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Re-estimating International Elasticity of Substitution – A Preliminary Study of Impact of Quality on Trade

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Increasingly many developed countries are losing their export market shares to lower priced emerging countries. Emerging countries unlike higher wage developed countries are able to produce a similar product to be traded at a lower cost. To regain its competitive streak, developed countries would need to compete in terms of higher quality products rather than lower priced products. This paper, thus, attempts to quantify the effect of higher quality goods trade within Europe. Using a panel data comprising of 11 European countries for a total of 15 manufacture goods sectors ranging over 14 years (from 1990 to 2003), the paper attempts to re-estimate import elasticities of substitution and quality elasticities to determine the relative strength of Europe in terms of offering lower prices or higher quality products. This paper concludes that improving product quality is important for trade and such product improvement is much more beneficial to European countries in sectors that produce differentiated goods rather than homogeneous ones.

JEL Codes: F12, F13, F14 and F49

1. Introduction

Europe has been characterized as a high-wage, high cost region producing products with relatively higher prices. In contrast, emerging countries are able to produce the same product produced in Europe for a lower price. Hence, Europe is rapidly losing its reign on exports within the region as well as outside the region, in favor of lower-priced emerging countries (Aiginger, 2001).

One way in which Europe can regain its trade competitiveness is by trading products that are of higher quality (Fontagné, Gaulier and Zignago, 2007). To improve the quality of their tradable products, a Research and Development (R&D) innovation policy has been recommended in Europe via the introduction of the Lisbon Agenda. This strategy involves increasing the R&D expenditure in various sectors of the economy so as to improve the quality of the products emanating from these sectors.

In order to study the impact of a R&D innovation policy on trade, we need correctly estimated international elasticities of substitution between the domestic good and its foreign counterparts. Differentiating the product by product quality makes the good less substitutable, thereby increasing the exports of the higher quality good towards a domestic market.

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Many papers have provided incorrect estimates of these elasticities of substitution precisely because they fail to take into account the impact of product quality on these estimates. When quality is not taken into consideration, prices incorporate some of the quality effect thereby over-estimating the elasticities of substitution. These wrongly estimated elasticities of substitution tend to be below unity unlike the 'true' elasticities under the 'New' trade theory. Under the 'New' trade theory, elasticities of substitution tend to higher than one in industries producing a large number of varieties (Helpman and Krugman, 1985). In turn, the impact of product quality on trade is biased when utilizing these wrongly estimated elasticities of substitution in the trade equations.

The main aim of this paper is to analyze the impact of improving product quality via a R&D policy on trade within Europe. In order to perform this analysis, our paper attempts to correct the estimates of international elasticities of substitution in two steps: First, we account for product quality in the trade equation and second, we use the correct trade equation to analyze the impact of product quality on trade.

In particular, our paper differs from the previous literature in the use of our database. Our paper uses a recent and highly disaggregated trade database that allows for 15 sectoral classifications typically absent in most studies. In addition, our paper is unique in creating a quality variable. Most previous studies have used simple R&D expenditures as quality variables (Eaton and Kortum, 2002). Our paper uses not only direct R&D expenditures (which are the actual amount of money dedicated to improving the product quality in a particular sector) but also indirect R&D expenditures (in the form of patent citations) as quality variables. In this way, our quality variable allows for sectoral interactions within the country as well as across countries that could potentially improve product quality.

Our corrected elasticities of substitution approach higher than one, conforming to the elasticities of substitution under the 'New' trade theory. Such results reaffirm the importance of correctly estimated elasticities of substitution in assessing the impact of product quality and hence the impact of a R&D policy on trade. Finally, our results reinforce predictions on the elasticities of substitution, quality elasticities and the type of sector. For example, the results confirm that elasticites of substitution (quality elasticities) tend to be higher (lower) in sectors that produce homogenous products while these elasticities (quality elasticities) are lower (higher) in sectors producing highly differentiated products. On the whole, our paper contributes to existing literature in this field by providing a unique way to account for sectoral interactions in determining product quality and reinforces results on international elasticities of substitution using a highly disaggregated trade database.

The next section of the paper reviews current literature on the study of quality impact and correct estimations of international elasticities of substitution. The third section introduces the theoretical model to estimate these elasticities of substitution and describes our and the final section concludes the paper.

