quality represents a parallel shift of the demand curve that results in a higher price; a higher willingness to pay for the high quality variety than for the low quality variety. The product variety (CN8) with the highest market share has

[9] 5-"Chemicals and Related Products", 6-"Manufactured goods classified chiefly by material", 7-"Machinery and transport equipment", 8-"Miscellaneous manufactured articles".
[10] Rauch divides-digit SITC product categories into three groups: differentiated, reference price and homogeneous products. He uses two standards to make this classification, one "liberal" and one "conservative".
[11] Baldwin R. and J. Harrigan (2011) discuss how zeroes should be treated.

the highest quality after controlling for importer size[12] and price. Thus, a CN8's quality will rise if its price rises without losing market share.

The first specification takes the following form:

$$ln(f1hd) = a\ ln(pricehd) + \beta\ ln(popd) + \lambda 1,h + \lambda 2,t + \lambda 3,ht \quad (1)$$

where *f1hd* indicates the share of shipments of variety *h* defined by the CN8 classification shipped to destination *d* relative to aggregate shipments of product *j* defined by the SITC5 classification of products. For instance, let *f1hd* be the share of cotton skirts exported to Italy relative to total quantity of skirts exported. The unit value of cotton skirts shipped to Italy is denoted by *pricehd* while *popd* is the population of Italy.

The second specification extends equation (1) by a variable that accounts for the nested share of variety's *h* shipments (cotton skirts) to destination *d* (Italy) in aggregate shipments of variety *h, f2hd*. This extension allows for more appropriate substitution patterns by placing varieties into appropriate nests, avoiding quality changes in the presence of closely substituted products. The extended specification takes the following form:

$$ln(f1hd) = a\ ln(pricehd) + \beta\ ln(popd) + \gamma\ ln(f2hd) + \lambda 1,h + \lambda 2,t + \lambda 3,ht \quad (2)$$

Quality is inferred by a variety-fixed effect $\lambda 1\ h$ combined with a time fixed-effect $\lambda 2,t$. The former captures the time-invariant part of quality, while the latter accounts for the variation of quality over time. Finally, $\lambda 3,ht$ is the third component of quality which is not observed and plays the role of the estimation error[13]. The sum of the three components is the quality of variety *h* shipped to destination country *d* at time *t*.

The nested share inclusion allows for more plausible correlation structures among consumer preferences; according to Berry (1994) it partially relaxes the independence of irrelevant alternatives property. To illustrate, suppose that skirts made of polyester are exported to Spain and cotton skirts are exported to Italy. Now consider that cotton skirts are exported to Sweden too. In a standard CES framework (as in Feenstra and Romalis (2012), Hallak and Sivadasan (2013)), the prediction would be that both market shares of exported skirts would fall

[12] In our case, the exporter size is the same for every trade transaction.
[13] Since the estimation error and the nested share are potentially correlated with the CN8's price, instrumental variables are required to identify the parameters. Khandelwal (2010) instruments prices with the distance of the destination country and *f2hd* with the number of destinations per CN8. Both instruments are statistically irrelevant in Greek export case.

proportionally. However, it is plausible to think that the fraction of skirts exported to Italy would be affected more than that to Spain, as the variety exported to Sweden is cotton and not polyester.

4.2 Estimation

I estimate equations (1) and (2) using Ordinary Least Squares with fixed effects that account for all unobservable characteristics that shift the level of exports, controlling also for over-stated trade flows like those appearing in neighbor countries (e.g. warehouses or distribution networks)[14].

In my analysis, I first obtain OLS estimations for equations (1) and (2) respectively. As seen in table A2, for both vce's options regressions, a statistically significant negative price coefficient comparable to that in Khandelwal's (2010) analysis is yielded. The bottom panel of this table shows the number of regressions and observations of the entire sample that have a negative and statistically significant price coefficient. Specifically, 20 of the regressions, or 19566 observations of an entire sample consisting of 20135 observations, have a statistically significant negative price coefficient. Furthermore, the estimated coefficients are in line with the assumptions regarding the explanatory power of country size presented in theoretical studies of this field; holding other factors constant, population has a positive effect on export quality. Finally, a positive conditional on market share coefficient with a slightly higher value compared to Khandelwal (2010) is observed in the augmented regression.

