European Commission

JRC TECHNICAL REPORTS

Measuring quality, willingness to pay and selling capacity at a country-product-destination level using aggregate trade data

Francesco Di Comite

2016

EUR 27977 EN

Joint Research Centre

Measuring quality, willingness to pay and selling capacity at a country-product-destination level using aggregate trade data

Contact Information
Name: Francesco Di Comite
Address: Joint Research Centre, Edificio Expo. c/ Inca Garcilaso, 3. E-41092 Seville, Spain
E-mail: franesco.di-comite@ec.europa.eu
Tel.: +34 9544-88371

JRC Science Hub
https://ec.europa.eu/jrc

JRC102122

EUR 27977 EN

ISBN 978-92-79-59413-7 (PDF)

ISSN 1831-9424 (online)

doi:10.2791/975002 (online)

Table of contents

Abstract

This paper describes a methodology to identify different components of external competitiveness using readily accessible, aggregate trade and macroeconomic data. Building on demand system with quadratic preferences, asymmetric varieties and heterogeneous consumers, it is shown how to use trade data to identify quality at a country-product level and willingness to pay and selling capacity at a country-product-destination level. These indicators of external competitiveness can be used to complement the existing ones, mostly based on symmetric preferences with constant elasticity of substitution, to refine our understanding of the determinants of a country's trade balance, which is one of the main components of the current account. An example of the type of analysis that can be performed with these indicators is illustrated focusing on two EU countries recently experiencing diverging trajectories in terms of external competitiveness, Latvia and Finland.*

JEL codes: F12 - F41 - L11

Keywords: International trade - Quality measurement - Selling capacity - External competitiveness - Willingness to pay - Latvia - Finland

*I am grateful to Florian Mayneris, Gianmarco Ottaviano, Pierre Picard, Jacques Thisse and Hylke Vandenbussche for useful comments and suggestions. An earlier version of this paper has been published under the title "Measuring quality and non-cost competitiveness at a country-product level" (Di Comite, 2012). The opinions expressed are those of the author only and should not be considered as representative of the European Commission's official position.

1. Introduction

A key factor in assessing the sustainability of a country's external position is its capacity to finance the purchase of external goods and services through its exports. This is why an increasing amount of attention and effort is being given to the definition of suitable indicators of external competitiveness which may be used to identify imbalances and unsustainable long-term trends. The external position of a country may be affected by several factors, stemming from both the demand and the supply side of the economy, the latter being typically associated with productivity and export performance and the former with consumption and import growth. This paper focuses on the supply side of the economy, and specifically on the ability of countries to compete in export markets through the development of better products, in terms of markups and quantities sold.

There are currently different models available to practitioners who want to identify specific drivers of external competitiveness, but they are mostly based on symmetric varieties and heterogeneity in productive efficiency alone, thus drawing most of the attention towards the cost dimension of competitiveness. In contrast, a parsimonious methodology is proposed here to exploit trade and macroeconomic data to extract information on the evolution of what is referred to as product "quality", consumers' "willingness to pay" and exporters' "selling capacity" in a given market. A formal definition of these concepts will be introduced in Section 3, but as a first approximation it can be mentioned that the term "quality" captures the characteristics of an exported product positively affecting markups and sales, whereas "willingness to pay" captures the value attributed by consumers to a product variety, given their current level of consumption, and "selling capacity" captures the characteristics of a product affecting sales but not equilibrium markups or prices. In order to identify these three elements, a particular demand structure is assumed, based on asymmetric quadratic utilities with heterogeneous consumers and variable elasticity of substitution à la Di Comite, Thisse and Vandenbussche (2014). This demand structure has the advantage of being at the same time flexible, tractable and fully identifiable. This paper presents all the steps needed to build the indicators with examples and illustrations, based on two EU countries following divergent trajectories in terms of external competitiveness in recent years: Latvia and Finland.

The choice of the modelling framework is motivated in the next section, where alternative trade models are presented which can also be used to identify demand parameters. Section 3 then presents the model used in this paper and the steps needed to identify its parameters. Section 4 turns to the empirical implementation of the estimation procedure and addresses the issues related to data requirements and availability. An example of the use of these indices, aggregated at the country level for illustration purposes, is presented in Section 5, with a particular focus on the Latvian and Finnish external competitiveness developments. Section 6 shows the additional information that can be extracted by displaying disaggregate product values and the distributions of product characteristics at the country level. Finally, Section 7 concludes.

2. Estimating demand parameters in the trade literature

The economics field of International Trade has traditionally focused on why countries differ in terms of their export performance and composition. The first attempts to propose a comprehensive theory of trade were based on comparative advantages à la Ricardo and homogeneous goods. However, the increasing availability of disaggregate trade data allowed us to observe unexpected patters such as: significant levels of intra-industry trade; price discrimination across markets; different prices within the same markets for different varieties of the same good; weak correlations between prices and quantities sold across markets. These observations pushed the literature in the direction of developing new models, introducing on consumers' "love for variety" and product differentiation into the picture.

These types of model are part of what is called the New Trade Theory, pioneered by Krugman (1980, 1979) on the basis of the model outlined by Dixit and Stiglitz (1977), which recently received new impulse following the discovery of significant heterogeneity across firms in terms of economic performances (Bernard, Eaton, Jensen and Kortum, 2003) and pricing behaviour (Manova and Zhang, 2012). These findings have contributed to the development of different variations of so-called *monopolistic competition* theories, where firms are assumed to exert market power, like a monopolist, on the particular variety they produce, but are constrained by the presence of other firms selling imperfect substitutes in the same market. In addition, varieties are assumed to be so many as to be individually negligible in terms of aggregate market outcomes, which means that individual firms take market indices as given and are not able to influence them with their choices or to collude with other firms to extract more profits from consumers. These assumptions lie at the basis of a large majority of modern trade theories.

The main differences between existing New Trade models lie in the particular demand structure used to describe consumer behaviour. The most popular alternatives rely on constant elasticity of substitution (CES), translog, or quadratic utilities.[2] Whereas all of these approaches rely on product differentiation in a monopolistic competition setting, their functional forms differ in such a way that each model allows for different identification strategies and interpretation of structural parameters. In particular, frameworks based on CES utility functions, such as Melitz (2003), Baldwin and Harrigan (2007), Feenstra and Romalis (2014) or Henn, Papageorgiou and Spatafora (2013), are particularly useful, because of their tractability, when the focus of the exercise is on income effects or when trade is embedded as a module in a more complex general equilibrium model. Yet, when the interest of the researcher revolves around individual product characteristics such as quality, willingness to pay, or selling capacity, then discrete-choice models yielding translog preferences and quadratic utilities provide the most appropriate setting.[3] However, the latter have the additional advantage of being analytically tractable when variety characteristics are defined over a continuum, even with asymmetric preferences. This is not the case for discrete choice models, which normally need to be defined over a small finite set of types to be solved and are characterized by symmetric varieties (Anderson, de Palma and Thisse, 1992).

Recently, Bank of Latvia's Benkovskis and Wörz (2012) and Benkovskis and Rimgailaite (2011), showed how to measure the evolution of quality-adjusted relative export prices in a CES framework, building on a methodology incrementally developed by Feenstra (1994), Hummels and Klenow (2005) and Broda and Weinstein (2006). These studies show that even if export prices increased, quality-adjusted relative export prices in Latvia and the other new EU member states decreased significantly between 2002 and 2009, therefore not resulting in a loss of competitiveness. In other words, higher export prices were due to a shift towards higher quality production, rather than a pure increase in costs. Similarly, Feenstra and Romalis (2014) use an adapted quality-augmented CES utility function in order to obtain non-homotheticity in income and provide quality-adjusted price indexes for imports and exports for virtually every country of the world.

Finally, more theoretically agnostic, data-driven approaches can be found in the empirical literature, such as Cheptea, Fontagné and Zignago (2014) or Gaulier, Santoni, Taglioni and Zignago (2013), who disentangle pure competitiveness effects from compositional based on sector and geographic specialisation of exporters. The idea of empirically extracting individual components from overall trade variations dates back to Fagerberg (1988), who investigated different sources of competitiveness not based on labour cost reductions to advance an explanation for Kaldor's (1978) observation that the countries experiencing the highest increase in unit labour costs in the postwar period were also the countries that

[2] A recent paper discussing the different frameworks and their differences in expected outcomes is Feenstra and Weinstein (2010).

[3] See Fajgelbaum, Grossman and Helpman, (2011) or Khandelwal (2010) for discrete choice models, and Melitz and Ottaviano (2008) and Ottaviano, Tabuchi and Thisse (2002) for the quadratic utility function.

had the largest increase in market shares, which is known as Kaldor's paradox.

Based on a similar interest on measurement of the determinants of external competitiveness, a new methodology is illustrated here based on a non-homothetic quadratic utility function à la Melitz and Ottaviano (2008), as generalized by Di Comite, Vandenbussche and Thisse (2015). Firm-level studies have shown that cost heterogeneity or demand shifters alone (such as quality) do not suffice to explain trade patterns (see, for example, Brooks, 2006, Kee and Krishna, 2008, Foster, Haltiwanger and Syverson, 2008, or Braguinsky, Ohyama, Okazaki and Syverson, 2014), as they leave a significant amount of unexplained variability in quantities sold. This has also been observed on intra-EU trade data, leading to the definition of the concept of "non-price competitiveness" as an additional source of competitiveness for Member States (European Commission, 2011). To make sense in a rigorous way of this additional source of variation affecting quantities but not prices, Di Comite, Thisse and Vandenbussche (2014) propose to use a spatial interpretation of product characteristics à la Lancaster (1979), where varieties are allowed to be differentiated along vertical and horizontal dimensions. Demand-shifting vertical differentiation is thus interpreted as "quality", which is used also to determined consumers' "willingness to pay" for the variety once local market conditions and quantities sold are accounted for. Slope-changing horizontal differentiation can be linked to what is here referred to as "selling capacity", which captures the amount of sales of a given variety in a market at the equilibrium level of prices and markups.[4]

In order to decompose changes in export performance into individual demand parameters, the originally firm-level quadratic utility framework has to be adapted to deal with country-product-level data. The advantage of such approach is that it allows varieties to be asymmetric along different dimensions, all of which can be identified in every period. To this end, some assumptions are needed both on the behaviour of consumers, whose preferences must fit into a simple quadratic utility function, and on the productive capacity of firms, which are assumed to have access to the same technology within a country, not to be capacity constrained and to adjust the scale of production only through changes in labour inputs.

The main intuition behind this approach is that information on costs, prices and quantities sold over time can be used to estimate key demand parameters for each variety in the market and to distinguish between idiosyncratic and market-wide determinants of market outcomes. In particular, taking labour costs as exogenously given, overall demand effects can be determined and aggregate market effects can be disentangled from variety-specific demand effects. In turn, variety-specific demand effects can be split into quality (price-shifting vertical differentiation) and selling capacity (quantity-shifting horizontal differentiation), in addition to consumers' willingness to pay for a particular variety. Notice that the procedure described in this paper is based on a rough, data-parsimonious approximation of marginal costs of production, as it uses only information on unit labour costs at the product level. The main advantage in terms of data is that unit labour costs are typically available for most countries of the world, so that the methodology illustrated here for EU member states can be extended to a wider set of countries. When data allows for a micro-level identification of marginal costs, Vandenbussche (2014) illustrates how to aggregate firm-level cost data to the country-product level to have more precise cost estimates within the same framework using the ORBIS dataset.

A visual illustration of the demand-parameters identification procedure is shown in Figure 1. A more formal description of the model follows in the next section.