2. Literature Review

Most economic literature on the estimation of elasticities of substitution attempt to improve the estimation of these elasticities by adding a proxy for product quality since product quality itself is unmeasurable and unobservable. It is in the use of the quality proxy that these studies diverge.

The earliest proxy for quality has been the unit values of the tradable products. Aiginer (2001)[i] and Fontagné, Gaulier and Zignago (2007)[ii] used unit values as a measure of quality of products. However, some authors argue against the use of trade unit values as proxies for quality since these values tend to portray not only quality but also production costs.

Erkel-Rousse and Le Gallo (2002) and Hallak and Schott (2010) have acknowledged this problem by complementing trade unit values with additional quality proxies. Erkel-Rousse and Le Gallo (2002) compared unit values with quantities of products traded affirming that a high quality good is one which has a relatively high unit value and is met with higher quantities of the good being demanded. Similarly, Hallak and Schott (2010) used market share data to define a high quality good. Keeping in mind these papers, we have similarly used unit values complimented with quality variables to measure the impact of quality on trade.

A direct measure for quality has been used by Crozet and Erkel-Rousse (2004) and Crozet, Head and Mayer (2011). These works measure quality based on the perceptions of consumers. Crozet and Erkel-Rousse used a survey done by the Centre d'Observation Economique (COE) of the Chambre de Commerce et d'Industrie de Paris (CCIP) which focused on consumer perceptions of which countries produce higher quality goods in which sectors. In a similar fashion, Crozet, Head and Mayer used quality ratings obtained from a guidebook on French champagne producers.

However, these quality measures do not measure the real quality of the product rather it measures the perception of consumers on defining the quality of the products. These papers make a strong assumption that consumers are well informed regarding the quality of the products coming from specific countries and hence are able to choose a higher quality product given this knowledge. This is not true in reality as most of what consumers perceive is influenced by media and advertising. Thus, a better and direct proxy for quality has been recommended to be R&D expenditures which are the actual amounts of money spent in a particular sector with the sole intention of improving the product quality (Greenhalgh, Taylor and Wilson, 1994; Ioannidis and Schreyer, 1997; Eaton and Kortum, 2002).

The problem with using direct R&D expenditures as quality proxies is that it ignores the indirect R&D expenditure that accrues from the initial R&D expenditure. The quality of a good in a particular sector can be improved by sharing technological know-how used in another sector. Ignoring such sectoral interactions in the form of knowledge spillovers tends to underestimate the overall impact of innovation on product quality outcome (Mohnen, 1990; Mairesse and Sassenou, 1991; Grililiches, 1992; Nadiri, 1993; Cameron, 1998). Thus, our paper revitalises the role of knowledge spillovers in improving product quality by considering both direct and indirect R&D expenditures as our quality variable.

Our paper also differs from past literature by using a highly disaggregated trade database that allows us to look at trade in various sectors of a country. Previous studies have restricted their analysis to cross-sectional data which reduces the scope for country, sector and time variations (Hummels and Klenow, 2005 and Hallak, 2006). Studies that improve this methodology by using panel-data face other restrictions on data. For instance, Crozet and Erkel-Rousse performed their study across four countries over a time period of five years for two main sectors (consumer goods and

other goods sectors). On the other hand, Fontagné, Gaulier and Zignago (2007) have an extensive database on disaggregated bilateral trade that covers the largest set of countries (163 countries) with a ten year period for 25 sectors. Yet, their study remains limited in their use of quality proxy that fails to take into account sectoral interactions and knowledge spillovers which is corrected for in our paper.

3. The Methodology and Model

Our paper attempts to study the role of product quality on trade within Europe. To do so, we correct the estimation of elasticities of substitution by accounting for product quality effects. We hypothesize that accounting for product quality effects improves and increases the estimates of these elasticities of substitution to above unity, which conforms to the 'true' elasticities of substitution under the 'New' trade theory. We also hypothesize that the product quality is important in accounting for trade within the countries and thus the impact on trade should be positive and highly significant.

