Export Quality Upgrading Among the New EU Member States? An Application on Czech Republic, Hungary and Poland

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Abstract

This paper uses the model proposed by Khandelwal (2010) to estimate quality of exported manufactured products from a sample of the new EU member states to the EU15 market during the period 2005-2013, namely Czech Republic, Hungary and Poland. The results indicate that all three countries upgraded the quality of their exports to the EU15 market. A type of "catching up" process seems to be taking place as the country with lowest estimated export quality in 2005 displays the highest rate of quality upgrade while the country with highest export quality in 2005 displays the lowest rate of quality upgrade. It is also found that some of the exported products are considered to be of high enough quality by the EU15 consumers while some exported products do not. These are the ones with highest relative quality upgrade, suggesting adjustment to the demand for high quality in EU15.

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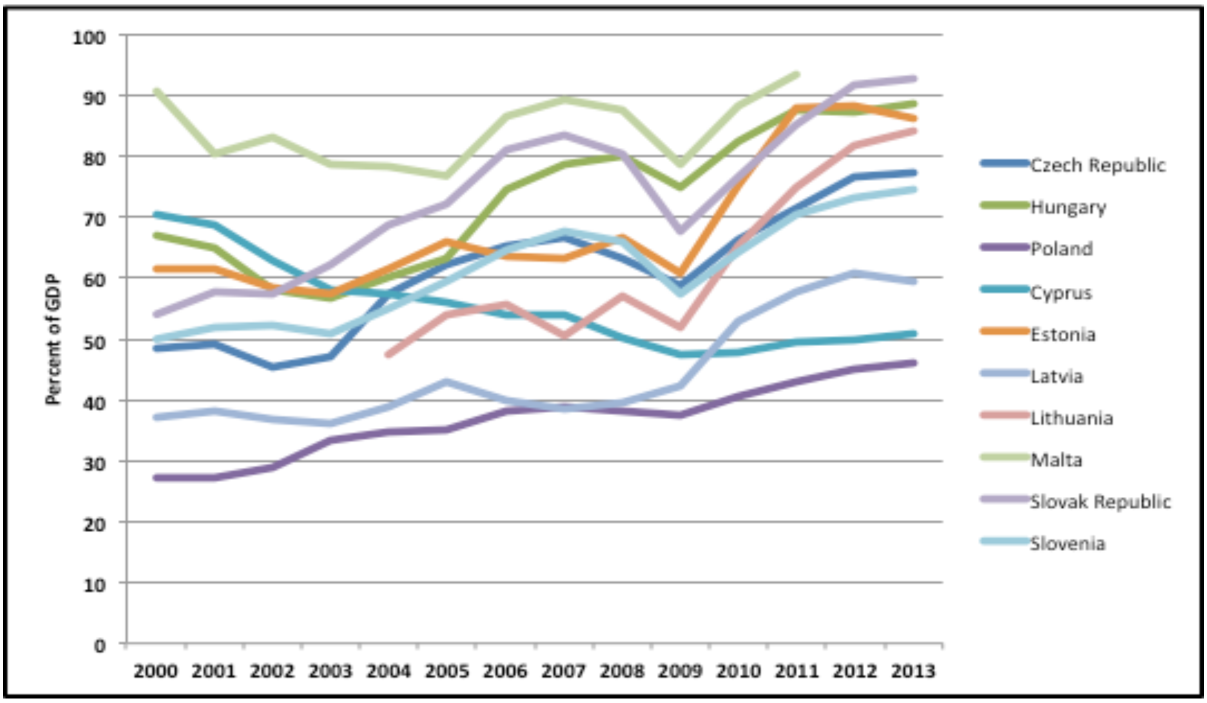
1. Introduction

In 2004 ten states joined the European Union (EU) and enlarged the European Single Market (ESM). The ESM refers to the EU as one territory in which its members enjoy free movement of goods and services, unhindered by regulatory obstacles and internal borders. Since entering EU, exports of goods and services have become an increasingly important part of the new EU member states economies. Figure 1.1 shows how the new member states exports of goods and services as a share of GDP has developed from 2000 to 2013. It can be seen that around the time of accession to the EU in 2004, the share increased for all countries but Cyprus. Despite a drop in 2009, which is probably due to the global financial crisis, export shares have risen steeply until recent years.