[INSERT FIGURE 1 HERE]

[4]In a previous version of this working paper, the concept has been labelled "non-cost competitiveness" but it could give rise to confusion since also the other component of external competitiveness identified with this methodology, quality, is not a priori related to marginal production costs, even if there is robust evidence that points in that direction such as Kugler and Verhoogen (2012). Notice also that the level of product aggregation changed from the previous version of the working paper to the current one, from CN2 to CN8.

3. The Model

The identification strategy proposed here is based on a quadratic utility function where varieties are allowed to affect preferences asymmetrically. The advantage of such specification is that its optimization yields tractable linear demands and its parameters can be given an intuitive interpretation. A typical quadratic utility function á la Ottaviano, Tabuchi and Thisse (2002) can be thought of as the combination of four components:

- A positive demand shifter capturing the willingness to pay of a consumer for the first unit consumed of a given variety of a certain type of differentiated good;
- A negative quadratic term capturing the decrease in marginal utility provided by the consumption of other units of the same variety;
- A negative quadratic term capturing the decrease in marginal utility provided by the consumption of a positive amount of any variety of the same class of goods;
- A numéraire capturing the marginal utility provided by an external good, which can be also interpreted as a Hicksian composite good representing the entire bundle of consumption of the representative consumer considered.

To have a simple model of monopolistic competition with variable elasticity of substitution, non-constant markups and asymmetric varieties vertically and horizontally differentiated, these four elements can be formalized in the following representative consumer's utility, considering a particular variety $s \in S_i$ of a certain product consumed in market i, with a compact notation:

$$U_i = \int_{s \in S_i} \alpha_s q_{s,i} ds - \int_{s \in S_i} \frac{\beta_{s,i}}{2} q_{s,i}^2 ds - \frac{\gamma}{2} \left[\int_{s \in S_i} q_{s,i} ds \right]^2 + q_0, \tag{1}$$

where the demand shifter α_s is a positive and continuous function measuring the vertical differentiation of variety s (i.e. its intrinsic quality, which is independent of the market where it is shipped) defined over the total mass of varieties present in market i, S_i.[5] The market-variety-specific satiation parameter $\beta_{s,i}$ can be interpreted as a measure of horizontal differentiation in spatial terms (which can be interpreted as a measure of selling capacity) because in equilibrium it can be shown not to affect profit-maximizing prices but only quantities sold. The parameter γ captures the substitutability between each pair of varieties in S_i, assuming the same pairwise substitutability patterns within the same product category. Since it applies to all the varieties of a given product, it has no subscript in order to simplify notation. Finally, the term q_0 is the numéraire of the model and may be seen as representing the consumption of all the other goods in the economy in such a way that the marginal utility derived from the consumption of any other good of the economy (which can be normalized to 1 without loss of generality) must be equal to the marginal utility of consuming an additional unit of a variety s of the product under consideration. The term numéraire is used to emphasize the fact that it is used as the unit of account of prices and any other parameter in the model. Since we abstract from long-term equilibria, we assume the number of varieties in a market, S_i, to be fixed and focus on pricing strategies in the short term.

The demand for a variety s, given a standard budget constraint $\int_{s \in S_i} p_{s,i} q_{s,i} ds + q_0 = y_i$ where y_i is the consumer's income, can be written as:

$$q_{s,i} = \frac{\alpha_s - p_{s,i}}{\beta_{s,i}} - \frac{\gamma(\mathbb{A}_i - \mathbb{P}_i)}{\beta_{s,i}(1 + \gamma \mathbb{N}_i)} \tag{2}$$

[5] The expression "mass of varieties" is used in the literature to stress the assumption that each individual variety is too small to affect market aggregates and thus has to take price, quality and cost indices in market i as given. Notice that even in the context of macro data, where countries are observed but not individual firms, the assumption can still hold as long as firms within a country cannot coordinate their pricing behaviour (or, alternatively, be big enough to represent a significant share of a country's export).

where $\mathbb{N}_i$, $\mathbb{A}_i$ and $\mathbb{P}_i$ are market aggregates expressing effective number of competitors, quality and price levels in market i, as obtained by weighting respectively the number of firms, their quality levels and prices by each variety's own selling capacity parameter in such a way that each type of variety marginally affects market aggregates, proportionally to expected consumers' purchases in market i , $1/\beta_{s,i}$:

$$\mathbb{N}_i \equiv \int_{s\in S_i} \frac{ds}{\beta_{s,i}} \quad , \quad \mathbb{A}_i \equiv \int_{s\in S_i} \frac{\alpha_s}{\beta_{s,i}} dr \quad , \quad \mathbb{P}_i \equiv \int_{s\in S_i} \frac{p_{s,i}}{\beta_{s,i}} dr. \tag{3}$$

Since it suffices to look at short-term pricing decisions to extract information on the variety characteristics, it is possible to abstract from long-term issues such as entry or exit from the market and to focus on the short-term problem of the firm, which is to maximize operating profits on each variety produced.[6] Under the assumptions of variety-specific linear costs (implicitly including transport costs) and segmented markets, operating profits in a market, $\Pi_{s,i}$, can be measured as the product of markups on each unit sold, $p_{s,i} - c_s$, and quantities sold, $q_{s,i}$:

$$\Pi_{s,i} = (p_{s,i} - c_s) q_{s,i}. \tag{4}$$

Noticing that the total amount of consumption of a certain product is equal to $\int_{s\in S_i} q_{s,i} ds = Q_i = \frac{\mathbb{A}_i - \mathbb{P}_i}{1+\gamma\mathbb{N}_i}$, the combined optimization problems of firms and consumers yields the following equilibrium prices and quantities:

$$p^*_{s,i} = \frac{\alpha_s + c_s}{2} - \frac{\gamma Q_i}{2} \tag{5}$$

$$q^*_{s,i} = \frac{p^*_{s,i} - c_s}{\beta_{s,i}} = \frac{1}{\beta_{s,i}} \left(\frac{\alpha_s - c_s}{2} - \frac{\gamma Q_i}{2} \right) \tag{6}$$

3.1 Parameter identification: quality, willingness to pay and selling capacity

The price and quantity equations outlined above are used to identify the vertical and horizontal differentiation parameters α_s and $\beta_{s,i}$, which will respectively correspond to an index of quality and an index of selling capacity of each variety (defined as a country-product combination). These results are convenient because variety- and market-variety-specific structural variables are clearly split and allow for direct identification. Equilibrium prices depend not only on each variety's intrinsic quality, α_s, and marginal costs of production,c_s , but also on the total consumption of the differentiated good in the market Q_i, weighted by its degree of substitutability across different varieties, γ. Equilibrium quantities depend, in addition, on the selling capacity parameter $1/\beta_{s,i}$, which can therefore be directly measured from the following relation:

$$\frac{1}{\beta_{s,i}} = \frac{q^*_{s,i}}{p^*_{s,i} - c_s} \tag{7}$$

Consumers' willingness to pay (WTP) for variety s in market i expresses the value (in terms of the numéraire) that consumer i attributes to one unit of variety s given the quantities already owned of that variety and market conditions (approximated by the aggregate quantity index Q_i). It can be derived from the quadratic preferences, yielding the marginal price consumer i would pay for a given amount of variety s owned, i.e. its inverse demand

[6]Given the assumption of negligibility of each variety in term of market aggregates, even if a firm produces more than one variety its decisions for each variety would be independent from the others. This means that the issues of complementarity between varieties or cannibalization can be neglected in this context.

function:

$$WTP_{s,i} = p_{s,i} = \alpha_s - \beta_{s,i} q_{s,i} - \gamma Q_i \tag{8}$$

As for quality, it can be measured both in relative or absolute terms. In the first case, relative quality differences can be directly measured as the difference between a country's α_s and a benchmark, say α_r, comparing the prices and marginal costs of production of the two varieties sold in the same market. From the difference between $p^*_{s,i}$ and $p^*_{r,i}$ derives

$$\alpha_s - \alpha_r = 2(p^*_{s,i} - p^*_{r,i}) - (c_s - c_r), \tag{9}$$

which can be rewritten as

$$\Delta\alpha_{s-r} = 2\Delta p^*_{s-r,i} - \Delta c_{s-r} \tag{10}$$

A visual representation of how each demand parameter affects the inverse linear demand functions for varieties s and r in market i is shown in Figure 2.

[INSERT FIGURE 2 HERE]

It should be noticed that the relative difference in quality between varieties s and r, $\Delta\alpha_{s-r}$, provides only the difference in terms of numéraire between the price at which the first marginal unit of variety s and the first marginal unit of variety r would be sold in each market served, but no information on the absolute quality levels of the two varieties. To this end, it is necessary to estimate the values of α_s and α_r in absolute terms, which requires, as a preliminary step, the estimation of the substitutability parameter γ. This step requires two additional assumptions: the first is that the degree of substitutability between different varieties of the same product does not vary over time, which is reasonable over short periods of time and well-defined product categories; the second assumption is that the weighted average quality of each product in market i, $\tilde{\alpha}_i$, is constant over time, which amounts to assume that the average quality improvements for each product follows the general quality improvement in the economy, maintaining the relative quality of each product stable in the period of observation (while the quality of each variety of the products is allowed to vary). The quality, price and cost of the weighted average variety in market i can be computed by dividing the market indices $\mathbb{A}_i$, $\mathbb{P}_i$ and $\mathbb{C}_i \equiv \int_{s \in S_i} \frac{c_{s,i}}{\beta_{s,i}} dr$ by the effective number of firms, $\mathbb{N}_i$:

$$\tilde{\alpha}_i = \frac{\mathbb{A}_i}{\mathbb{N}_i} \quad , \quad \tilde{p}_i = \frac{\mathbb{P}_i}{\mathbb{N}_i} \quad , \quad \tilde{c}_i = \frac{\mathbb{C}_i}{\mathbb{N}_i}. \tag{11}$$

Equation (5) can then be rewritten as

$$2\tilde{p}_i - \tilde{c}_i = \tilde{\alpha}_i - \gamma Q_i. \tag{12}$$

Therefore, under the assumption of constant average product quality over time, it is possible to estimate $\hat{\gamma}$ at a product level by regressing the time series of $[2\tilde{p}_i - \tilde{c}_i]$ on $[Q_i]$. The intuition is that, holding average quality fixed, the substitutability parameter captures the impact the total quantities sold of a given product on the prices and markups of its varieties. In addition, the constant of the time-series regression yields an estimation for the time-invariant average quality level of each product, $\hat{\tilde{\alpha}}_i$, from which all the others can be measured as $\hat{\alpha}_s = \hat{\tilde{\alpha}}_i + \Delta\alpha_{s-\tilde{i}}$ noting that the difference between each variety s and the market average $\tilde{i}$ is independent of Q_i or the other market aggregates that can vary over time, so that $\Delta\alpha_{s-\tilde{i}} = 2\Delta p^*_{s-\tilde{i},i} - \Delta c_{s-\tilde{i}}$.