In order to prove our hypotheses, we adopt a trade equation established by Erkel-Rousse (1997, 2002) and developed by Crozet and Erkel-Rousse (2004). Using the same equation, our paper varies in the use of quality proxy and the use of highly disaggregated trade database to estimate the relevant effects on trade.[iii]

We consider an import market share function, denoted as $mshare_{kijI't}$, which looks at imports m between exporter i and importer j for a particular sector k over time t as a fraction of imports m between j and the competitors of the exporter country, denoted as I'. This fraction of imports between i and j over imports between I' and j is a function of four key variables namely relative prices denoted as $price_{kijI't}$, relative quality denoted as $quality_{kijI't}$, number of varieties represented by $variety_{ijI't}$ and the distance variable denoted as $dist_{ijI't}$.

The equation to be estimated is given in log terms below:

$$\log(mshare_{kijI't}) = -(e_p - 1)\log(price_{kijI't}) + e_q \log(quality_{kijI't}) + e_g(variety_{ijI't}) - e_d \log(dist_{ijI't}) + fixed\ effects + intercept + u_{kijI't}$$

Where

$$mshare_{kijI't} = \frac{M_{kijt}}{\sum_{i' \in I'} M_{ki'j}}$$

$$price_{kijI't} = \frac{p_{kijt}}{\overline{p_{kI'jt}}}$$

$$variety_{ijI't} = \frac{variety_{kit}}{\overline{variety_{kI't}}}$$

$$quality_{ijI't} = \frac{quality_{kijt}}{\overline{quality_{kI'jt}}}$$

The variables $\overline{p_{kIjI't}}$, $\overline{variety_{kI't}}$ and $\overline{quality_{kI'jt}}$ stands for the average import prices, average variety and average quality originating for the set of i's competitors I'.

$mshare_{kijI't}$ reflects the import share of goods from a particular sector k originating from an exporter country i to an importer country j over time, t. $price_{kijI't}$ reflects the relative import price of a good k coming from country i to country j. $variety_{ijI't}$ reflects the relative level of varieties of the exporting country. We proxy variety with the employment of a sector in the exporter country. $quality_{ijI't}$ reflects the relative quality of the imported good. Finally, $dist_{ijI't}$ reflects the relative distance between the trading partners i and j relative to the distance between the importer country and its trading competitors (I' and j). This variable is added together with the intercept as an invariant factor that affects the relative import market share. Distance, according to Anderson and Marcouiller (1999) and Rauch (1999) may be added to control for barriers to trade that are not accounted for by the relative prices.

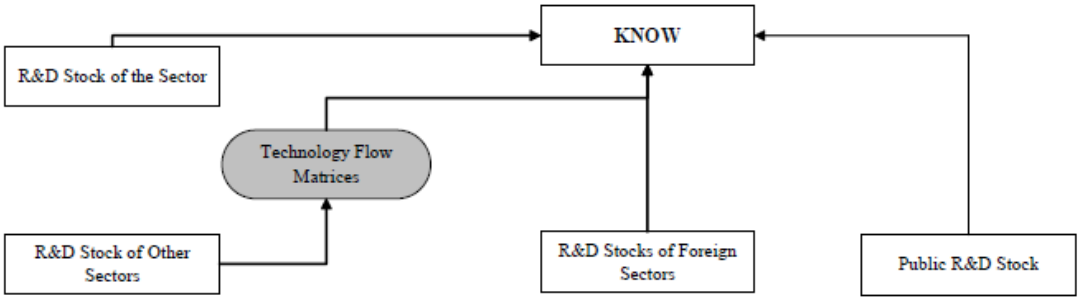
We are interested in estimating the elasticity of substitution represented by e_p as well as the relative quality elasticity between the same good k originating from different countries, denoted by e_q. Due to several mismeasurements that could arise in the data especially for the price variable, it might be that e_p does not exactly equal to theoretical elasticity of substitution.

Intuitively, this model suggests that exporters can attempt to procure a greater market share via two channels: they can lower their prices relative to those of their competitors or they can enforce their relative strength through the differentiation channel, that is, by either increasing the number of varieties offered or improving the quality of their product relative to that of their competitors. Note that the coefficient of the price factor in the model is strictly negative since we assume that the elasticity of substitution, $e_p > 1$.