Figure 1.1 – Export of goods and services as share of GDP[1]

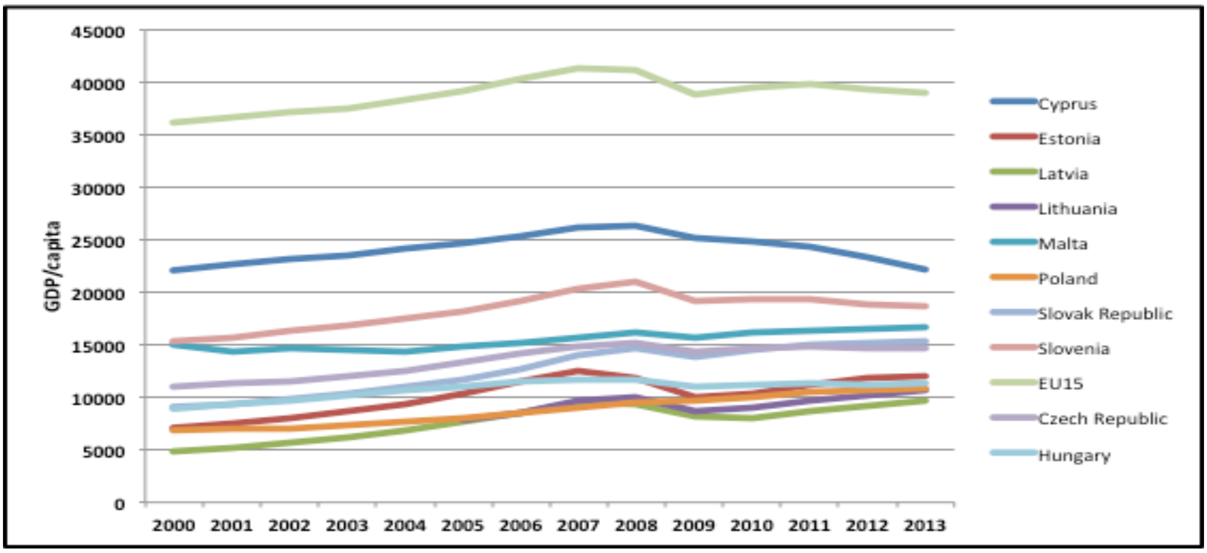


Note: (1) Development of export of goods and services as a percentage of GDP. Source: World Bank data (2015)

In addition, data on exports provided by IMF (2015) reveal that the majority of the new EU member states exports are shipped to the first fifteen member states of the EU[1], henceforth referred to as EU15[2].

A theory developed by Linder (1961) argues that countries with similar demand structures, which are determined by per capita income, will display a more intense trade, with the important implication that richer countries both demand and export higher quality products. The new member states, however, do not have the same level of economic development as the EU15. Figure 1.2 show the GDP per capita for the EU15 and the new EU member states.

Figure 1.2 – GDP per capita in EU[1]



Note: (1) The GDP per capita for EU15 is calculated as the average over the EU15 countries GDP per capita. Source: World Bank data (2015).

Based on this theory and the difference in GDP per capita, trade between the new member states and EU15 should therefore not be that intense. However, the creation of a single market was intended to spur on economic growth for its members by stimulating competition and trade, which leads to improved efficiency and raised quality (European Commission, 2015a). This implies that the new member states have to meet the demand of high quality products in order to be competitive in the EU single market.

[1] See Table A.1 in the appendix

[2] The first 15 member states of EU are: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, and United Kingdom.

Therefore, a question arises on whether the new EU member states can provide a quality level of their products that match the one demanded in EU15 and if the new EU member states have upgraded the quality of their exports to EU15 since they became members.

This paper strives to answer these questions by estimating quality for a sample of the new EU member states, namely Czech Republic, Hungary, and Poland.[3] As a reference China is included in the analysis as they hold the position of second largest trading partner to the EU (European Commission, 2015b).

I use the method proposed by Khandelwal (2010) to estimate quality of the sampled countries export quality to the EU15 market. It is found that all sampled countries indeed upgraded their export quality to the EU15 market during the period 2005-2013. In addition, a "catching up" process seems to be taking place among the sampled new EU member states. The country with lowest estimated quality in 2005 display highest relative rate of quality upgrade while the country with highest estimated quality in 2005 have the lowest relative rate of quality upgrade.

A division is made between varieties that display a positive or a negative relationship between price and market share in the EU15 market. The former are referred to as "normal" as an increased income in EU15 leads to a higher demand for these varieties despite a price increase. The varieties that display a negative relationship between price and demand are referred to as "inferior" as an increased income and higher price leaves demand to fall for these varieties. These findings are explained as the "normal" varieties being deemed to have high enough quality by the EU15 consumers while the "inferior" varieties do not. However, the relative quality upgrade is higher for the "inferior" varieties.