Finally, knowing $q_{s,i}$ and Q_i, having measured $\beta_{s,i}$ and estimated $\hat{\tilde{\alpha}}_i$ and $\hat{\gamma}$, the willingness to pay of consumer i for variety s can be identified as

$$W\hat{T}P_{s,i} = \hat{\alpha}_i - \beta_{s,i} q_{s,i} - \hat{\gamma} Q_i \tag{13}$$

4. Empirical implementation

To operationalize the identification strategy described above, a preliminary step consists in identifying varieties and markets object of the analysis. The ideal field of application of the theories of monopolistic competition is the firm- or plant-level in differentiated consumer-goods sectors, as it would better fit the assumption of a similar demand structure for the different varieties and of a multitude of small competitors individually irrelevant for market aggregates. Unfortunately, cross-country micro-level data is still scarce in many countries and where available it can be expensive or incomplete (as it may be based on public registries covering mostly large firms or surveys filled by firms on a voluntary basis), even if efforts are currently being undertaken by international networks of researchers such as CompNet to fill this gap (see European Central Bank, 2014).[7] For this reason, it may be currently preferable to turn to more aggregate trade datasets such as Eurostat COMEXT, which is free, complete and adopts a homogeneous data collection methodology across EU Member States, even though it only considers trade in goods. In such a context, a *variety s* can be defined as a country-product combination. As for the definition of a *product*, different levels of aggregation are available. In the Combined Nomenclature framework, for example, 4 levels of aggregation are available, ranging from CN2, where all the goods are split into 98 2-digits product categories, to CN8, which comprises roughly 10.000 8-digits product codes, including the intermediate levels CN4 and CN6.[8]

A second issue to consider is the definition of a *market i* in which the different varieties compete. Ideally, in the case in which varieties are identified with country-product pairs, the market i would be a third country in which all the different varieties compete on a levelled ground facing similar barriers to entry and transport costs.[9] In the case of EU28 Member States, for example, this market could be the US, but unfortunately some Member States export very few product categories to the US, which means that choosing the US (or other non-EU countries) as the relevant market for the analysis would cause a significant loss of information and would bias the resulting indicators due to selection effects. For this reason, it is here decided to consider the entire EU28 as the relevant market i, looking at the intra-EU28 exports of each Member State. This choice may be more suitable for small and medium sized Member States than for larger ones though, because the domestic market of the exporter would be implicitly excluded from the total intra-EU28 exports. In addition, it may be argued that big exporters may not take market prices as given, but rather try to influence them pricing strategically. However it should be kept in mind that, even if aggregate country-product level trade data is used, exports of a country are normally the sum of many individual exporters,[10] each having a negligible impact on market aggregates, so that the basic assumptions of the monopolistic competition framework (notably, that individual price makers cannot affect market aggregates strategically with their behaviour) are not violated in substance. Furthermore, focusing on intra-EU28 trade flows

[7] When firm-level data is available, Vandenbussche (2014) shows the methodology to follow to aggregate the information up to the product-country level to have more precise estimates of marginal costs of production for the estimation of demand parameters using the ORBIS database.

[8] To give some concrete examples, consider the CN8 code 90041010, which identifies the product "Sunglasses with optically worked lenses". At a higher level of aggregation, this product definition is included in the CN6 definition "Sunglasses" (code 900410), which in turn is part of the CN4 product definition "Spectacles, goggles and the like" (code 9004) and the CN2 definition "Optical, photographic, cinematographic, measuring, checking, precision, medical or surgical instruments and apparatus" (code 90). It should be remembered that the definition of a product is relevant because the substitution effects described in the model involve only varieties of the same product, the rest of the economy being captured by the numéraire. Therefore, the higher the level of aggregation, the looser the relation between the varieties included in it and less acceptable the technical model assumption of equal substitution patterns between varieties of the same product, which is a common feature of virtually all existing trade models.

[9] The advantage of having the different varieties facing market-specific costs of shipment is that it leaves variety-specific or market-variety-specific differences in parameters as the only source of variability across varieties' performance in a destination market.

[10] A notable exception is represented by sectors that are highly regulated or highly concentrated. These would be indeed better described by an oligopolistic rather than a monopolistic competition framework, but it would be impossible or arbitrary to treat each product category differently and then aggregate results over the entire economy.

has the advantage of allowing for the extraction of reliable and comparable information on export and import markets, which can be used to estimate the expected consumption of a particular product, or Q_i in the model.

Country-product quality and selling capacity parameters can then be aggregated at the national level for each EU Member State. After having defined a variety s as country-CN8 product combination and import market i as the EU28 internal market, it is also useful to define a relevant benchmark to interpret the results. Two natural choices come to mind. The first one is to use the minimum and the maximum level reached by each parameter and then normalise all the values between 0 and 1. The second, in the case of EU countries, is to compare each country with the EU28 average for costs, prices and quality and EU28 totals for quantities and selling capacity.[11] Three benchmarks are therefore identified in this paper: $s = 0$ for the worst variety, $s = max$ for the best, $s = EU28$ for the EU28 as a whole.[12] Thus, the normalization of the quality parameter between 0 and 1 can be:

$$\alpha_{s,norm} = \frac{\alpha_s - \alpha_0}{\alpha_{max} - \alpha_0} \tag{14}$$

and the normalisation in terms of EU average, considering the baseline EU levels equal to 100:

$$\alpha_{s,normEU28} = \frac{\alpha_s}{\alpha_{EU28}} * 100 \tag{15}$$

The same normalisation procedure can be followed for the normalization of the other parameters.

4.1 Data requirements

In terms of data requirements, the methodology proposed here is rather parsimonious. All the necessary information can be retrieved from two freely accessible sources: Eurostat COMEXT, which reports trade flows to and from the EU countries; and DG ECFIN's annual macroeconomic database (AMECO) for the additional macroeconomic information needed to build market indices.

In terms of **trade data** (COMEXT) the following is needed:

- *Exports* from the 28 EU Member States to the rest of the EU *in values* (billion euros);
- *Exports* from the 28 EU Member States to the rest of the EU *in volumes* (100 Kg);
- Total *intra-EU28 imports in values*;
- Total *EU28 imports from extra-EU countries in values*.

As for the additional **macroeconomic data** (AMECO), this is the list of variables needed:

- Importer's *total consumption* at current prices (AMECO code: UCNT).
- *Compensation of employees* by main branch of the economy (NACE rev.1 ISIC categories):
  - Total economy (AMECO code: UWCD);

[11]The two alternative forms of normalising the data have pros and cons because the normalisation between 0 and 1 can suffer from the presence of outliers, whereas the use of EU28 average relies on a benchmark which is mostly determined by the values of a handful of bigger countries, which may not necessarily represent an average value for all the products considered

[12]Note that the market subscript i can be omitted, since all the results refer to shipments to the same export destination (the rest of the EU), so that the subscript EU28 can be used to identify the EU28 average variety without creating confusion.

  - Agriculture, forestry and fishing (ISIC: A, B) (AMECO code: UWC1);
  - Industry, including energy (ISIC: C, D, E) (AMECO code: UWC2);
  - Manufacturing (ISIC: D) (AMECO code: UWCM).
  - Services (ISIC: G to P) (AMECO code: UWC5);

- *Gross Value Added* by main branch of the economy (NACE rev.1 ISIC categories) at current prices:

  - Total economy (UVG0)
  - Agriculture, forestry and fishery products (ISIC: A, B) (AMECO code: UVG1)
  - Industry, including energy (ISIC: C, D, E) (AMECO code: UVG2)
  - Manufacturing (ISIC: D) (AMECO code: UVGM)
  - Services (ISIC: G to P) (AMECO code: UVG5)

4.2 An intermediate step: building trade and macro variables

Starting from these variables, it is possible to build all the others and estimate the parameters associated with each country-product in each period (years in this paper, but trade statistics are available also on a monthly basis). The first step is to construct **intermediate trade and macroeconomic variables**:

- *Export prices*, or $p_{s,i}$ in the model, which can be measured as the unit values (values/volumes) of the exports associated with each product category, in €/Kg. The resulting value is of course an approximation, as many different prices and products can be grouped together within a product category, but it is the best that can be done with aggregate data;

- *Unit labour cost* (ULC) at the economic branch level, which is the ratio of labour costs over value added at a product level can be computed dividing the *compensation of employees at current prices* by the *gross value added produced by the branch at current prices*. Each CN8 product categories can then be allocated to the different branches of activity homogeneously across products of the same branch as shown in the appendix for CN2 products (and applied homogeneously for more disaggregate levels).[13]

- *Physical unit labour cost* (PULC), or c_s in the model, which captures the marginal labour costs of producing a physical unit of the exported good, which is used as a proxy of differences in marginal costs of production across EU member states (assuming a similar technology and sourcing costs of intermediate inputs of production). It can be approximated by attributing a share of costs equal to the ULC to the values exported of each product, whereas trade data captures the total revenues earned from the export of a product. Therefore, it should be kept in mind that this measure abstracts from subsidies, direct taxes on products and intermediate consumption at a product level, which means that further refinements based on Social Accounting Matrices can contribute to have a more precise assessment of marginal costs and will be implemented in future versions of the model (even if the level of product definition will then be much more aggregate than the CN8 level). Alternatively, if reliable and comparable firm-level data is available for different countries, micro-level cost information can be aggregated up to the country-product level as in Vandenbussche (2014);

- *Product consumption in the import market*, which is the data equivalent of Q_i in the model, capturing the amount consumed of a certain product. This information is not

[13] Notice that this measure of unit labour costs has the disadvantage of displaying negative markups (higher labour costs than value added) for some country-products in particular years, especially in transition economies, which are then dropped from the sample.

readily available, especially for the most disaggregate levels of product definition. To tackle this issue, quantities can be inferred by combining the data on aggregate consumption with trade data, which should provide an indication of the particular tastes of a market. In particular, the share of each product in total imports can be assumed to reflect the share of a particular product in total consumption (which is however an approximation, since trade data often covers only trade in goods, whereas total consumption also includes services). In addition, it could be argued that also the exports of a country can provide some information of local preferences, at least as far as differentiated manufactured goods are concerned. Therefore, in the examples provided here total consumption of a particular product is obtained as the average of import share and export share of a particular product, multiplied by total consumption. Then, to convert this value into quantities, it is divided by the average price of the intra-EU exports. Notice that this is again an approximation, but will not affect substantially the relative performance of each variety because it will applied uniformly to all the varieties of a product category;

- *Varieties' market shares* are not needed for the estimation of the parameters, but can represent a useful consistency check of the results of the model. Market shares are in fact affected by both quality and selling capacity, which implies that in case of divergent trends, they can help assess what is the overall impact on countries' competitiveness. In addition, market shares can be expressed as a function of the estimated demand parameters to see how each of them contributes to the overall market share developments. In terms of quantities, the relationship between market shares and the demand parameters it can be written as

$$\frac{q_{s,i}}{Q_i} = \frac{\gamma}{2\beta_{s,i}} \left(\frac{\alpha_s - c_s}{\tilde{\alpha}_i - \tilde{c}_i} \cdot \frac{2 + \gamma \mathbb{N}_i}{\gamma \mathbb{N}_i} - 1 \right)$$

4.3 Empirical parameter identification and estimation

Following the empirical strategy illustrated in Section 3., the variables presented above can then be used to estimate the key **demand parameters** of the model as follows:

- *Selling capacity*, the inverse of the parameter,$\beta_{s,i}$, can be immediately measured by dividing quantities shipped by the markups, which can be measured as the difference between export prices and physical unit labour costs.[14] A way to interpret this parameter is that it measures the amount of goods that a country is able to export for a given (profit maximizing) level of markups. The advantage of this concept is that it can be seen as capturing all the characteristics of a variety that affect its sales but not the price consumers will be willing to pay for it (an example being the size of the distribution network or consumers' awareness of a product due to, say, gradual demand build-up over time), as in Foster, Haltiwanger and Syverson (2016);

- The *degree of substitutability* between varieties of the same product, the parameter γ, has to be estimated for very disaggregate product categories such as CN8. To this end, as explained in the previous section, it is possible to run a time-series regression with dependent variable $[2\tilde{p}_i - \tilde{c}_i]$ as a dependent variable and $[Q_i]$ as a regressor. The export price and PULC subscripts indicate that only the average quality in the EU28 market for each product must be considered. To identify it, the average price and cost can be computed as described in Section 3. The coefficient associated with the regressor can then be used as the product-level estimate of the degree of substitutability between varieties. The intuition is that since the term γQ_i enters symmetrically in all the varieties pricing decisions, it is enough to see how the inverse-demand intercept of the

[14] Notice that input material costs are not considered at this stage, but future refinements of the methodology, based on Input/Output tables and Social Accounting Matrices can include them. Here the implicit assumption for cross-country comparisons is that EU countries have similar technologies and sourcing costs for intermediates.

average quality changes in reaction to changes in the total amount of other varieties consumed to have an estimate of the parameter γ;

- The *average quality levels*, $\tilde{\alpha}_i$, can also be retrieved from the same regression as its time-invariant constant under the assumption previously discussed that the average quality for each product is constant over time in terms of the numéraire, which in turn captures the marginal utility of consumption of any other good in the economy;

- The *quality levels of all the other varieties*, α_s, can be computed starting from $\tilde{\alpha}_i$, noticing that differences in quality levels across varieties are measured as $\Delta\alpha_{s-r} = 2\Delta p^*_{s-r,i} - \Delta c_{s-r}$. This measure of quality can be seen as the intercept of the inverse demand function in the absence of competition (i.e. when $\gamma Q_i = 0$), which is the highest price a consumer would be willing to pay to buy a positive amount of variety s, even if this value cannot be directly observed in the market because of competition effects;

- The *willingness to pay for each variety*, $WTP_{s,i}$, can finally be computed for each level of quantity sold of s in i by plugging the parameters α_s, $\beta_{s,i}$ and γ into Equation (13), which yields the linear relation between quantities sold $q_{s,i}$ and the price consumers are willing to pay to buy an additional unit of s, $p_{s,i}$.