Subsequently, I construct quality indices for the 21 SITC5 products exported to obtain sectoral and aggregate indices. The aggregate export quality indices are calculated as the weighted sum of the industry indices according to the annual revenues of each industry. Diagrams 1 and 2 depict the estimated aggregate and sectoral (by SITC1 category) export quality indices; a substantial heterogeneity is presented at the sectoral level, without differing by the method of estimation. Industries 5 (Chemicals and Related Products), 7 (Machinery and Transport Equipment) and 8 (Miscellaneous manufactured articles) move closely and in low levels, in the indices obtained by both OLS estimations. In these cases, there is an

[14] I include in my regressions the following vce options of the OLS regression commands on Stata13; explaining their properties and also the meaning of their inclusion. The vce(robust) command extension uses the robust or sandwich estimator of variance. This estimator is robust to some types of misspecification so long as the observations are independent. The vce(cluster clustvar) variance estimator allows intra-group correlation in the standard errors, relaxing the usual requirement that the observations must be independent. Instead, the observations are independent across groups (clusters) but not necessarily within groups.

obvious decrease in the estimated export quality until 2009-2010, with many small recovery periods in the meantime for each industry separately. After this deep crisis period, an increase is observed in the same indices as average export quality appears to recover. Industry 6 (Manufactured goods classified chiefly by material) moves at a higher level of quality but it follows the same pattern displaying a gradual drop during the examined period, recovering sharply afterwards. Finally, another way to reach the same conclusions is to examine appendix where the percent change in quality is presented in tables B1 and B2 with 2010 as a base year.

Finally, I study the dispersion of Greek exports quality with respect to the destination countries' size. The dispersion of Greek export quality across years and destination sizes is plotted in box plot 1 using the disaggregated unobserved quality estimations, while box plot 2 presents how the Greek export quality moves across destination countries' GDP[15] per year until 2012. A common pattern is observed across all years showing that for high and low-income countries the exported quality raises sharply, while it drops for middle-income[16] countries. It is also obvious that between 1998 and 2002 Greece exports low quality products to countries with GDP per capita below 6,772,522,911 US Dollars, export flows that disappear after the introduction of Euro[17]. In box plot 1 we can see that the U-shape of quality dispersion persists across years with the difference between the dispersion levels lessening in the global display. These findings are not in line with the conclusion reached by Henn, Papageorgiou and Spatafora (2013), as the average quality does not move in parallel to the income per capita, a fact that may stems from the different approach used in inferring unobserved quality.

5. Conclusions

The aim in this thesis has been to evaluate the progress of the quality of Greek exports and to reveal a possible quality-destination relationship. For this reason, I infer from the Greek export data unobserved quality between 1998 and 2012 and subsequently I construct export quality indices based on Khandelwal (2010). Using exclusively Greek export data from the industrial sector I estimate a specification based on the premise that higher quality is assigned to products with higher market shares conditional on price. The quality indices constructed

[15] Constant GDP per capita expressed in US Dollars is used.
[16] The income level of each country is measured in logarithmic GDP per capita units. A middle-income country is denoted by 45,850,763,591 US Dollars.
[17] In 2002, Euro was introduced in all transactions as a means of payment.

present a substantial heterogeneity between manufacturing industries with fluctuations across the years. Both aggregate and industry specific export quality display a gradual drop until 2010 and increases up to 2012 fully recovering the previous years' decrease. Finally, the link of Greek exports' quality with product destination reveals a persisting low quality exports pattern to middle-income countries.

The empirical findings of this thesis are in line with that provided by Khandelwal (2010). Nevertheless, further work is required to improve these estimates. A first step for improvement would be to find suitable fundamentals in order to instrument the core variables of the specification estimated for the Greek economy, which could also be a robustness proof for this process. Furthermore, the inclusion of a bigger number of SITC5 product codes is required for our estimation results to be generalized to the industrial sector. Looking ahead, an interesting discussion would be the encounter of the selection bias problem stemming from the fact that only survivor export goods (i.e. those who export all the fifteen years of the sample) are included in the data set used in the present analysis.