A second method proposed by Di Comite *et al.* (2014) is used to validate the findings from Khandelwal's (2010) method.

The remainder of the paper is structured as follows. Section 2 reviews the literature on quality and trade. Section 3 describes the theoretical models proposed Khandelwal (2010), and Di Comite *et al.* (2014). Section 4 describes the data and empirical implementation for the two methods. Section 5 explains the instrument variables used for Khandelwal's (2010) method. In section 6 the results are described, and section 7 concludes the paper and suggests possible future research in the field.

[3] The reason for not including all the new EU member states from 2004 in the analysis is that the method used to estimate quality relies on bilateral exchange rate as an instrument variable, which will be explained in section 5. Czech Republic, Hungary and Poland are the only new EU member states that are not a part of the euro zone, i.e. they do not have the euro and therefore an observable bilateral exchange rate.

2. Literature overview

The body of literature dealing with intra-industry trade (IIT) and quality has been steadily growing during the last three decades. There is a consensus in the literature concerning the difficulty of measuring quality, as it is an unobserved product characteristic. Here follows some findings in the field.

Product differentiation can be either horizontal or vertical. A paper by Greenway *et al.* (1994) deals explicitly with identifying vertical and horizontal IIT in the UK in 1988 and further examines to what extent country-specific factors effects horizontal and vertical IIT in the UK trade. It is found that about two thirds of the IIT in the UK trade is vertical, suggesting that quality factors play an important role in UK trade. The authors further find that horizontal and vertical IIT differ in importance depending on country type of trade partner. Implications for vertical and horizontal IIT due to membership of the European Community is tested and it is found that such membership has positive effect on both horizontal and vertical IIT. No support for the classic trade theory of relative factor endowments is found but rather that demand and trade react positive to similarity in countries as Linder (1961) proposed.

Schott (2004) examines highly disaggregated US import data for the period 1972-1994 and finds that countries relative factor endowments do not result in specialization across products, as would be expected according to traditional trade theory such as the Heckscher-Ohlin theorem, but rather to specialization within products. He shows that capital- and skill abundant countries, typically with a high level of income, produce the higher quality varieties within a product and can therefore ask a higher price relative to more labor abundant countries. The latter typically have a lower level of income and produce lower quality varieties of the same product. These findings can serve as an explanation to why developed economies both produce and export in industries often related to developing countries, such as apparel and textiles. Schott (2004) also finds that high-wage countries shift their production towards more capital and skill intensive activities *within* industries as they become more exposed to labor-intensive imports from low-wage countries.

A study by Krishna and Maloney (2011) that also uses unit values as a measure for quality, finds in accordance with Schott (2004) a positive relationship between a country's income and export quality. The analysis covers US import data over the period 1990-2000 for two groups, namely OECD countries in the first group and non-OECD countries in the second. The authors also find that the initial relative quality of exported goods across countries, and across goods exported from a country display a high level of heterogeneity, and further that the rate of quality upgrading varies substantially across countries. It is shown that the higher income group of the analysis, the OECD countries, has the fastest rate at which the unit values of their exports increase. As the OECD countries also have a higher initial quality level of their products, this suggest an increasing "divergence" in product quality between the two groups. Krishna and Maloney (2011) explain the quality divergence between OECD countries and non-OECD countries partially by the mix of products the OECD countries export, implying that the type of products being exported matters for quality growth, which is consistent with the findings of Hausmann *et al.* (2007).

Kugler and Verhoogen (2012) expand the literature on heterogeneous firms and quality choice by investigating product level heterogeneity in Columbia. Their data covers the period 1984-2005 and consists of prices and quantities of all inputs used by manufacturing plants employing 10 or more workers, and prices and quantities of all output. To proxy for scope of quality differentiation the authors use advertising- and R&D expenditures. They rely on the framework proposed by Melitz (2003) and extend it to incorporate endogenous choice of input and output quality. They find that larger plants, where size is measured by gross output, have higher output prices, and further, that there exists a positive correlation between input price and plant size. It is also found that as the scope of quality differentiation increases so do the elasticities of plant size-output price, and plant size-input price. This suggests that more "capable", bigger plants purchase the more expensive high-quality inputs to produce output of higher quality and hence charge a higher price.