In terms of *units of measurement*, the quality index, α_s, unit values, $p_{s,i}$, and physical unit labour costs (PULC), c_s, and the willingness to pay ($WTP_{s,i}$) are expressed in *€/Kg*; the degree of pairwise substitutability, γ, is in €/Kg^2; the parameter for selling capacity, $1/\beta_{s,i}$, is measured in Kg^2/€; finally, market shares and unit labour costs (ULC) are unit-less.

Even though the three structural parameters of the model provide valuable information on the characteristics of the varieties exported, they cannot be immediately used in absolute terms for policy advice, but need to be related to a benchmark and interpreted in relative terms. An example of how the parameter identification methodology can be used to assess the competitiveness of a country is provided in the next section, based on the Latvian and Finnish experience. This choice of countries is mainly motivated by the fact that the idea of translating the micro-level methodology presented above into a macro setting has been first explored in the preparatory work of Di Comite, Giudice, Krastev and Monteiro (2012) focussing on Latvian Balance-of-Payment assistance. The comparison with Finland is then introduced in this paper to show how the methodology can highlight diverging trends in the different components of external competitiveness for the two countries. Whereas in Latvia the latest years have seen an improvement in both quality and cost competitiveness, resulting in a constant increase in market share, Finland displays a worsening of both cost and quality indicators, which are not compensated by the increase in selling capacity, resulting in a loss of competitiveness reflected in the contraction of export market shares.

5. Estimating quality and selling capacity in Latvia and Finland

Using the identification strategy presented in the previous section each variety's parameters can be estimated in every year. Such information can then be further aggregated to provide information on the overall country developments. In the context of CN8 trade data, each country exports a subset of the roughly 10000 CN8 products in the sample, whose average can be weighted by the relative export share to have an idea of the overall quality and selling capacity of the tradable sector. An alternative way of having aggregate results is to use the product category called "total", which in COMEXT corresponds to the sum of all the manufacturing export products in values and quantities.

The comparison between export-value-weighted parameters (called *wavrg* in the figures) and parameters associated with the unweighted aggregate category (referred to as *total*) can be used to assess the importance of export composition effects and sector specialisation of the country. Furthermore, weighted averages allow for a more meaningful comparison between countries, or between a country and a relevant group of countries, say the EU28. Indeed, quality and selling capacity can be compared product by product and then aggregated at a country level, getting rid in this way of product specialization biases. In other words, the indicators capture how each country performs given its export structure, which means that countries specialised in low value added products can still perform very well in terms of this external competitiveness indicator (as opposed to other metrics of competitiveness which can take also export composition into account).

The trends are generally similar in the two types of aggregation, but the absolute level may vary substantially, as can be seen from Figure 3 where unweighed totals (left axis) and weighted averages (right axis) are shown for PULC, export prices and the quality index. It is worth stressing that the differences in the evolution of the two series (apart from measurement errors) are mainly driven by changes in the export composition. For example, when the relative importance of higher-value products increases as a share of total exports, the weighted-average quality index increases more than the unweighted one. Thus, comparing the two series can provide useful information on the resource reallocation undergoing in the economy. Given this additional information content, they are presented together in the rest of the analysis.

[INSERT FIGURE 3 HERE]

This first graph only plots the raw parameters that can be identified from Finnish and Latvian trade data, which are just a first approximation of the results. It can already be noticed from the vertical axes of the figures that Finnish exports appear to be significantly more expensive and of higher quality than Latvian ones, even though the gap is closing over time. It is also remarkable the difference in Latvian exports between "total" and weighted average ("wavrg") values, indicating a high share of low-price products among Latvian exports, which are cheaper than other products from the same country but roughly in line with the same products exported by the other countries.

More meaningful indicators of competitiveness are discussed in what follows, based on pure cross-sectional indicators are presented, based on sample maxima and minima and on EU28 as a benchmark, and on their evolution over time. [15]

5.1 Normalisation from 0 to 1 of cross-sectional indicators

The first class of indicators that can be built through the methodology presented here consists of cross-sectional indicators comparing the performance of different varieties within the same import market, in this case the EU28 internal market. Since the different products considered can be very heterogeneous in terms of structural parameters (costs, prices, quality and units sold), they could not be meaningfully aggregated in terms of absolute values. However, they can be aggregated in terms of normalized values. Attributing a value of 0 to the lowest-scoring variety for each parameter and 1 to the highest-scoring variety, the normalized values of the roughly 10000 CN8 products can be weighted by relative importance of each product in terms of exported values. This implies that two countries with exactly the same parameter values for the same products can be associated with a different overall indicator because of differences in their export structure, this indicator being tilted in favour of the country with better performances in its most important products.

Results for the Latvian export sector are shown in Figure 4, considering PULC, export prices and quality indices. They are displayed on a 0-to-1 scale because these are the upper and the lower bound of the index. For example, as far as the unweighted totals are concerned, Latvia lies on the lower bound in all the years except 2007. This means that out of the 28 varieties (country-products) Latvia is the one with the lowest levels of physical unit labour costs, export prices and quality index in the *total* category. Yet, since Latvian

[15] The variable list, summary statistics and full dataset are available on request.

product parameters are not the lowest ranked for all the exports, its position improves when weighted averages of the normalized values of all its CN8 product exports are considered. In particular, it can be noticed that in the last decade the normalized weighted average quality index more than doubled, while the PULC in 2010 are back to the levels of 2004, after a sudden increase in 2006, 2007 and 2008.

Turning to Finland, starting from 2007 new wage agreements entered into force at the national ad sectoral level causing a steep increase in physical unit labour costs of Finnish exports can be observed, which drives prices up and is not associated with any noticeable increase in quality.[16]

[INSERT FIGURE 4 HERE]

5.2 Normalisation of cross-sectional indicators to EU28 values

As an alternative to a normalisation based on the minimum and maximum values, a particular benchmark can be used to put a Member State's figures into context. This approach has the advantage of being more robust to outliers because the extreme values in the sample (minima and maxima in the normalisation) can be driven by exceptional circumstances or temporary shocks. On the other hand, the disadvantage is that by using this approach alone it is impossible to distinguish between changes in the numerator (the Member State) and changes in the denominator (the benchmark). The latter has thus to be chosen carefully and should not be excessively volatile over time. The natural choice as a benchmark is then the EU28 average, even if others can be thought of.

As an example, in Figure 5 *total* and *wavrg* quality indices, export prices and physical unit labour costs for Latvia and Finland are compared to the EU28 averages (setting EU28=1). Again, it can be noticed that weighted averages parameters are higher than unweighted totals and in this case provide a more realistic assessment of the country's performance. Indeed, the sectoral specialisation of Latvia in low-price export can be seen from the low value of average export prices and physical unit labour costs in the total category, which are just 20 to 30% of EU average in 2013. However, this extreme result is nuanced when weighted averages are considered, as taking product specialisation into account leads to a more credible relative position in terms of prices and PULC.

It is remarkable that, by 2013, the weighted average quality of Latvian exports, corrected by the relatively unfavourable sectoral specialisation of the country, appears to overtake the weighted average quality of Finnish exports, while prices and notably labour costs are still lower than EU28 average in Latvia and higher in Finland.

[INSERT FIGURE 5 HERE]

The same exercise is repeated for the indicator of selling capacity in Figure 6, showing similar trends when the unweighted total and the weighted averages are considered. What has to be kept in mind when dealing with selling capacity is that country size is likely to matter because, for example, it may affect the number of exporting firms. In addition, it should be remembered that EU28 selling capacity indicator does not capture EU28 averages but totals (since total quantities enter in the numerator), which is the reason why Latvia and Finland selling capacity values are so low in absolute terms. Therefore, the focus should be on trends rather than levels. In this respect, the two countries do not display strong trends, but whereas Latvia is slightly decreasing, Finland seems to be on a slowly improving trend.

[INSERT FIGURE 6 HERE]

[16]As noted in the OECD Economic Surveys on Finland, February 2014, the year 2008 was characterised by a strong decline in Electronics and electrical equipment exports, which is interpret in the report as a loss in "non-cost competitiveness".

However, the selling capacity indicator should not be considered in isolation because it only captures the ability to sell a variety for a given level of prices and costs, but not the profitability of each unit sold, which is instead better captured by the quality and PULC indicator in Figure 5.

The joint observation of Figures 5 and 5 suggests that, with respect to the EU28, while Latvian exporters are increasing the quality of their exports (so that the demand for their products is shifting outwards) they are at the same time experiencing an increase in the slope of their inverse demand function (see figure 2), which imply lower quantities sold for a given level of markups. The opposite appear to be the case in Finland.

The overall effect on total exports and market shares is therefore ex ante uncertain, in this case, and can only be assessed by looking directly at relative export performance in terms of market shares. As can be seen from Figure 7, the overall market share evolution of Latvia and Finland goes in opposite directions, the higher markups and lower selling capacity of Latvian exporters resulting in higher market shares, whereas the lower markups and higher selling capacity of Finnish exporters maps into lower market shares.

[INSERT FIGURE 7 HERE]

5.3 Cross-sectional indicators over time

Finally, the cross sectional indicators can be tracked over time to obtain an indicator that indicates the relative cumulative evolution of certain parameter vis-Ãă-vis a benchmark. Using again EU28 as the relevant reference point, Figure 8 shows how the distance between Latvian and EU28 parameters changes over time. To build these indicators, first a cross sectional analysis has to be undertaken, defining the relative parameter values of the Member State as compared to the EU28, which can be set again equal to 1, as in Figure 5. The proposed cross-sectional longitudinal indicator is then just the difference between the relative value of a Member State's parameter in 2004 and its relative value in the following years. For example, if the relative weighted average quality index of Latvian products is 98% of the EU28 level in 2004 and 107% in 2013, the value of the cross-sectional longitudinal indicator in 2013 will be 9, as is actually the case shown in Figure 8. This kind of analysis can provide interesting insights. For instance, focusing on the pane in which Latvian weighted average results are displayed, it is striking how in 2011 the physical unit labour costs differentials with respect to the EU28 have come back to the levels of 2002 whereas the quality index improved significantly. The Latvian trends are in stark contrast with the Finnish ones, especially in the last years of the series.

[INSERT FIGURE 8 HERE]

While this cross-sectional longitudinal indicator can be used to obtain a yearly value for cumulative changes with respect to a reference period of time, it still has the disadvantage of being subject to the risk of interpreting outliers as long-term trends. Think for example of the Latvian values in 2007 and how they were caused by temporary shocks rather than by real cumulative long-time trends. Even the indicators encapsulating cross sectional and longitudinal elements cannot be taken at face value but need to be complemented with more in-depth analysis. To this end, it the next section some possible ways to deepen the analysis are presented.