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Table A1: SITC5 codes included in the analysis *(description, SITC code and number of CN8 codes within SITC)*

Description	SITC5 (# CN8)
Chemicals and Related Products, n.e.s. (5)	
Paints & varnishes (including enamels & lacquers) based on synthetic polymers/chemically modified natural polymers, dispersed/dissolved in a non-aqueous medium; plastics in solution	53342 (5)
Manufactured Goods Classified Chiefly by Material (6)	
Other embroidery	65659 (5)
Non-woven, whether/not impregnated, coated, covered/laminated, n.e.s.	65720 (9)
Textile fabrics impregnated, coated, covered/laminated with plastics, other than those of heading	65732 (4)
Twine, cordage, ropes & cables, whether/not plaited/braided & whether/not impregnated, coated, covered/sheathed with rubber/plastics	65751 (5)
Machinery and Transport Equipment (7)	
Refrigerators, household-type (electric/other), whether/not containing a deep-freeze compartment	77521 (5)
Microwave ovens; other ovens; cookers, cooking plates, boiling rings, grillers & roasters	77586 (5)
Miscellaneous Manufactured Articles (8)	
Other travel goods, handbags & similar containers	83199 (6)
Trousers, bib & brace overalls, breeches & shorts, men's/boys', of textile materials, not knitted/crocheted	84140 (14)
Dresses, women's/girls', of textile materials, not knitted/crocheted	84240 (6)
Skirts & divided skirts, women's/girls', of textile materials, not	84250 (5)

knitted/crocheted	
Trousers, bib & brace overalls, breeches & shorts, women's/girls', of textile materials, not knitted/crocheted	84260 (13)
Blouses, shirts & shirt-blouses, women's/girls', of textile materials, not knitted/crocheted	84270 (6)
Jackets & blazers, women's/girls', knitted/crocheted of textile materials	84423 (4)
Dresses, women's/girls', knitted/crocheted of textile materials	84424 (4)
Skirts & divided skirts, women's/girls', knitted/crocheted of textile materials	84425 (4)
Blouses, shirts & shirt-blouses, women's/girls', knitted/crocheted of textile materials	84470 (4)
Jerseys, pullovers, cardigans, waistcoats & similar articles, knitted/crocheted	84530 (7)
Articles of apparel, men's/boys', n.e.s., not knitted/crocheted	84587 (9)
Paper/paperboard labels of all kinds, whether/not printed	89281 (4)
Other builders' ware of plastics	89329 (5)

Note: Lines in bold denote the aggregate (SITC1) product classifications' description. The rest of the lines denote disaggregated (SITC5) product classifications' description.

Table A2: Quality estimation (OLS) results

	Equation 1		Equation 2	
	(A)	(B)	(A)	(B)
Price coefficient mean	-1.5243	-1.5243	-0.9112	-0.9112
Price coefficient median	-1.4978	-1.4979	-0.8084	-0.8085
Coefficient conditional on market share mean			0.5889	0.5889
Coefficient conditional on market share median			0.5605	0.5605
Coefficient on population mean	0.1065	0.1065	0.0540	0.0540
Coefficient on population median	0.1326	0.1326	0.0528	0.0529
Estimations with statistically significant negative price coefficient	21	21	20	20
Observations with statistically significant negative price coefficient	20135	20135	19566	19566
Total estimations	21	21	21	21
Total observations across all estimations	20135	20135	20135	20135

Note: The top panel shows first and second equations' estimation statistics for each of the 21 products. The bottom panel reports statistics that apply to the entire sample. Constant included in the regression but not reported. Columns (A) and (B) contain regressions with robust and clustered standard errors respectively.

Diagram 1: Greek export quality indices 1998-2012, OLS estimation with clustered standard errors.