Building on these findings, Bas and Strauss-Kahn (2015) analyse the effect of input-trade liberalization in China for the period 2000-2006. In 2001 China joined the World Trade Organization (WTO), which resulted in decreased tariffs. Further, China provides a natural control group as they have a dual trade regime, meaning that firms who import inputs used for products that are solely intended for the export market are exempted from paying tariffs and has been so since 1979. These firms have "processing" status. All other "ordinary" firms need to pay tariffs. The analysis only covers domestic Chinese firms of both types and leave out foreign owned companies. It is found that firms import a wider range of input varieties due to trade liberalization and that the "ordinary" firms raise their export prices, and more so if the inputs originate from the most developed countries and the output is exported to high income countries. The findings suggest that trade liberalization hence leads firms to upgrade the quality of their exported products by upgrading the quality of the inputs used to produce them.

This study adds to demonstrate the positive effect of liberalizing trade may have on export performance. Apart from an increase in the amount of goods produced and exported (see, Bas and Strauss-Kahn, 2014; Goldberg *et al*., 2010), it also leads to an upgrade of product quality.

Many studies dealing with quality and trade rely on analyzing a product's quality by equating it to its unit values. A study by Szczygielski and Grabowski (2012) analyses the appropriateness of measuring quality with unit prices by formulating a "proportionality hypothesis". The two variables, price and quality, are expected to be proportional in equilibrium if prices truly reflect quality. The test of the specified hypothesis is based on an estimation of a demand function where it is assumed that quality is the main factor of differentiation and that prices are the accurate way to measure this effect. It then follows that a marginal change in price should not result in a considerable change in sold quantities as quality is the only non-price determinant of demand, and if price only changed marginally, then quality should also only change marginally. The authors list a range of cases where the proportionality hypothesis is theoretically doubtful; when there is horizontal and asymmetric product differentiation affecting the price, when there is a non-linear utility function, and when there is a non-linear cost function. The hypothesis is then tested empirically on German import data for the period 1994-2009, where it is found that the majority of imports do not show support for the hypothesis, implying that unit prices do not correctly reflect quality.

Khandelwal (2010) relaxes the assumption that price equals quality and uses highly disaggregated US import data that contains information on both quantities and price in order to estimate quality. Controlling for price, varieties with higher market share are assumed to be of higher quality. Quality is estimated for imported manufactured products and then used to construct quality ladders, which is defined as the range of qualities within a product and hence give the scope of quality differentiation within a product market. It is found that the scope of quality differentiation differs widely across products. Khandelwal (2010) uses this finding to explain why low-wage competition affects employment and output in the US differently across different product markets. A market characterized by a long quality ladder is found to have richer countries using their comparative advantages (e.g. better technology, capital and skill) to produce high-quality varieties and hence "shelter" themselves from low-wage competition. In a market characterized by a long quality ladder there is hence "space" for both high-quality and low-quality varieties and therefore the effect of low-wage competition from poorer countries is not that prevalent. On the contrary, a market with a short quality ladder indicates that the scope of quality differentiation is relatively small, which results in a greater exposure to low-wage competition.

To my knowledge no other studies apply Khandelwal’s (2010) method on the EU market to analyze export quality development of its new member states. By doing so I attempt to fill this small gap in the literature on export quality, trade liberalization and assimilation to a trade union.

3. Theoretical model

3.1 - Khandelwal's (2010) method

The model is based on the construction of a demand curve, which is derived from a discrete choice model, following Berry (1994). The unit subject to consumer choice is called *variety* and is defined as a country's export in a given product. Hence, a variety contains information on both a product and its origins. The utility that consumer *i* derive from variety *j* at time *t* is given by

$$U_{i,j,t} = x_{j,t}\beta_i - \alpha p_{j,t} + \xi_{j,t} + \epsilon_{i,j}, \qquad \textbf{(3.1)}$$

where $x_{j,t}$ is a Kx1 vector of variety *j* specific attributes which may change over time, and β_i denotes consumer taste. The second term, $p_{j,t}$ represents the price of variety *j* at time *t*. The terms $\xi_{j,t}$ and $\epsilon_{i,j}$ denote unobserved characteristics of the variety.

The term $\xi_{j,t}$ is referred to as the vertical attribute, i.e. the quality of the variety, which is unobservable. Quality is an attribute valued by all consumers, implying that consumers are willing to pay more for a variety of higher quality, all else equal. This term consist of three different parts:

$$\xi_{j,t} = \xi_j + \xi_t + \Delta\xi_{j,t}, \qquad \textbf{(3.2)}$$

where ξ_j is the time-invariant part of variety $j's$ quality. ξ_t captures time effects common to all varieties at time *t*. The third part, $\Delta\xi_{j,t}$, represents the variety-time deviation from the fixed effects, which is not observed by the researcher but merely by the consumer.