6. Cross-country comparisons of country-product characteristics

In order to build weighted average country indices for the cross-sectional indicators, country-product-specific demand parameters have to be estimated for every observation in the sample. Even though for policy purposes the country aggregates can be more interesting and easy to interpret, relevant information can be obtained also by observing the overall distribution of country-product specific variables, as shown by Vandenbussche (2014). To this end, for illustration purposes, Figure 9 shows the distribution of the quality parameter across products in each EU country, subdivided in EU13 and EU15 for ease of comparison.

The plots are produced by considering the quality index of all the CN8 products exported by each country to the internal EU28 market in 2013, and sorting them from the lowest to the highest value, repeating the process for the normalisation to the EU28 and from 0 to 1 and sorting the countries by their median value. The extremes of the core of the boxes indicates the 25th and 75th percentile of the distribution. It can be noticed that there is substantial heterogeneity across countries in terms of the range and median levels of quality, which may represent an interesting research question to address in future research.

[INSERT FIGURE 9 HERE]

An additional dimension that deserves further attention is the evolution over time of the distribution of country-product demand parameters. For example, Figure 10 plots the Kernel distribution of the quality index of Latvian and Finnish exports in 2003 and 2013, providing a picture which is consistent with the observation of a country-level trend of relative quality increase in Latvia and decrease in Finland.

[INSERT FIGURE 10 HERE]

7. Conclusion

In this paper, a methodology has been proposed which can be used to complement current indicators of external competitiveness by extracting information on the capacity of a country's firms to compete abroad. In particular, it is shown how information on country-product characteristics can be obtained by combining product-level trade data with estimates of product-level macroeconomic data to approximate marginal costs of production and consumption.

The identification strategy proposed is extremely parsimonious in terms of data requirements and is based on a tractable yet comprehensive model of monopolistic competition with asymmetric product differentiation. Building on the specific properties of a utility function displaying variable elasticity of substitution and heterogeneity in product characteristics, the model is used to identify two independent components of demand, these being referred to as quality and selling capacity. The former, which can be interpreted as an indicator of vertical differentiation, captures all the product characteristics that shift demand outwards and then increase consumers' willingness to pay, allowing firms to extract higher prices and markups for their products. The latter, which can be associated with taste mismatch or idiosyncratic horizontal differentiation in the context of firm analysis (see Di Comite, Thisse and Vandenbussche, 2014) captures all the product characteristics that affect the amount of goods that a consumer will buy for a given price.

In this paper, it has been shown how these concepts of differentiation can be applied to trade and macro data to extract information on the evolution of countries' competitive performance over time. Different types of indicators can thus be developed to investigate the sustainability of determinants of external positions of a country. For illustration, in the paper is shown how the methodology can be used to make sense of the recent external competitiveness developments of Latvia and Finland, tracking the evolution of their demand parameters at the country-product level from 2003 to 2013.

In terms of the data needs, the model needs only trade data, which can be easily found at both country and product-country level from Eurostat COMEXT, and macroeconomic data such as unit labour costs and consumption, which can be obtained from European

Commission DG ECFIN's annual macroeconomic database (AMECO), at a higher level of aggregation. The methodology presented here relies on strong assumptions in order to reduce the data requirements to a minimum, so there are clearly many directions in which the empirical identification methodology can be improved in the future. For instance, it is possible to exploit the high frequency of trade statistics to move from a yearly to a monthly analysis, even though the other macroeconomic statistics would have to be adapted to match the same time profile. Also, it would be possible to obtain better estimates of marginal costs of production, which take into account non-labour related variable costs such as energy or input materials. Finally, consumption estimates at a product level have been inferred only indirectly in this paper, following a procedure aimed at getting the most out of the narrowest possible data requirements, but more precise estimates could be obtained following more sophisticated approaches.

In terms of policy advice, it should be noted that the methodology presented in this paper provides a way to measure external competitiveness but it does not explain what drives it or how the parameters can be affected by policy. A promising future avenue of research for both empirical analysis and policy prescriptions would involve using the current model to study how quality upgrading or enhanced selling capacity can be achieved.

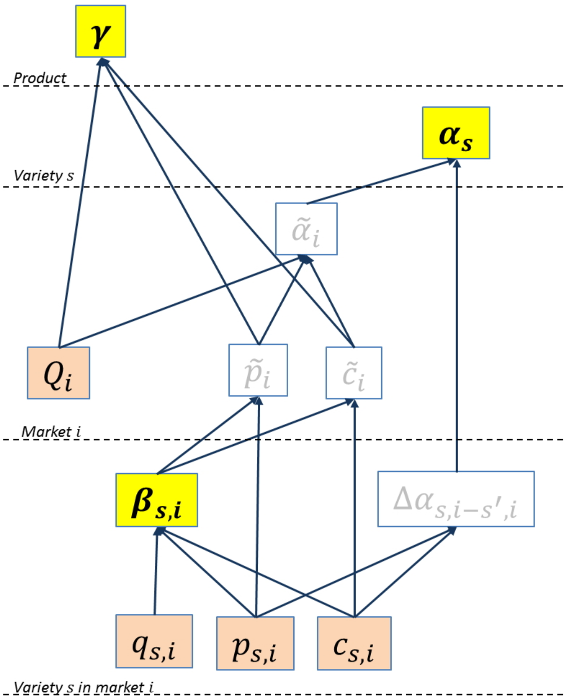
References

- Anderson, S., de Palma, A. and Thisse, J. (1992). Discrete Choice Theory of Product Differentiation. Cambridge, MA: MIT Press.
- Baldwin, R. and Harrigan, J. (2011). Zeros, quality, and space: trade theory and trade evidence. American Economic Journal: Microeconomics 3: 60-88.
- Benkovskis, K. and WÃ□rz, J. (2012). Non-price competitiveness gains of Central, Eastern and Southeastern European countries in the EU market. Oesterreichische Nationalbank, Focus on European Economic Integration 3: 27-47.
- Benkovskis, K. and Rimgailaite, R. (2011). The quality and variety of exports from the new EU member states. European Bank for Reconstruction and Development, The Economics of Transition 19: 723-747.
- Bernard, A. B., Eaton, J., Jensen, J. B. and Kortum, S. (2003). Plants and productivity in international trade. American Economic Review 93: 1268-1290.
- Braguinsky, S., Ohyama, A., Okazaki, T. and Syverson, C. (2015). Acquisitions, Productivity, and Profitability: Evidence from the Japanese Cotton Spinning Industry. American Economic Review 105: 2086-2119.
- Broda, C. and Weinstein, D. E. (2006). Globalization and the gains from variety. The Quarterly Journal of Economics 121: 541-585.
- Cheptea, A., FontagnÃľ, L. and Zignago, S. (2014). European export performance. Review of World Economics 150(1): 25-58.
- Di Comite, F. (2012). Measuring quality and non-cost competitiveness at a country-product level. European Economy, Economic Papers 467, Directorate General Economic and Monetary Affairs (DG ECFIN), European Commission.
- Di Comite, F., Giudice, G., Krastev, R. and Monteiro, D. (2012). The evolution of the Latvian external sector: imbalances, competitiveness and adjustment. In European Commission, EU Balance-of-Payments assistance for Latvia: Foundations of Success: 40 - 58
- Di Comite, F., Thisse, J.-F. and Vandenbussche, H. (2014). Verti-zontal differentiation in export markets. Journal of International Economics 93 (1): 50-66.

- Dixit, A. K. and Stiglitz, J. E. (1977). Monopolistic competition and optimum product diversity. American Economic Review 67: 297-308.
- European Central Bank (2014). Micro-based evidence of EU competitiveness: The CompNet database. ECB Working Paper Series 1634, Competitiveness Research Network, Frankfurt am Main.
- European Commission (2011). Product Market Review 2010-2011: The microeconomic roots of growth performance and trade competitiveness in the EU. European Economy 8.
- Fajgelbaum, P., Grossman, G. M. and Helpman, E. (2011). Income distribution, product quality, and international trade. Journal of Political Economy 119: 721 - 765.
- Fagerberg, J. (1988). International competitiveness. Economic Journal, 98(391): 355-74.
- Feenstra, R. C. and Romalis, J. (2014). International Prices and Endogenous Quality. The Quarterly Journal of Economics 129(2): 477-527.
- Feenstra, R. C. and Weinstein, D. E. (2010). Globalization, markups, and the U.S. price level. National Bureau of Economic Research Working Papers 15749.
- Foster, L., Haltiwanger, J. and Syverson, C. (2016). The Slow Growth of New Plants: Learning about Demand? Economica 83: 91-129.
- Foster, L., Haltiwanger, J. and Syverson, C. (2008). Reallocation, firm turnover, and efficiency: selection on productivity or profitability? American Economic Review 98: 394-425.
- Gaulier G., Santoni, G., Taglioni, D. and Zignago, S. (2013). Market shares in the wake of the global crisis: The quarterly export competitiveness database, Banque de France Working Paper 472.
- Henn, C., Papageorgiou, C. and Spatafora, N. (2013). Export Quality in Developing Countries. IMF Working Papers 13/108.
- Hummels, D. and Klenow, P. J. (2005). The variety and quality of a nation's exports. American Economic Review 95: 704-723.
- Kaldor, N. (1978). The Effect of Devaluations on Trade in Manufactures. Further Essays on Applied Economics, Duckworth: 99-118.
- Kee, H. L. and Krishna, K. (2008). Firm-level heterogeneous productivity and demand shocks: Evidence from Bangladesh. American Economic Review 98: 457-462.
- Khandelwal, A. (2010). The long and short (of) quality ladders. Review of Economic Studies 77: 1450-1476.
- Krugman, P. R. (1980). Scale economies, product differentiation, and the pattern of trade. American Economic Review 70: 950-959.
- Krugman, P. R. (1979). Increasing returns, monopolistic competition, and international trade. Journal of International Economics 9: 469-479.
- Kugler, M. and Verhoogen, E. (2012). Prices, Plant Size, and Product Quality. Review of Economic Studies 79(1): 307-339.
- Lancaster, K. J. (1979). Variety, Equity and Efficiency. Oxford: Basil Blackwell.
- Manova, K. and Zhang, Z. (2012). Export prices across firms and destinations. Quarterly Journal of Economics 127: 379-436.

- Melitz, M. J. (2003). The impact of trade on intra-industry reallocations and aggregate industry productivity. Econometrica 71: 1695-1725.
- Melitz, M. J. and Ottaviano, G. I. P. (2008). Market size, trade, and productivity. Review of Economic Studies 75: 295-316.
- Ottaviano, G. I. P., Tabuchi, T. and Thisse, J.-F. (2002). Agglomeration and trade revisited. International Economic Review 43: 409-436.
- Vandenbussche, H. (2014). Quality in Exports. European Economy, Economic Papers 528, Directorate General Economic and Monetary Affairs (DG ECFIN), European Commission.

Figure 1: *Identification strategy for quality (α_s), selling capacity ($\beta_{s,i}$) and substitutability (γ) at the product, variety and market level.*



Varieties: s, s';

Market: i;

Consumer preferences for s in i:

$$U_{s,i} = \int_{s\in S_i} \alpha_s q_{s,i} ds - \int_{s\in S_i} \frac{\beta_{s,i}}{2} q_{s,i}^2 ds - \frac{\gamma}{2}\left[\int_{s\in S_i} q_{s,i} ds\right]^2 + q_0$$

Observables:

- $q_{s,i}$: quantities sold of s in i;
- $p_{s,i}$: price of s in i;
- $c_{s,i}$: marginal cost of s in i;
- Q_i: total quantities sold in i;

Demand parameters to estimate:

- $\boldsymbol{\alpha_s}$: quality of s;
- $\boldsymbol{\beta_{s,i}}$: selling capacity of s in i;
- $\boldsymbol{\gamma}$: product substitutability;

Intermediate estimates:

- $\tilde{p}_i$: average price in i;
- $\tilde{c}_i$: average marginal cost in i;
- $\tilde{\alpha}_i$: average quality in i;
- $\Delta\alpha_{s,i-s',i}$: quality differences in i.