To study these relationships between imports and price and quality, we consider the data for a group of 11 European countries over the period of 1990 to 2003 for a total of 15 manufacture goods sectors. The data is largely compiled from various sources. In particular, the data on import trade flows disaggregated over sectors is obtained from the January 2012 revised version of the WIOD (World Input-Output Database) which is a recently created database. The data on employment was taken partly from WIOD and revised with information from CHELEM and Eurostat. To represent prices, we use import price indices that are taken from the CEPII database. These price indices have been transformed to correspond to the nomenclature of our sectors. Likewise, the distance data is also obtained from CEPII. The distance is measured in kilometers between the major cities of the partners and the information on the country-city pair can be found in the Appendix. Finally, the quality data is constructed using data on direct R&D expenditures, taken from OECD and Eurostat, as well as indirect R&D expenditures which are measured using patent citations in other sectors.

The construction of the knowledge variable is slightly complex. We use the value of R&D expenditures in a particular sector as well as the R&D expenditures in other sectors. We convert the R&D expenditures from other sectors via technology flow matrices.[iv] Figure 3.1 charts the construction of the knowledge variable as a quality proxy.

Figure 3.1: Constructing the Knowledge Variable



Source: Brécard et al, 2004

Our quality proxy is called 'KNOW' in Figure 3.1. This quality variable is also named the knowledge variable as it is an accumulation of technological knowledge that goes into improving the product quality via direct R&D expenditures coming from public, private and foreign sources and the knowledge spillovers that come from other sectors. These knowledge spillovers are proxied using the number of patents that are used in sectors other than the sectors that produce these patents. These patent citation counts are then translated into indirect R&D expenditures via the use of the technology flow matrices created by Johnson.

Given our limited data on R&D expenditures, we have opted to use only 11 European countries over a relatively short time period of 14 years over 15 manufacture sectors. In total, we obtain 23 100 panel observations. The list of countries involved in the study as well as the list of manufacture goods sectors is provided in the Appendix. Our use of the quality proxy and the highly disaggregated trade database improves the existing theoretical model that we have used for our paper.

4. The Findings

The main estimation results are provided in the tables in this section: Tables 4.1, 4.2 and 4.3. Table 4.1 depicts the results of our regressions on pooled data. We use two regression methodologies – Ordinary Least Squares (OLS) and Instrumental Variables (IV). Our panel data is disaggregated across trading partners and sectors. Given such high level of disaggregation, we add controls in the pooled regressions to account for sectoral and country-specific heterogeneity. We perform simple OLS and IV regressions with and without fixed effects to account for temporal effects in the data.

The IV regression is performed using the lagged price indices as instruments for prices. This instrument is selected in an attempt to address possible endogeneity that might be present in the import price indices.

Table 4.2 reports the results for all the specific sectors considered in the model. We run simple OLS with fixed effects regression for each sector and present the results in this table. By performing regressions on each sector, we are able to eliminate the presence of sectoral heterogeneity across the data.

Table 4.3 provides the results for country-specific estimations. Similarly, we run simple OLS with fixed effects regressions for each importing country and present the results in this table which allows us to account for importer specific effects on the data.

Table 4.1: Pooled Results

	Without quality adjustment				With quality adjustment			
Estimation Method	OLS	OLS	2SLS	2SLS	OLS	OLS	2SLS	2SLS
$1 - e_p$	-0.11***	-0.11***	-0.15***	-0.17***	-0.60***	-0.81***	-0.91***	-0.19***
e_p	1.11	1.11	1.15	1.17	1.60	1.81	1.91	1.19
e_q	-	-	-	-	1.18	1.15	1.21	1.19
e_g	0.65*	0.22*	0.65*	0.22*	0.61*	0.22*	0.61**	0.22*
e_d	-0.44**	-0.09**	-0.43**	-0.10***	-0.41**	-0.11***	-0.40**	-0.12***
Constant	10.38***	8.90***	10.33*	8.86***	8.71****	7.59***	8.40**	7.22***
Fixed effects	Yes	No	Yes	No	Yes	No	Yes	No
R^2	17.22	10.50	17.54	13.73	15.04	16.32	16.16	17.54
Observations	26320	26320	26320	26320	26320	26320	26320	26320

Note: *, **, *** refers to significance testing under 10%, 5% and 1% significance level

Based on the results from Table 4.1, we observe that the relative price variable is significantly negatively related to the import share. This is because the relative price we consider is the price of import good relative to the price of the competitor's good. If the price of the importer good from j is higher than the average price of the importer good from I's, i's competitors, then consumers would prefer to buy from i's competitors given that both goods are identical (no quality effects intervening) thereby reducing the import share coming from i. Thus, the relationship between relative price and imports is negative.