The term $\epsilon_{i,j}$ is the horizontal attribute of variety *j*. The horizontal component is different from the vertical in that consumers value these horizontal product attributes differently. This term explains why a variety with high price and low quality is ever consumed. It is assumed that the error term $\epsilon_{i,j}$ is identically and independently distributed with type 1 extreme values across the consumers *i*. This leads the probability of consumer *i* to choose variety *j* to take a multinomial logit form (Pula and Santabárbara, 2011). Combined with the assumption that there are an infinite number of consumers, the market share for variety *j* at time *t* can then be expressed as

$$S_{j,t} = \frac{exp(x'_{j,t}\beta - \alpha p_{j,t} + \xi_{j,t})}{\sum_{j=1}^{J} exp(x'_{j,t}\beta - \alpha p_{j,t} + \xi_{j,t})}. \qquad \textbf{(3.3)}$$

Taking logs on both sides yields

$$\ln(S_{j,t}) = x'_{j,t}\beta - \alpha p_{j,t} + \xi_{j,t} - \zeta, \qquad \textbf{(3.4)}$$

where

$$\zeta = ln\left(\sum_{j=1}^{J} exp\left(x'_{j,t}\beta - \alpha p_{j,t} + \xi_{j,t}\right)\right). \qquad \textbf{(3.5)}$$

There has to be an option not to consume any of the imported varieties and consume domestic products, or simply not to consume at all. Hence an “outside” variety is needed to control for this. The utility of the outside variety is normalized to zero and this anchors the valuation of the inside varieties (Khandelwal, 2010). The market share of the outside variety is given by

$$S_{0,t} = \frac{exp(0)}{\sum_{j=1}^{J} exp\left(x'_{j,t}\beta - \alpha p_{j,t} + \xi_{j,t}\right)} \qquad \textbf{(3.6)}$$

Taking logs on both sides give

$$ln(S_{0,t}) = 0 - \zeta. \qquad \textbf{(3.7)}$$

Subtracting (3.7) from (3.4) result in

$$ln(S_{j,t}) - ln(S_{0,t}) = x_{j,t}\beta - \alpha p_{j,t} + \xi_{j,t} \qquad \textbf{(3.8)}$$

This model can be used with instrument variables to regress difference in market shares on $x_{j,t}$ and $p_{j,t}$ (Berry, 1994). However, the multinomial logit demand curve (3.8), assumes the same pattern of substitution across all varieties. To account for this limitation I extend (3.8) into a nested logit model. The nested logit model has a strength against the simple logit model (3.8) in that it allows for more reasonable correlation patterns of consumer tastes across varieties. I follow Berry (1994) and Cardell (1997) in the explanation of the nested logit model where the varieties are first grouped into G+1 exhaustive and mutually exclusive sets, g = 0,1,..., G. The outside variety is the only member of group 0. The utility that consumer i derives from variety j in group g is then given by

$$U_{i,j,t} = x_{j,t}\beta - \alpha p_{j,t} + \xi_{j,t} + \varrho_{ig} + (1-\sigma)\epsilon_{i,j} \qquad \textbf{(3.9)}$$

Similar to (3.1) the error term $\epsilon_{i,j}$ is an identically and independently distributed extreme value. For consumer i the term ϱ_{ig} is common to all varieties in group g and has a distribution that depends on σ. The term σ is the substitution parameter and takes a value between zero and one. As σ closes to one, the correlation of consumer taste within a group goes to one. As σ approaches zero the model is once again the standard logit rather than the nested logit. The correlation patterns depend on the grouping of varieties, which needs to be specified prior to the estimation. According to Cardell (1997), the distribution of ϱ_{ig} is the unique distribution with the property that if $\epsilon_{i,j}$ is an extreme value random variable, then the term $\varrho_{ig} + (1-\sigma)\epsilon_{i,j}$ is also an extreme value random variable. In line with Berry (1994), based on the assumptions regarding the distribution of the random component and the transformations made in (3.1) – (3.8), the demand curve

$$ln(S_{j,t}) - ln(S_{0,t}) = x_{j,t}\beta - \alpha p_{j,t} + \sigma(\bar{s}_{j/g,t}) + \xi_{j,t} \qquad \textbf{(3.10)}$$

can be derived. Where $\bar{s}_{j/g,t}$ is the nest share, measured as the import share of variety j in total imports of varieties grouped in to group g. The last term $\xi_{j,t}$ is presumed to be correlated with both $p_{j,t}$ and $\bar{s}_{j/g,t}$ and calls for use of instrument variables in order to remedy for biased and inconsistent OLS estimates (Verbeek, 2012). I will return to a discussion about instrument variables used for this method in section 5.