Figure 2: *Visual representation of the inverse demand function and role of each parameter in the model.*

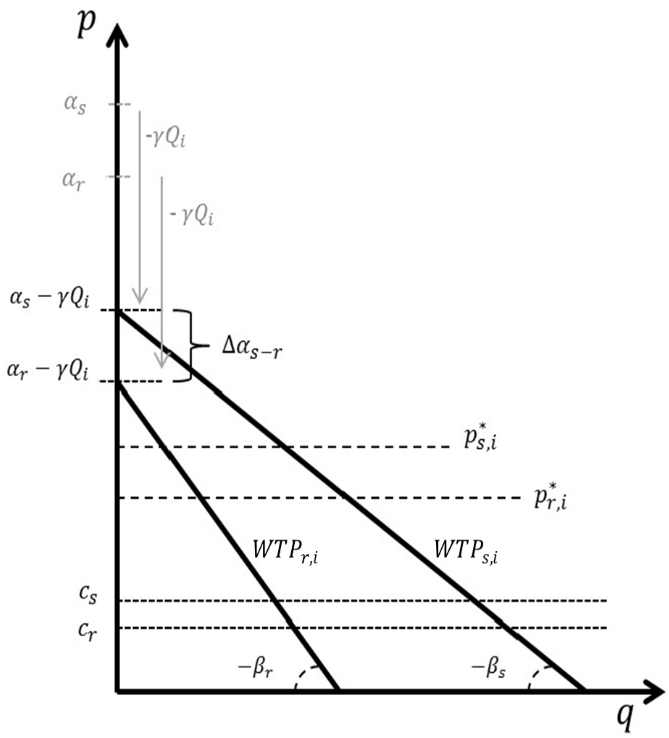
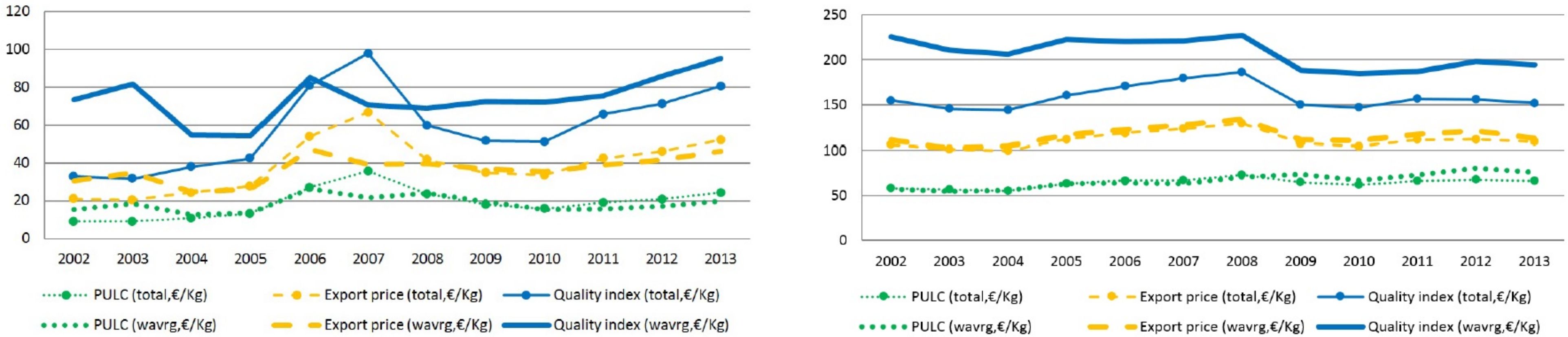


Figure 3: Physical unit labour costs (PULC), quality and export prices of Latvian and Finnish exports.

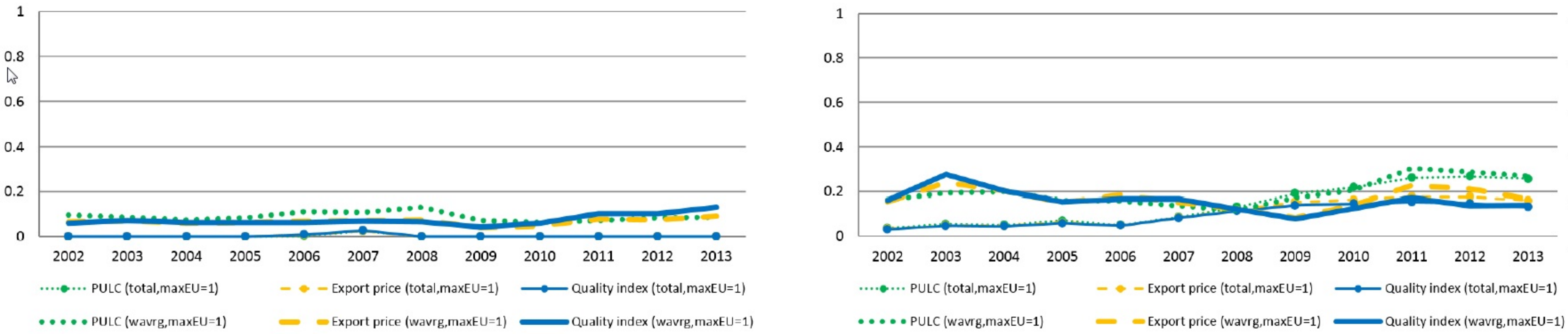
(a) Latvia (b) Finland



Source: Author's calculations based on Eurostat COMEXT and AMECO data. Note: "Wavrg" parameters are corrected for export composition by measuring them at a product level and then aggregating them by weighting each product by its share in total exports (in values). "Total" parameters are just computed using the Eurostat category "total" as an individual product.

Figure 4: Physical unit labour costs (PULC), quality and export prices of Latvian and Finnish exports, normalised between 0 and 1.

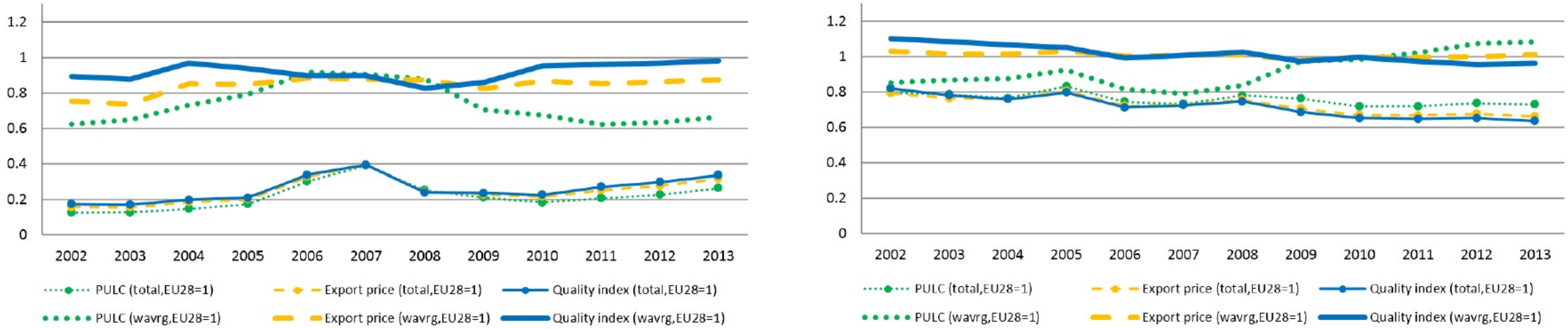
(a) Latvia (b) Finland



Source: Author's calculations based on Eurostat COMEXT and AMECO data. Note: "Wavrg" parameters are corrected for export composition by measuring them at a product level and then aggregating them weighting each product by its share in total exports (in values). "Total" parameters are just computed using the Eurostat category "total" as an individual product. For each product, values are rescaled for the 28 country varieties between 0 and 1.

Figure 5: *Evolution of ULC, quality and export prices of Latvian and Finnish exports as compared to the EU28 average.*

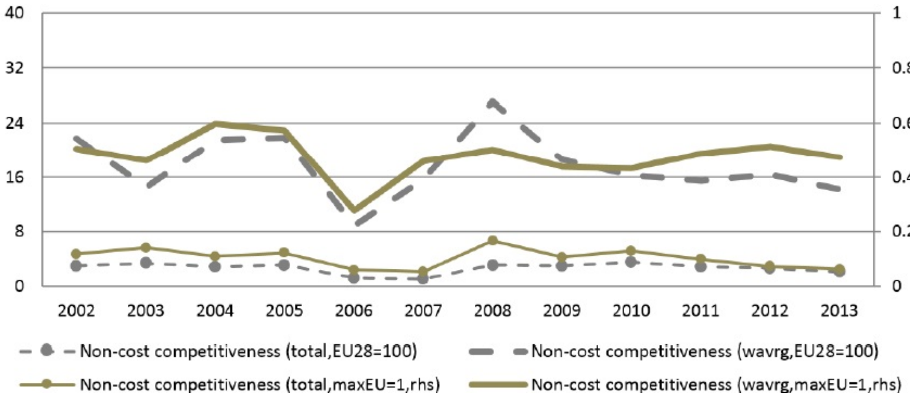
(a) Latvia (b) Finland



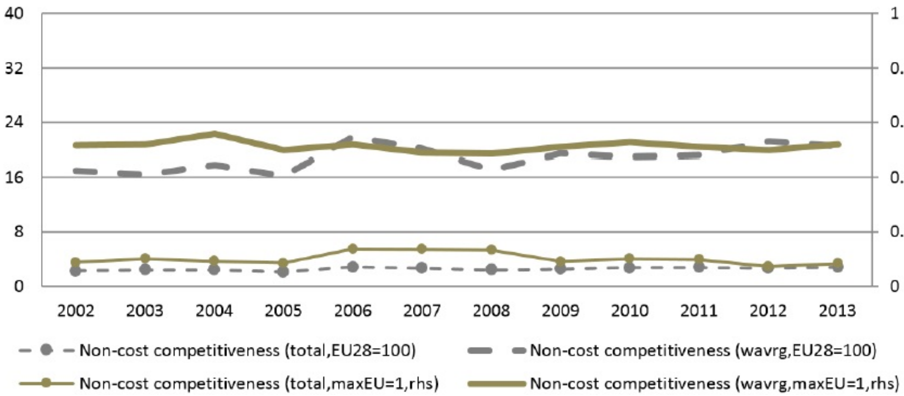
Source: Author's calculations based on Eurostat COMEXT data. Note: EU28 average values=1. "Wavrg" parameters are corrected for export composition by measuring them at a product level and then aggregating them by weighting each product by its share in total exports (in values). "Total" parameters are just computed using the Eurostat category "total" as an individual product.

Figure 6: Evolution of selling capacity of Latvian and Finnish exports as compared to EU28 total.