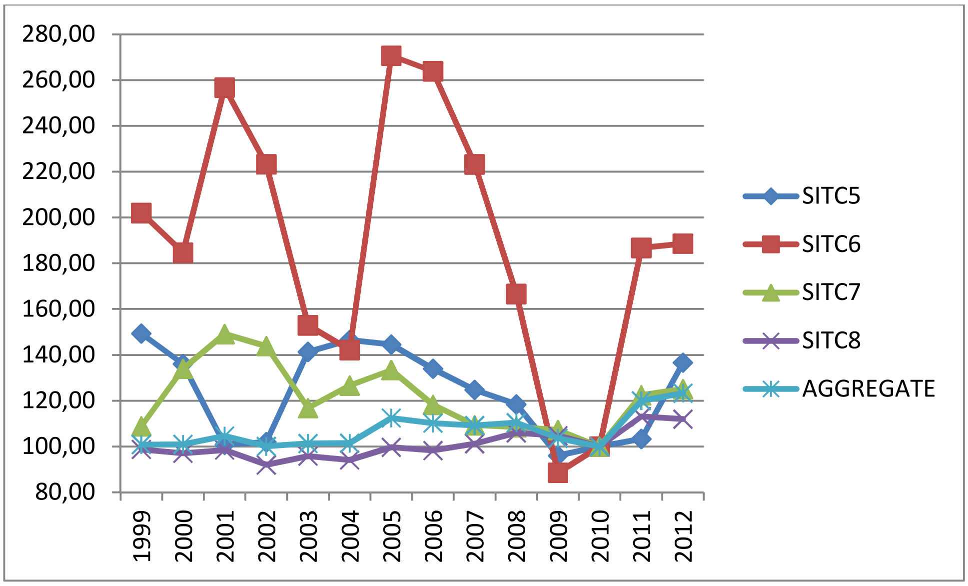
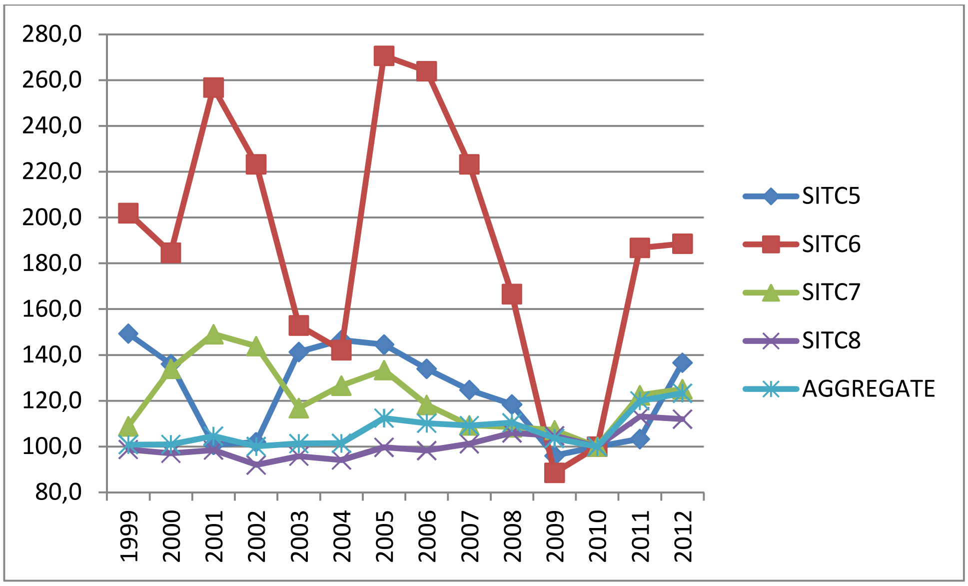
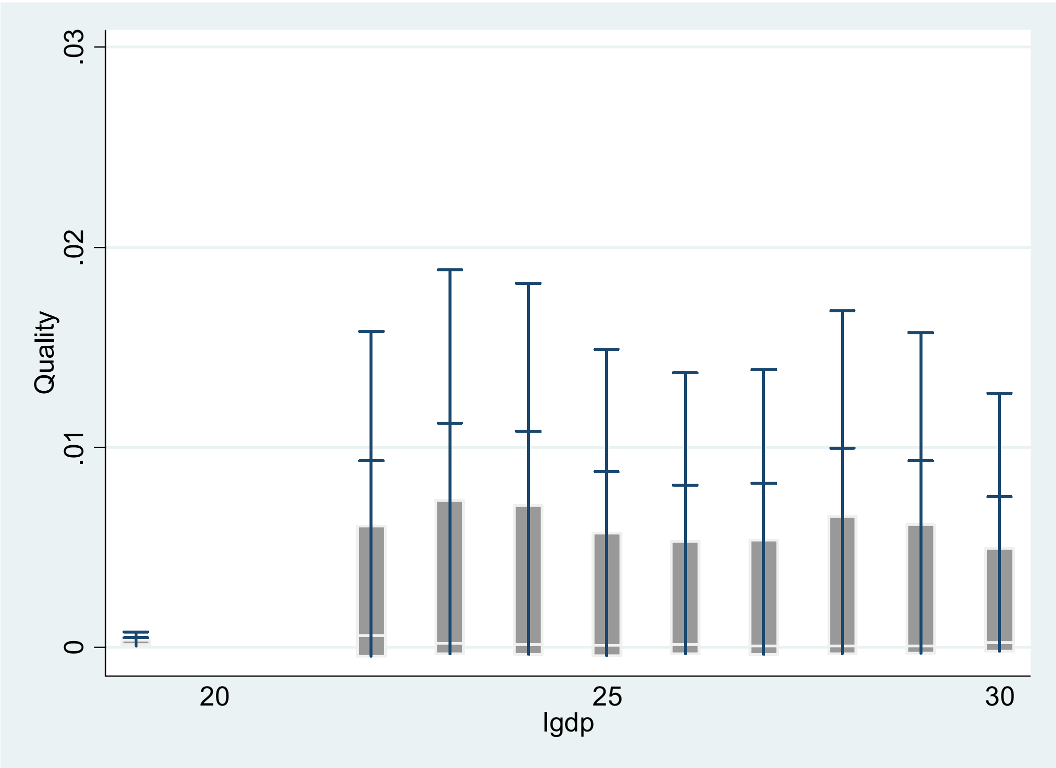