As predicted, adjusting for quality decreases the price coefficients given by (1-e_p) under all the estimations. This increases the elasticity of substitution e_p to above 1, thereby correcting the under-estimation bias.

The quality proxy is highly significant according to the results above. Indeed, an improvement in the quality of imported products does lead to higher demand for these imports. Notably, the regressions with fixed effects display higher coefficients for quality than those without fixed effects. As the model for fixed effects is recommended to account for within effects coming from the countries as well as from the sectors, we choose to consider these higher coefficients which are significant and above unity.

The variety effect is positively significant in all regressions. This is because the variety proxy helps to control for the effect of varieties on consumer preferences. According to Acemoglu and Ventura (2002), the variety proxy captures the effect of varieties on export potential because the number of employees employed in a particular sector is proportional to number of varieties that sector produces. Thus, an exporting country with a higher export potential (proxied by higher employment) tends to export increasing varieties of goods in relation to its competitors. This means that the importing country j prefers to import more goods from i rather than its competitors I' so as to provide higher varieties of the same good k in its country for its consumers.

We also note that the coefficient of the variety proxy falls with the addition of the quality proxy. This decline is due to the fact that without the quality proxy, the variety variable captures part of the effect of vertical differentiation. With the quality effect, the effects are then differentiated. This is in line with empirical findings that support this negative relationship between quality and variety. Indeed, firms make a trade-off between quality and variety of their products. An exporter that improves his product quality can choose

to reduce his product variety and vice versa. According to Krugman (1979), the parameter relative to the variety proxy should equal unity. Unfortunately in our case, the coefficient of the variety variable does not approach unity. This could be due to the weak proxy. Thus, we should analyze the role of variety in import trade and in determining international elasticities of substitution with care.

Distance, as expected, varies negatively and significantly with trade flows. As larger distances increase transportation costs, countries tend to trade more with neighboring countries. Thus, distance between trading partners is another significant variable in determining trade flows.

Table 4.2: Bilateral Results

Sector	Name	Initial e_p	Adjusted e_p	e_q	Product Differentiation by Rauch	Product Differentiation by OMSP	Estimated Classification
1	Agriculture	0.097	1.414	1.529	HOM	HOM	HOM
2	Refined Oil	0.050	1.549	1.632	HOM	HOM	HOM
3	Ferrous and Non-Ferrous Metals	0.154	1.360	1.559	HOM	HOM	HOM
4	Non-metallic mineral products	0.026	1.390	1.647	HOM	HOM	HOM
5	Chemicals	1.006	1.339	2.442	DIF	HOM	DIF
6	Metal Products	1.007	1.355	1.381	DIF	HOM	HOM
7	Agricultural and Industrial Machines	1.014	1.067	2.043	DIF	DIF	DIF
8	Office Machines	0.032	1.048	3.448	DIF	DIF	DIF
9	Electrical Goods	1.037	1.019	2.795	DIF	DIF	DIF
10	Transport Equipment	1.038	1.035	2.740	DIF	DIF	DIF
11	Food, Drink and Tobacco	0.053	1.524	1.719	HOM	HOM	HOM
12	Textiles, Cloth and Footwear	1.003	1.546	1.262	DIF	HOM	HOM
13	Paper and Printing Products	1.037	1.452	1.516	DIF	HOM	HOM
14	Rubber and Plastic	1.025	1.340	1.491	DIF	HOM	DIF
15	Other Manufactures	0.027	1.623	1.947	DIF	DIF	HOM

According to Table 4.2, all of the sectors show an elasticity of substitution higher than 1 with quality adjustments. These values were obtained by running the regressions using

the OLS estimator with fixed effects even though the results were robust for the IV regression. Most of these sectors had an initially lower estimate of the elasticity of substitution which increased with quality adjustment. This simply shows that adjusting for quality helps to correct for the downward bias in estimating the elasticities of substitution.