3.2 – Critique to Khandelwal's (2010) method

Vandenbussche (2014) brings forth some limitations in the method Khandelwal (2010) proposes. Firstly, Vandenbussche (2014) questions the use of the discrete choice framework used in Khandelwal (2010), which according to Anderson *et al.* (1992) is very close to a CES type of demand structure. Such a utility function cannot correctly separate taste and quality from each other in product demand. According to Vandenbussche (2014), a linear demand stemming from a quadratic utility function is the only form of demand structure that can clearly separate horizontal from vertical differentiation.

In addition Vandenbussche (2014) points out that Khandelwal's (2010) approach relies on assigning higher quality to varieties with higher market shares at equal prices. However, market shares can also be affected by other factors, such as taste or preferences. This indicates that Khandelwal's (2010) method could potentially overestimate the effect quality have on market shares.

Secondly Vandenbussche (2014) argues that the variety fixed effects, which is one of the components of the quality measure in Khandelwal (2010), captures both cost and quality effects. According to Khandelwal (2010) a disentanglement of marginal cost and quality is not necessary since higher marginal costs are the only thing that can lead to higher quality in his model. Hence, quality and marginal cost always vary together. However, Vandenbussche (2014) claims that fixed costs are the main underlying source of quality improvement. For that reason variety fixed effects are not optimal to measure quality as they simultaneously capture cost increases, or a combined increase of quality and costs.

Vandenbussche (2014) explains that the "verti-zontal" method proposed by Di Comite *et al.* (2014) accounts for the suggested limitations in Khandelwal (2010) and is therefore a better method for estimating export quality.

3.3 – The verti-zontal model

I follow the model proposed by Vandenbussche (2014), which is based on Di Comite *et al.* (2014), in order to enable a comparison to Khandelwal's (2010) method.

In the verti-zontal model each variety has a unique demand in each destination market, facing varying competition depending on the number of close substitutes in the destination market. A higher number of close substitutes in a market indicate more competition. The model uses a quadratic consumer utility function, which results in a linear demand curve, and further assumes a representative consumer for each destination market with a "love- for-variety". The following demand curve is presented:

$$p_{s,i} = \alpha_s - \beta_{s,i} * q_{s,i} - \gamma * Q_{S,i} \qquad \textbf{(3.11)}$$

where i denotes destination country and s index a certain variety belonging to product category *S*. $p_{s,i}$ is the unit value of variety s in destination country i. α_s is the willingness to pay for variety s and is interpreted as quality, $\beta_{s,i}$ is the linear demand curve slope, γ measures the substitutability between varieties, and $Q_{S,i}$ is the consumption of all other available varieties in product category *S* in market *i*. According to Vandenbussche (2014), $\beta_{s,i}$ can be interpreted as the mismatch in taste between a consumer's ideal variety and the one provided. A steep curve indicates that a variety is not well liked by the consumers in the destination market, and therefore has a small market share. A flat curve suggests the opposite. The parameter γ measures how close or remote varieties are in terms of substitution. The parameter is non-varying because substitutability between varieties in the market does not change. Vandenbussche (2014) explains it as a beer of different brand is a better substitute to a beer than wine is and that this relationship does not change.

Concerning the supply side of the model, constant returns to scale in production are assumed, although firms vary in their costs of producing a variety. The profit maximization problem a firm faces when exporting variety s to country i is then given by

$$Max\pi_s = p_{s,i}q_{s,i} - c_s q_{s,i}, \qquad \textbf{(3.12)}$$

where $p_{s,i}$ is the export price in destination country i for variety *s*, $q_{s,i}$ denotes the corresponding quantity, and c_s is the marginal cost of producing variety s, which does not vary with destination market, i.e. the cost of production is the same, irrespective of destination market. It is important to note that quality and marginal cost are not linked in the model. This translates into the assumption that quality is positively affected by long-term fixed costs, such as R&D expenditures, but not necessarily by marginal costs. The equilibrium price derived from (3.12) is

$$p^*_{s,i} = \frac{\alpha_s + c_s}{2} - \frac{\gamma Q_{S,i}}{2} \qquad \textbf{(3.13)}$$

From (3.13) it is clear that prices in equilibrium increase in both quality and production costs. Vandenbussche (2014) stress the importance of separately accounting for the effect that quality and cost of production have on price. The last term in (3.13) describes how price is affected negatively due to the competition effect in the destination market.