Diagram 2: Greek export quality indices 1998-2012, OLS estimation with robust standard errors

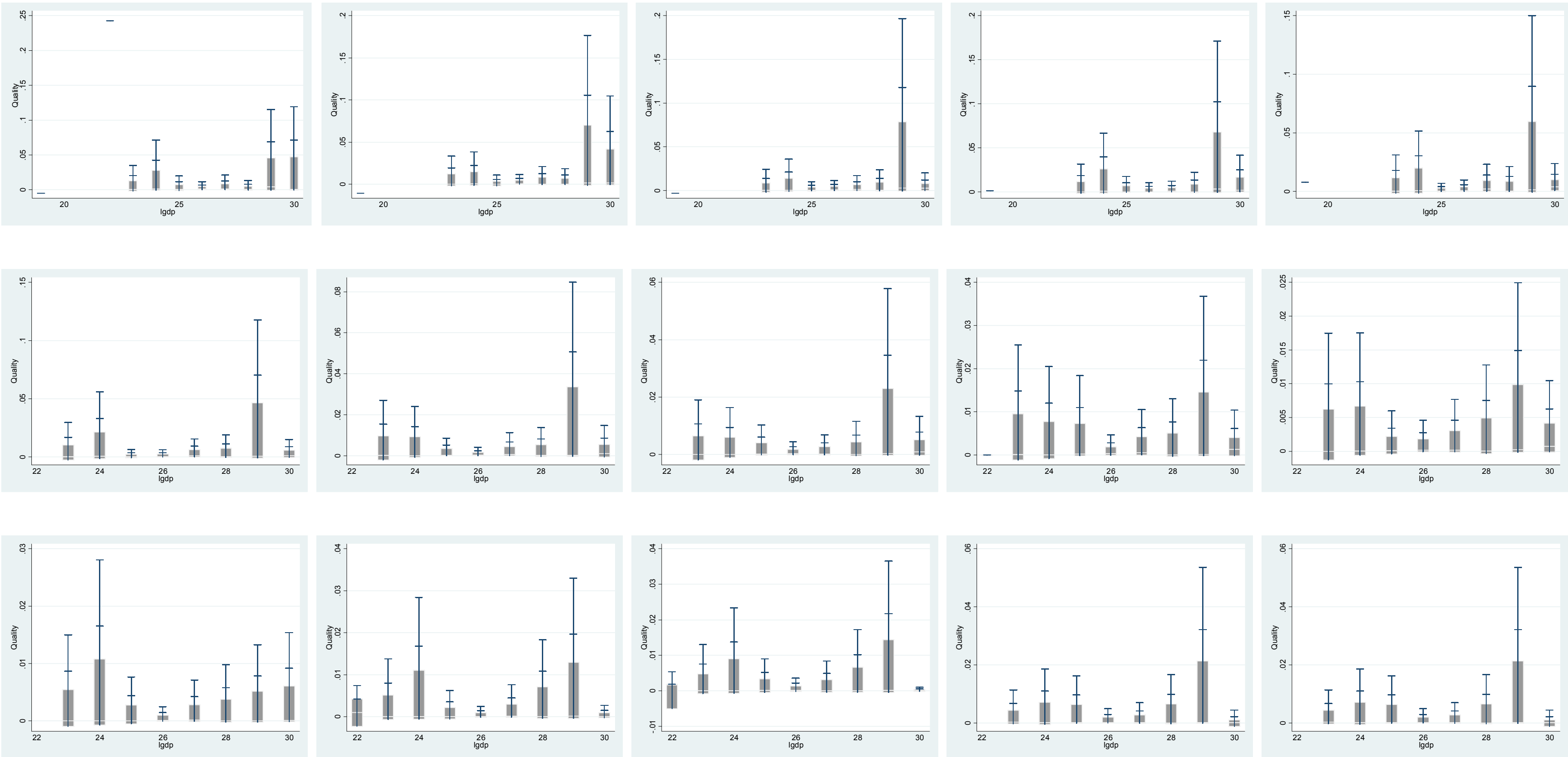


Box plot 1: Greek export quality move across destinations' income; period 1998-2012



Note: Grey bars indicate the lower and upper quartiles of the estimated quality. The median is the line subdividing the grey eponymous box. Whiskers, lines, span all data points within 1.5 IQR (interquartile range) of the nearer quartile.

Box plot 2: Greek export quality move across destinations' income per year



Note: Grey bars indicate the lower and upper quartiles of the estimated quality. The median is the line subdividing the grey eponymous box. Whiskers, lines, span all data points within 1.5 IQR (interquartile range) of the nearer quartile.

Table B1: Greek export quality indices 1998-2012, OLS estimation with clustered standard errors

YEAR	SITC 5	SITC 6	SITC 7	SITC 8	AGGREGATE
1998	152.9	195.9	140.6	104.6	109.6
1999	149.3	201.9	108.8	98.7	100.8
2000	136.0	184.6	133.9	97.0	100.9
2001	100.7	256.7	149.1	98.4	104.5