The two columns of Table 4.2 entitled Product Differentiation, record the type of product classification, be it homogenous (HOM) or differentiated (DIF). This product classification is based on Rauch's calculations (1999) as well as the work of Oliveira-Martins, Scarpetta and Pilat (OMSP, 1996) on STAN sectors. However, the sectoral classification in our case differs slightly from that of STAN sectors since there are more sectors under STAN. As such, we had to regroup certain sectors such that they conform to the calculations performed by Rauch and OMSP. Given this limitation, it is possible that some sectors though they seem to produce differentiated products have relatively higher elasticities of substitution that correspond to those of the homogeneous sectors. For instance, the Other Manufactures sector, despite being categorized as a sector that produces highly differentiated products according to both Rauch and OMSP classifications, portrays an elasticity of substitution that is high, in line with the elasticities of substitution corresponding with homogeneous products. Keeping in mind these shortfalls, we have created our own classification of the sectors using our estimations and this is presented in the last column of Table 4.2.

The industries with low product differentiation have relatively higher elasticities of substitution compared to the industries with high product differentiation. Under the OMSP classification, most industries classified as non-industrialized sectors or sectors producing highly homogeneous products, display relatively higher elasticities of substitution, which range between 1.340 and 1.549. The sectors with high product differentiation or largely industrialized sectors had relatively lower elasticities of substitution ranging between 1.019 and 1.340 with the exception of the Other Manufactures sector which display a high elasticity of substitution of 1.623.

These results do not display the same results in terms of magnitude where earlier studies recorded the range for homogenous sectors to be between 3.5 and 6 while for the differentiated sectors to be between 3.5 and 4.0. Nevertheless, these results are in line with the sectoral results derived by a similar study performed by Erkel-Rousse and Mirza (2002). Notably, sectors that produce differentiated and industrialized products tend to display lower elasticities of substitution as shown above. With the exception of Other Manufactures sector, the results coincide with past empirical work that proved that industries producing homogenous and non-industrialized products tend to have higher elasticities of substitution than industries producing differentiated and industrialized products due to the higher substitutability among homogeneous goods.

Now, we consider the role of quality innovation on import of these products. Most of the coefficients produce a highly positive and significant effect of quality on imports. Thus, an improvement in the quality of exporting goods relative to those of the competitors leads to an increase in its export share. A 1% increase in relative product quality leads to a higher export share varying between 1.26% and 3.45%. The sectors that display relatively high coefficients for quality are largely the sectors producing highly differentiated products namely Chemicals, Agricultural and Industrial Machines, Office Machines, Transport Equipment and Paper and Printing Products. These industrialized sectors have large scope for product differentiation. Thus, quality improvements are

more useful in these sectors than in the homogeneous product sectors such as Agriculture.

Table 4.3: Import Price Elasticity by Importing Country

Importing Country	Initial e_p	Adjusted e_p
DE (Germany)	0.986	1.181
DK (Denmark)	1.044	1.961
ES (Spain)	1.029	2.691
FI (Finland)	0.986	1.325
FR (France)	1.028	1.183
IE (Ireland)	1.086	4.266
IT (Italy)	1.050	3.244
NL (Netherlands)	1.009	2.039
NO (Norway)	1.026	1.743
Sweden (SE)	1.012	1.737
UK (United Kingdom)	1.087	1.667

We look at the elasticities of substitution from the point of view of the importing country given quality adjustments. The results are consolidated based on the OLS regression with fixed effects. Our results are furthermore robust across estimation methods. This extension of the analysis across countries differs from our main reference paper (Crozet and Erkel-Rousse, 2004) and helps to shed more insight on the correct estimates of elasticities of substitution in Europe.

Out of the sample of 11 countries, all of them display an elasticity of substitution superior to 1 after quality adjustment. In fact, the elasticities of substitution were often insignificant prior to the adjustment for most countries like Germany, France and Spain. Adjusting for quality not only raises the elasticities but it also restores the significance to the elasticities.

According to Table 4.3, richer countries tend to display lower elasticities of substitution as opposed to our intuition which suggests that richer countries usually have higher import price elasticities. According to Imbs and Méjean (2010), rich countries tend to import goods that are not substitutable, while the reverse is true for large developing countries. Hence, these richer countries like Germany and France tend to display lower import price elasticities compared to relatively poorer countries like Spain and Italy.