(a) Latvia



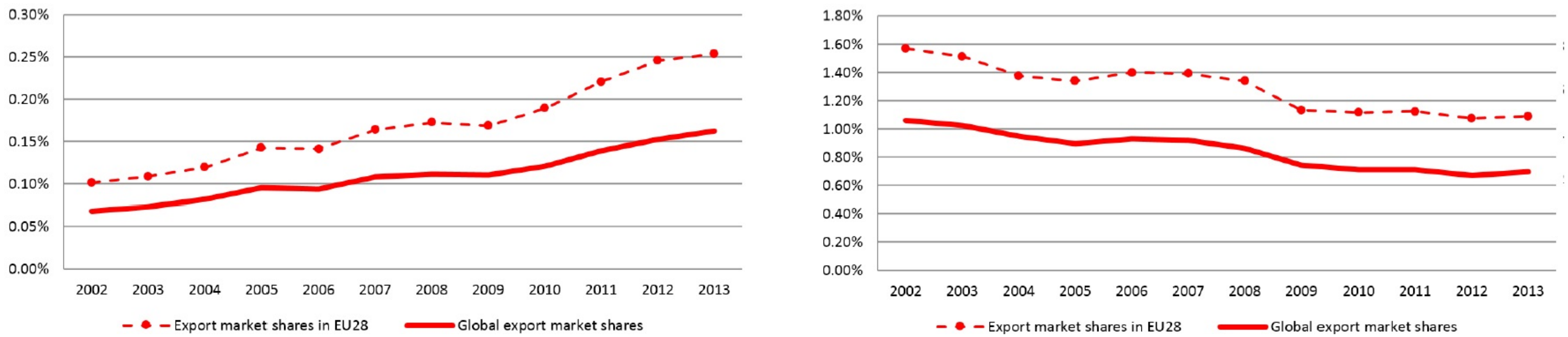
(b) Finland



Source: Author's calculations based on Eurostat COMEXT data. Note: EU28 total values=100. "Wavrg" parameters are corrected for export composition by measuring them at a product level and then aggregating them by weighting each product by its share in total exports (in values). "Total" parameters are just computed using the Eurostat category "total" as an individual product.

Figure 7: Evolution of market shares of Latvian and Finnish intra-EU exports as compared to total intra-EU exports.

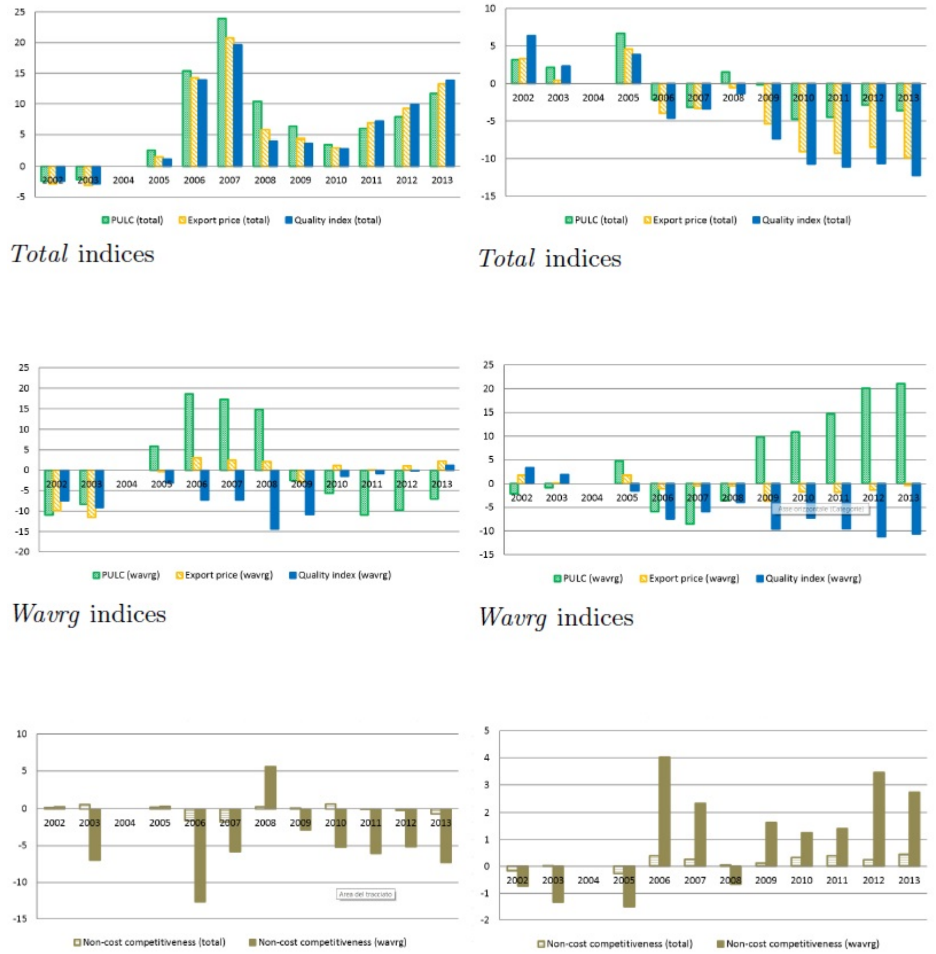
(a) Latvia (b) Finland



Source: Author's calculations based on Eurostat COMEXT data. Note: EU28 average values=1. "Wavrg" parameters are corrected for export composition by measuring them at a product level and then aggregating them by weighting each product by its share in total exports (in values). "Total" parameters are just computed using the Eurostat category "total" as an individual product.

Figure 8: Percentage point changes in Latvian-to-EU28 and Finnish-to-EU28 ratios with respect to 2004 values for PULC, export prices, quality and selling capacity.

(a) Latvia (b) Finland



Total indices — *Total* indices

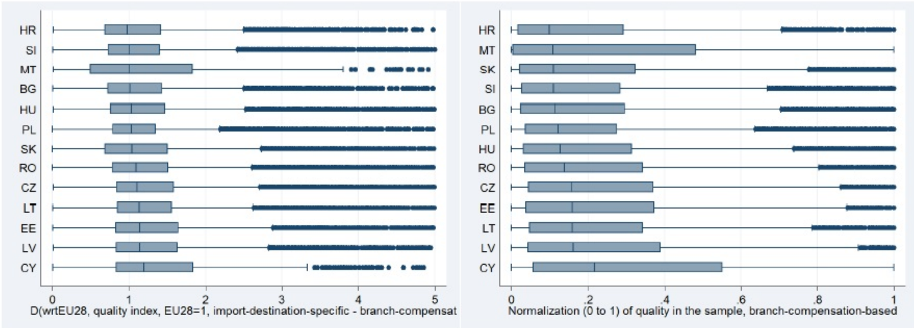
Wavrg indices — *Wavrg* indices

Total and *wavrg* selling capacity — *Total* and *wavrg* selling capacity

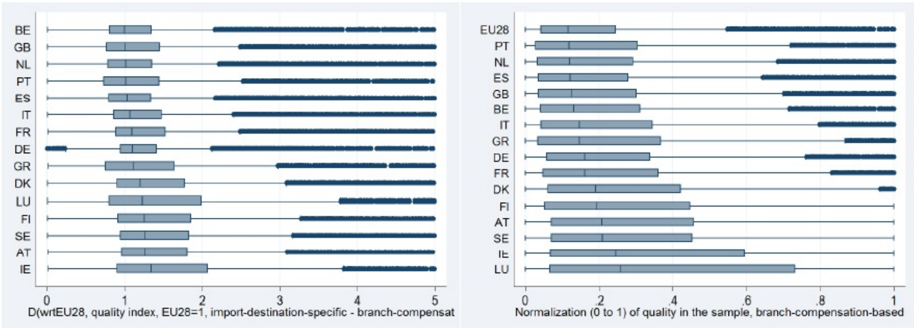
Source: Author's calculations based on Eurostat COMEXT data. Note: in every period the difference is reported between the country-to-EU28 ratios in the year considered and country-to-EU28 ratios of the same parameter in 2004. "Wavrg" parameters are corrected for export composition by measuring them at a product level and then aggregating them by weighting each product by its share in total exports (in values). "Total" parameters are computed using the category "total" as an individual product.

Figure 9: Product quality index distributions in EU28 countries.

(a) Product quality index compared to EU28=1 (b) Product quality index normalised from 0 to 1



EU13 countries EU13 countries

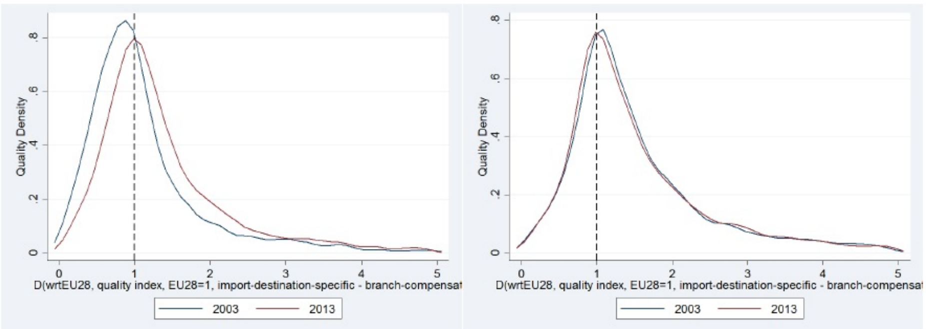


EU15 countries EU15 countries

Source: Author's calculations based on Eurostat COMEXT data. Note: country-product quality index values for each exported product are normalised to EU28=1 on the left panes and from 0 to 1 on the right panes. The values of each export product in each country are sorted from the lowest to the highest, reporting in the core of the plot the 25th, 50th and 75th percentile of the distribution.

Figure 10: Kernel density of product quality index distributions compared to EU28=1.

(a) Latvia (b) Finland



Source: Author's calculations based on Eurostat COMEXT data. Note: country-product quality index values are normalised to EU28=1. The values of each export product in Latvia and Finland are sorted from the lowest to the highest, plotting the Kernel distribution of the resulting histogram, with the density of the distribution estimated in 50 points of the country sample.

Annex A.1 - Branch-to-Product (CN2) conversion table

In the following table is shown how branch-level unit labour costs (ULCs) derived from Gross Value Added and Compensation of employees have been allocated to the different CN2 product categories in order to obtain the product-level physical unit labour costs (PULCs) used in the analysis. Higher levels of product disaggregation (CN4, CN6, CN8) follow the corresponding CN2 ULC.

AMECO branches (following NACE) (rev.1 sections)	CN2 product code	Product description
Agriculture, forestry and fishing (A+ B)	1	LIVE ANIMALS
Agriculture, forestry and fishing (A + B)	2	MEAT AND EDIBLE MEAT OFFAL
Agriculture, forestry and fishing (A + B)	3	FISH AND CRUSTACEANS, MOLLUSCS AND OTHER AQUATIC INVERTEBRATES
Agriculture, forestry and fishing (A + B)	4	DAIRY PRODUCE; BIRDS' EGGS; NATURAL HONEY; EDIBLE PRODUCTS OF ANIMAL ORIGIN, NOT ELSEWHERE SPECIFIED OR
Agriculture, forestry and fishing (A + B)	5	PRODUCTS OF ANIMAL ORIGIN, NOT ELSEWHERE SPECIFIED OR INCLUDED
Agriculture, forestry and fishing (A + B)	6	LIVE TREES AND OTHER PLANTS; BULBS, ROOTS AND THE LIKE; CUT FLOWERS AND ORNAMENTAL FOLIAGE
Agriculture, forestry and fishing (A + B)	7	EDIBLE VEGETABLES AND CERTAIN ROOTS AND TUBERS
Agriculture, forestry and fishing (A + B)	8	EDIBLE FRUIT AND NUTS; PEEL OF CITRUS FRUIT OR MELONS
Agriculture, forestry and fishing (A + B)	9	COFFEE, TEA, MATE AND SPICES
Agriculture, forestry and fishing (A + B)	10	CEREALS
Agriculture, forestry and fishing (A + B)	11	PRODUCTS OF THE MILLING INDUSTRY; MALT; STARCHES; INULIN; WHEAT GLUTEN
Agriculture, forestry and fishing (A + B)	12	OIL SEEDS AND OLEAGINOUS FRUITS; MISCELLANEOUS GRAINS, SEEDS AND FRUIT; INDUSTRIAL OR MEDICINAL PLANTS
Agriculture, forestry and fishing (A + B)	13	LAC; GUMS, RESINS AND OTHER VEGETABLE SAPS AND EXTRACTS
Agriculture, forestry and fishing (A + B)	14	VEGETABLE PLAITING MATERIALS; VEGETABLE PRODUCTS NOT ELSEWHERE SPECIFIED OR INCLUDED
Agriculture, forestry and fishing (A + B)	15	ANIMAL OR VEGETABLE FATS AND OILS AND THEIR CLEAVAGE PRODUCTS; PREPARED EDIBLE FATS; ANIMAL OR VEGETAB
Manufacturing (D)	16	PREPARATIONS OF MEAT, OF FISH OR OF CRUSTACEANS, MOLLUSCS OR OTHER AQUATIC INVERTEBRATES