2002	101.9	223.2	143.9	91.9	100.0
2003	141.3	152.9	116.8	95.8	101.3
2004	146.5	142.1	126.6	94.1	101.4
2005	144.5	270.6	133.4	99.6	112.4
2006	133.9	263.8	118.2	98.2	110.2
2007	124.7	223.2	109.2	101.2	109.1
2008	118.4	166.5	108.4	105.9	110.3
2009	96.0	88.5	107.2	104.7	103.6
2010	100.0	100.0	100.0	100.0	100.0
2011	103.2	186.7	122.4	113.1	120.0
2012	136.6	188.5	125.0	111.9	123.3

Table B2: Greek export quality indices 1998-2012, OLS estimation with robust standard errors

YEAR	SITC 5	SITC 6	SITC 7	SITC 8	AGGREGATE
1998	153.0	195.9	140.7	104.7	109.6
1999	149.3	202.0	108.9	98.7	100.8
2000	136.0	184.6	134.0	97.1	100.9
2001	100.8	256.8	149.1	98.5	104.5
2002	102.0	223.2	143.9	91.9	100.0
2003	141.3	152.9	116.8	95.8	101.3
2004	146.5	142.1	126.6	94.2	101.4
2005	144.6	270.6	133.4	99.7	112.4
2006	134.0	263.9	118.3	98.3	110.2
2007	124.8	223.2	109.3	101.2	109.1
2008	118.4	166.6	108.4	106.0	110.4
2009	96.0	88.6	107.3	104.7	103.6
2010	100.0	100.0	100.0	100.0	100.0
2011	103.3	186.8	122.4	113.1	120.0
2012	136.6	188.6	125.1	112.0	123.3