In addition, the importance of specialization of industries also determines the elasticities. Since the service industry is exempted from this study, it might bias the 'true' elasticities of substitution for some importing countries that focus more on service trade rather than goods trade like Ireland. Also, domestic consumers may prefer imports from other trading partners that are not included in this study which could bias the estimation of elasticity of substitution for some countries like Spain which trades intensively with Switzerland and Russia. We moreover do not consider the role of re-exports in these regressions. Thus, these results neglect the role of some countries like Ireland that serve as gateway to Europe markets for non-European products. Thus, our results should be consulted with these shortfalls in mind which might bias the estimation of the 'true' elasticities of substitution.

From the point of view of the importing country, if this country has a high elasticity of substitution, it means that consumers have a strong preference for its domestic goods. For a small increase in average price of its competitors, an importer is able to raise its market share via a large proportion because its consumers will substitute away from the higher priced competitor goods towards the lower priced domestic good. From the results in Table 4.3, we notice that importer countries that can procure higher domestic market share relative to its foreign competitors are Ireland, Italy and Spain.

Table 4.4: Quality elasticity by Exporting Country

Exporting Country	e_q
DE	1.419
DK	10.302
ES	8.048
FI	1.630
FR	1.375
IE	2.174
IT	5.320
NL	3.796
NO	2.839
SE	2.346
UK	1.808

Table 4.4 shows the impact of an increase in the market share between i and j due to a 1% increase in the product quality of the exporting good from i (represented as 1% deviation from the standard error of the regressions). The results presented above are the mean values calculated from the impact of product quality on each of the 15 sectors. The quality impacts are generally high implying that the impact on market share is higher than proportionate for a 1 unit deviation in the standard error for the quality variable. The range of impact lies between 1.4 and 10.3 deviation units. All exporting countries, thus, benefit from quality innovation with countries like Denmark, Spain and Italy benefiting more from it than others.

5. Summary and Conclusions

Our paper proves that elasticities of substitution are often under-estimated and that correcting for this bias through quality effects can help to ‘correctly’ estimate the ‘true’ values of import price elasticities. These elasticities tend to conform to the ‘New’ trade theory elasticities of substitution in that they are always superior to one and tend to be equal in industries producing large varieties.

When looking at the sectoral results, accounting for sectoral heterogeneity becomes all the more important as different sectors have different elasticities of substitution. In particular, sectors which produce highly homogeneous goods tend to have high elasticities of substitution due to the higher substitution effect among these goods. Highly differentiated goods sectors have lower elasticities of substitution with the exception for Other Manufactures sector. These sectors also have wider scope for innovation, thus they display higher relative quality elasticites as opposed to the homogeneous goods sectors.

On closer inspection of the various importers, we deduced that richer countries tend to have lower import price elasticities as these countries import goods that are more

differentiated and hence less substitutable with domestically produced products from the same sector. In addition, we also deduced that countries with higher import price elasticities are countries with stronger preference for their domestic products - namely Ireland, Italy and Spain.

In considering the role of product quality in influencing market share, we note that the impact of quality across all countries and sectors is positively significant and higher than unity. When looking at exporting countries, we conclude that improving the quality of a product by 1 unit deviation in standard error can contribute to an average increase in the export share of an exporter ranging between 1.4 and 10.3 standard deviation units. This result suggests that a policy aimed at improving the quality of a product allows the exporter to have an edge over its competitors.

These results could serve as a policy foundation wherein policy makers can simulate the various competitiveness policies in various exporting markets on which they have an advantage so as to increase their market share in that market and henceforth increase their economic growth which is more of a result of greater exports than as a result of higher consumption. Thus, a further study of this phenomenon as well as an extension of all forms of trade (service and goods trade) can yield interesting policy implications.

Endnotes

[i] Aiginger argued that the unit value of exports tend to reflect the willingness of a consumer to pay for a given product. Through the use of these unit values, he was able to classify countries within Europe as quality competitive and price competitive.

[ii] Fontagné, Gaulier and Zignago used unit values of imports to explain the difference in North-South trade.

[iii] For an in-depth treatment of the model, we strongly recommend that readers consult the paper entitled "Trade Performances, Product Quality Perceptions, and the Estimation of Trade Price Elasticities" (2004) by Crozet and Erkel-Rousse, published in the Review of International Economics. A basic mathematical derivation of the model is also reproduced in the Appendix.

[iv] These matrices were constructed under the methodology developed by Johnson for the OECD with sectoral differentiation (Johnson, 2002).