Manufacturing (D)	17	SUGARS AND SUGAR CONFECTIONERY
Manufacturing (D)	18	COCOA AND COCOA PREPARATIONS
Manufacturing (D)	19	PREPARATIONS OF CEREALS, FLOUR, STARCH OR MILK; PASTRYCOOKS' PRODUCTS
Manufacturing (D)	20	PREPARATIONS OF VEGETABLES, FRUIT, NUTS OR OTHER PARTS OF PLANTS
Manufacturing (D)	21	MISCELLANEOUS EDIBLE PREPARATIONS
Manufacturing (D)	22	BEVERAGES, SPIRITS AND VINEGAR
Manufacturing (D)	23	RESIDUES AND WASTE FROM THE FOOD INDUSTRIES; PREPARED ANIMAL FODDER
Manufacturing (D)	24	TOBACCO AND MANUFACTURED TOBACCO SUBSTITUTES
Industry, including energy (C + D + E)	25	- SALT; SULPHUR; EARTHS AND STONE; PLASTERING MATERIALS, LIME AND CEMENT
Industry, including energy (C + D + E)	26	ORES, SLAG AND ASH
Industry, including energy (C + D + E)	27	MINERAL FUELS, MINERAL OILS AND PRODUCTS OF THEIR DISTILLATION; BITUMINOUS SUBSTANCES; MINERAL WAXES
Manufacturing (D)	28	INORGANIC CHEMICALS; ORGANIC OR INORGANIC COMPOUNDS OF PRECIOUS METALS, OF RARE-EARTH METALS, OF RADIO
Manufacturing (D)	29	ORGANIC CHEMICALS
Manufacturing (D)	30	PHARMACEUTICAL PRODUCTS
Manufacturing (D)	31	FERTILISERS
Manufacturing (D)	32	TANNING OR DYEING EXTRACTS; TANNINS AND THEIR DERIVATIVES; DYES, PIGMENTS AND OTHER COLOURING MATTER;
Manufacturing (D)	33	ESSENTIAL OILS AND RESINOIDS; PERFUMERY, COSMETIC OR TOILET PREPARATIONS
Manufacturing (D)	34	SOAP, ORGANIC SURFACE-ACTIVE AGENTS, WASHING PREPARATIONS, LUBRICATING PREPARATIONS, ARTIFICIAL WAXES
Manufacturing (D)	35	ALBUMINOIDAL SUBSTANCES; MODIFIED STARCHES; GLUES; ENZYMES
Manufacturing (D)	36	EXPLOSIVES; PYROTECHNIC PRODUCTS; MATCHES; PYROPHORIC ALLOYS; CERTAIN COMBUSTIBLE PREPARATIONS
Manufacturing (D)	37	PHOTOGRAPHIC OR CINEMATOGRAPHIC GOODS
Manufacturing (D)	38	MISCELLANEOUS CHEMICAL PRODUCTS
Manufacturing (D)	39	PLASTICS AND ARTICLES THEREOF
Manufacturing (D)	40	RUBBER AND ARTICLES THEREOF
Manufacturing (D)	41	RAW HIDES AND SKINS (OTHER THAN FURSKINS) AND LEATHER
Manufacturing (D)	42	ARTICLES OF LEATHER; SADDLERY AND HARNESS; TRAVEL GOODS, HANDBAGS AND SIMILAR CONTAINERS; ARTICLES OF
Manufacturing (D)	43	FURSKINS AND ARTIFICIAL FUR; MANUFACTURES THEREOF

Manufacturing (D)	44	WOOD AND ARTICLES OF WOOD; WOOD CHARCOAL
Manufacturing (D)	45	CORK AND ARTICLES OF CORK
Manufacturing (D)	46	MANUFACTURES OF STRAW, OF ESPARTO OR OF OTHER PLAITING MATERIALS; BASKETWARE AND WICKER-WORK
Manufacturing (D)	47	PULP OF WOOD OR OF OTHER FIBROUS CELLULOSIC MATERIAL; RECOVERED (WASTE AND SCRAP) PAPER OR PAPERBOARD
Manufacturing (D)	48	PAPER AND PAPERBOARD; ARTICLES OF PAPER PULP, OF PAPER OR OF PAPERBOARD
Manufacturing (D)	49	PRINTED BOOKS, NEWSPAPERS, PICTURES AND OTHER PRODUCTS OF THE PRINTING INDUSTRY; MANUSCRIPTS
Manufacturing (D)	50	SILK
Manufacturing (D)	51	WOOL, FINE OR COARSE ANIMAL HAIR; HORSEHAIR YARN AND WOVEN FABRIC
Manufacturing (D)	52	COTTON
Manufacturing (D)	53	OTHER VEGETABLE TEXTILE FIBRES; PAPER YARN AND WOVEN FABRICS OF PAPER YARN
Manufacturing (D)	54	MAN-MADE FILAMENTS; STRIP AND THE LIKE OF MAN-MADE TEXTILE MATERIALS
Manufacturing (D)	55	MAN-MADE STAPLE FIBRES
Manufacturing (D)	56	WADDING, FELT AND NONWOVENS; SPECIAL YARNS; TWINE, CORDAGE, ROPES AND CABLES AND ARTICLES THEREOF
Manufacturing (D)	57	CARPETS AND OTHER TEXTILE FLOOR COVERINGS
Manufacturing (D)	58	SPECIAL WOVEN FABRICS; TUFTED TEXTILE FABRICS; LACE; TAPESTRIES; TRIMMINGS; EMBROIDERY
Manufacturing (D)	59	IMPREGNATED, COATED, COVERED OR LAMINATED TEX-TILE FABRICS; TEXTILE ARTICLES OF A KIND SUITABLE FOR IND
Manufacturing (D)	60	KNITTED OR CROCHETED FABRICS
Manufacturing (D)	61	ARTICLES OF APPAREL AND CLOTHING ACCESSORIES, KNITTED OR CROCHETED
Manufacturing (D)	62	ARTICLES OF APPAREL AND CLOTHING ACCESSORIES, NOT KNITTED OR CROCHETED
Manufacturing (D)	63	OTHER MADE-UP TEXTILE ARTICLES; SETS; WORN CLOTHING AND WORN TEXTILE ARTICLES; RAGS
Manufacturing (D)	64	FOOTWEAR, GAITERS AND THE LIKE; PARTS OF SUCH ARTICLES
Manufacturing (D)	65	HEADGEAR AND PARTS THEREOF
Manufacturing (D)	66	UMBRELLAS, SUN UMBRELLAS, WALKING STICKS, SEAT-STICKS, WHIPS, RIDING-CROPS AND PARTS THEREOF
Manufacturing (D)	67	PREPARED FEATHERS AND DOWN AND ARTICLES MADE OF FEATHERS OR OF DOWN; ARTIFICIAL FLOWERS; AR-TICLES OF H

Manufacturing (D)	68	ARTICLES OF STONE, PLASTER, CEMENT, ASBESTOS, MICA OR SIMILAR MATERIALS
Manufacturing (D)	69	CERAMIC PRODUCTS
Manufacturing (D)	70	GLASS AND GLASSWARE
Manufacturing (D)	71	NATURAL OR CULTURED PEARLS, PRECIOUS OR SEMI-PRECIOUS STONES, PRECIOUS METALS
Manufacturing (D)	72	IRON AND STEEL
Manufacturing (D)	73	ARTICLES OF IRON OR STEEL
Manufacturing (D)	74	COPPER AND ARTICLES THEREOF
Manufacturing (D)	75	NICKEL AND ARTICLES THEREOF
Manufacturing (D)	76	ALUMINIUM AND ARTICLES THEREOF
Manufacturing (D)	78	LEAD AND ARTICLES THEREOF
Manufacturing (D)	79	ZINC AND ARTICLES THEREOF
Manufacturing (D)	80	TIN AND ARTICLES THEREOF
Manufacturing (D)	81	OTHER BASE METALS; CERMETS; ARTICLES THEREOF
Manufacturing (D)	82	TOOLS, IMPLEMENTS, CUTLERY, SPOONS AND FORKS, OF BASE METAL; PARTS THEREOF OF BASE METAL
Manufacturing (D)	83	MISCELLANEOUS ARTICLES OF BASE METAL
Manufacturing (D)	84	NUCLEAR REACTORS, BOILERS, MACHINERY AND MECHANICAL APPLIANCES; PARTS THEREOF
Manufacturing (D)	85	ELECTRICAL MACHINERY AND EQUIPMENT AND PARTS THEREOF; SOUND RECORDERS AND REPRODUCERS, TELEVISIONS
Manufacturing (D)	86	RAILWAY OR TRAMWAY LOCOMOTIVES, ROLLING STOCK AND PARTS THEREOF; RAILWAY OR TRAMWAY TRACK FIXTURES AND
Manufacturing (D)	87	VEHICLES OTHER THAN RAILWAY OR TRAMWAY ROLLING STOCK, AND
Manufacturing (D)	88	AIRCRAFT, SPACECRAFT, AND PARTS THEREOF
Manufacturing (D)	89	SHIPS, BOATS AND FLOATING STRUCTURES
Manufacturing (D)	90	OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING, CHECKING, PRECISION, MEDICAL OR SURGICAL INSTRUMENT
Manufacturing (D)	91	CLOCKS AND WATCHES AND PARTS THEREOF
Manufacturing (D)	92	MUSICAL INSTRUMENTS; PARTS AND ACCESSORIES OF SUCH ARTICLES
Manufacturing (D)	93	ARMS AND AMMUNITION;
Manufacturing (D)	94	FURNITURE; BEDDING, MATTRESSES, MATTRESS SUPPORTS, CUSHIONS AND SIMILAR STUFFED FURNISHINGS; LAMPS AND
Manufacturing (D)	95	TOYS, GAMES AND SPORTS REQUISITES;
Manufacturing (D)	96	MISCELLANEOUS MANUFACTURED ARTICLES
Services (G + P)	97	WORKS OF ART, COLLECTORS’ PIECES AND ANTIQUES
Services (G + P)	98	COMPLETE INDUSTRIAL PLANT

How to obtain EU publications

Our publications are available from EU Bookshop (http://bookshop.europa.eu),
where you can place an order with the sales agent of your choice.

The Publications Office has a worldwide network of sales agents.
You can obtain their contact details by sending a fax to (352) 29 29-42758.

LF-NA-27977-EN-N

JRC Mission

As the Commission's in-house science service, the Joint Research Centre's mission is to provide EU policies with independent, evidence-based scientific and technical support throughout the whole policy cycle.

Working in close cooperation with policy Directorates-General, the JRC addresses key societal challenges while stimulating innovation through developing new methods, tools and standards, and sharing its know-how with the Member States, the scientific community and international partners.

Serving society
Stimulating innovation
Supporting legislation

Publications Office

doi:10.2791/975002

ISBN 978-92-79-59413-7