The quantity exported by each firm in equilibrium is given by

$$q^*_{s,i} = \frac{\alpha_s - c_s}{2\beta_{s,i}} - \frac{\gamma Q_{S,i}}{2\beta_{s,i}} = \frac{1}{\beta_{s,i}}\left(p^*_{s,i} - c_s\right) \quad \textbf{(3.14)}$$

Equation (3.14) shows that quantities of variety *s* exported to destination market *i* are increasing in quality but decreasing in marginal costs. The taste parameter $\beta_{s,i}$ can affect quantities shipped either positively or negatively.

Comparing (3.13) and (3.14) it is clear that quality enters both equations while taste only affects quantities exported. The consumers willingness to pay in destination market *i* is not affected by taste while quantities sold are. Quality on the other hand, does affect the willingness to pay. Hence, both taste and quality are needed to explain market shares in destination market *i.*

The verti-zontal model strives to separately identify quality from taste. Equation (3.13) can be rewritten in the following way to identify just quality:

$$\alpha_s - \gamma Q_{S,i} = 2p^*_{s,i} - c_s. \quad \textbf{(3.15)}$$

Inspecting (3.15) it is clear that identifying quality levels of each variety, α_s, requires data on γ, the substitutability parameter, which is not readily available. However, based on (3.15) it is possible to calculate quality ranks within each product, i.e. rank varieties quality against one another. In order to rank two varieties of a product, *s* and *r*, in terms of quality I use (3.15) and subtract them from each other. Since both varieties are exported to the same destination market, the subtraction leads the common term $\gamma Q_{S,i}$ to drop out and leaves:

$$(\alpha_s - \alpha_r) = 2\left(p^*_{s,i} - p^*_{r,i}\right) - (c_s - c_r) = \left[\left(2p^*_{s,i} - c_s\right) - \left(2p^*_{r,i} - c_r\right)\right] \quad \textbf{(3.16)}$$

This expression gives the ranking of varieties in terms of quality, relative to each other. It is important to note that this method does not give absolute quality levels but rather varieties relative quality ranking position within a product. The variety with highest quality ranking within a product is that with highest $(2p - c)$.

4. Data and empirical implementation

The aim of this paper is to estimate export quality of products from Czech Republic, Hungary and Poland to the EU15 and to see if they have upgraded their export quality since becoming EU members. This section describes the tools and techniques applied in the paper to estimate quality.

4.1 Hypothesis

Hypothesis: The sampled new EU member states, Czech Republic, Hungary and Poland have upgraded their quality during the period 2005-2013.

4.2 – Khandelwal´s (2010) method

I use the database Comext (2015), which is managed by the statistical division Eurostat of the EU, to collect the data needed for estimations of equation (3.10). The Comext database (2015) provides statistics on value and quantity of goods that are traded between the EU member states (intra-EU trade), and between member states and non-EU member states (extra-EU trade). The information about trade flows is reported monthly by member states and is available on an annual and monthly basis in Comext (2015). Since I consider EU15 as a single market I use the aggregate of all imports to the EU15 countries for my analysis.

The Comext database (2015) provides statistics at the most detailed level available, namely CN8-digit. CN, which is the abbreviation for Combined Nomenclature, is the goods classification system used by the EU for the purposes of foreign trade statistics. The CN8-digit code consists of 8 digits, where each additional digit specifies further details about the good.[4]

I use the EU's Classification of Products by Activity (CPA) system to identify manufactured products. The CPA follows a hierarchal structure where the first level consists of 21 sections identified by an alphabetical code (A to U). Each section contains 23 divisions identified by a two-digit numerical code. Each division contains groups identified by a three-digit code. Further, each group contains classes, which are identified by a four-digit code.

[4] For instance I can make distinctions in a broader category like *T-shirts, singlets and other vests, knitted or crocheted* (CN4-digit code 6109) and specify which material the product is made of. Due to the detailed level I can now say whether the product is made of cotton (CN8-digit code 61091000), of wool,
of man-made fibres (CN8-digit code 61099020), or of other textile materials (CN8-digit code 61099090).

These classes, or CPA four-digit codes correspond to the NACE Rev.2 four-digit codes. NACE Rev.2 is a European classification system of economic activity consisting of 4 digits. I will henceforth use *industry* when referring to a NACE Rev.2 four-digit category. I map the CN8-digit products into industries using correspondence tables provided by Eurostat´s metadata server called Ramon (2015). Table A.2 in the appendix explains the structure and the relationship between the different classifications systems used in this paper by using an example of alarm clock radios.