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Appendix

Theoretical Treatment of Import Market Share Model

The model takes into account the preferences of the consumer through a Spence-Dixit-Stiglitz sub-utility function, U_{kj}, which weighs the consumer's preferences between domestic and imported goods from different origins.

Given there are I≥2 countries involved in trading with each other and i refers to the exporting country while j refers to the importing country and k refers to the differentiated product that is traded. A representative consumer in the importing country j aims to maximize his Spence-Dixit-Stiglitz sub-utility function subject to his budget constraint:

$$U_{kj} = [\sum_{t=1}^{I} \sum_{v=1}^{n_{kj}} \alpha_{kij} y_{vij}^{\frac{\sigma-1}{\sigma}}]^{\frac{\sigma}{\sigma-1}}$$

Where y_{vij} stands for the total demand for variety v addressed to the producer of country i, n_{kj} reflects the number of varieties originating from country i. σ is the elasticity of substitution between domestic and imported goods from different origins. Here, the preference parameter is noted as α which corresponds to the quality of the product that is imported. In other words, these preference parameters stem from the national differences in terms of technological knowledge incurred through externalities as well as own R&D investment of a particular country.

In terms of the supply side, the producer solves for the profit maximization problem to obtain a price expression as seen below:

$$p_{kij} = c_{ki}(1 + t_{kij}) \frac{\epsilon_{kij}}{(\epsilon_{kij} - 1)}$$

Where c_{ki} represents the production cost per unit related to producing the good k in the exporting country i and ϵ_{kij} corresponds to the price elasticity of demand for the variety (k, i) in the importer country j.

Following closely to the model developed, we rewrite the trade equation by manipulating the sub-utility equation and the price expression to derive the following where E_{kj} referes to the share of country j's national revenue allocated to the consumption of product k:

$$M_{kij} = n_{ki} p_{kij} y_{kij} = \left(\frac{p_{kij}}{p_{kj}}\right)^{1-\sigma} \left(\frac{n_{kj} \alpha_{kij}^{\sigma}}{\sum_{i'=1}^{I} n_{ki'} \alpha_{ki'j}^{\sigma}}\right) E_{kj}$$

Expressing the total imports M between i and j with respect to the imports between j and the competing exporters i' results in an import market share expression shown below where n refers to the number of varieties:

$$\frac{M_{kij}}{M_{ki'j}} = \left(\frac{p_{kij}}{p_{ki'j}}\right)^{1-\sigma} \left(\frac{n_{ki}}{n_{ki'}}\right) \left(\frac{\alpha_{kij}}{\alpha_{ki'j}}\right)^{\sigma}$$

The log-transformation of this equation (through transforming it into growth rate and then integrating) leads to the derivation of the testable import market share equation which we see below. We have transformed the above equation including some other variables so as to parallel the import market share equation from our reference paper.

$$\log(mshare_{kijI't}) = -(e_p - 1)\log(price_{kijI't}) + e_q \log(know_{kijI't}) + e_g(emp_{ijI't}) - e_d \log(dist_{ijI't}) + fixed\ effects + intercept + u_{kijI't}$$

Where

$$mshare_{kijI't} = \frac{M_{kijt}}{\sum_{i'\in I'} M_{ki'j}}$$

$$price_{kijI't} = \frac{p_{kijt}}{\overline{p}_{kI'jt}}$$

$$emp_{ijI't} = \frac{emp_{kit}}{\overline{emp}_{kI't}}$$

$$know_{ijI't} = \frac{know_{kijt}}{\overline{know}_{kI'jt}}$$

List of European Countries

Germany. DE	*Italy, IT*
Denmark, DK	*Netherlands, NL*
Spain, ES	*Norway, NO*
Finland, FI	*Sweden, SE*
France, FR	*United Kingdom, UK*
Ireland, IE	

List of Sectors

NEMESIS Sectoral Index	*Sectoral Description*
1	*Agriculture*
2	*Refined Oil*
3	*Ferrous and Non-Ferrous Metals*
4	*Non Metallic Mineral Products*
5	*Chemicals*
6	*Metal Products*
7	*Agricultural and Industrial Machines*
8	*Office Machines*
9	*Electrical Goods*
10	*Transport Equipment*
11	*Food, Drink and Tobacco*
12	*Textiles, Cloth and Footwear*
13	*Paper and Printing Products*
14	*Rubber and Plastic*
15	*Other Manufactures*