I restrict the analysis to manufactured products, which correspond to section C of NACE Rev.2. Industries are chosen at random to represent all sectors (two-digit NACE codes). Table A.3 in the appendix shows the distribution of the 53 industries this analysis cover, over the NACE 2- digit sectors.

My database contains 3547 product labels (*g*), which are imported by EU15 from 250 trading partners (*c*) during the period 2005-2013 (*t*). An imported product *g* from country *c* is a variety *j*, i.e. *j*=(*c,g*).

The correlation patterns allowed for by the nested logit model in (3.10) is dependent on the grouping of varieties. The varieties are grouped into nests that are constituted by CN8-digit product labels, i.e. products (*g*). This implies an assumption of consumer preferences being more correlated for varieties within the same product than among varieties between products (Pula and Santabárbara, 2011). For example, a Polish pullover made of cotton is more substitutable with an Hungarian pullover of cotton than a Polish pullover made of wool. In this case pullovers made of cotton constitute one nest and pullovers made of wool constitute a different nest. In order to calculate market shares, information about EU15 consumption in the respective industries is needed. Apparent consumption is defined as

$$AC_k = Y_k + (M_k - X_k) \qquad \textbf{(4.1)}$$

where k subscripts the industry, Y_k is EU15 industrial production in industry k. M_k is EU15 imports to industry k and X_k is EU15 exports from industry k. The data on industrial production is found in Prodcom (2015), a database containing production statistics in EU, also provided by Eurostat. Prodcom (2015) provides detailed information down to 8 digits. However, as in some cases there are several CN8-digit product codes corresponding to the same 8-digit Prodcom code it is impossible to calculate market shares at this detailed level. Instead I look at the 4-digit Prodcom codes, which are the aggregate of the more detailed levels. The 4-digit Prodcom codes correspond to the 4-digit industry codes (see Table A.2 in the appendix). With this information acquired I can now rewrite (3.10) in the following way:

$$ln(S_{j,t}) - ln(S_{0,t}) = \xi_j + \xi_t - \alpha p_{j,t} + \sigma ln(ns_{j,t}) + \Delta\xi_{j,t} \qquad \textbf{(4.2)}$$

where the market share of variety *j*, $S_{j,t}$, is calculated as its imports to EU15 over total EU15 consumption in its respective industry. The market shares are calculated in values, i.e. value of variety *j* imports over value of total consumption in the industry. As the outside variety is the domestic option, the outside variety´s market share, $S_{0,t}$, is calculated as one minus the import penetration of the industry.[5] Note that the term $x_{j,t}\beta$ from (3.10) has been dropped in (4.2). This term describes observable characteristics of variety *j* at time *t*. Since there is no data on variety attributes this term is dropped (Pula and Santábarbara, 2011).

Quality is defined as the sum of ξ_j, ξ_t, and $\Delta\xi_{j,t}$ from (4.2), where ξ_j is the fixed component of quality that does not change over time. This component is captured by running (4.2) with variety fixed effects. The term ξ_t captures shocks at time *t* and is measured by including a year dummy, which captures the time effects. The third component of quality, $\Delta\xi_{j,t}$, is unobserved and functions as the estimation error. Equation (4.2) is based on the assumption that the higher the quality of a variety, the greater market share it has, after controlling for the variety´s relative price.

The term $p_{j,t}$ denotes the unit value, or unit price, of variety *j* at time *t*. The unit price is calculated as the value of variety *j*´s imports over the quantity of variety *j*´s imports. The Comext database (2015) provides statistics on quantity expressed in 100 kg so I divide the unit value by 100 in order to have the unit price expressed as euros per kilo. The values of import provided by Comext (2015) are expressed in euro and in nominal prices. I therefore deflate the calculated unit prices using CPI with base year 2010, obtained from the World Bank database (2015).

The nest share $ns_{j,t}$ controls for substitutability in (4.2). An easily substituted variety which relative price increase will experience a great loss of market share even though its relative quality remains unchanged. Without the nest share to control for this in (4.2), the loss of market share would suggest lower quality estimate. The nest share of variety *j* is calculated as the import value of variety *j* over the total value of imports in the nest, i.e. total imports of

[5] Import penetration is defined as imports over apparent consumption and can be seen as an indication of how well the domestic demand is met by imports.

product g. The nest share should theoretically be calculated as a market share but since no information regarding size of the EU15 market at product level is available, $ns_{j,t}$ is calculated as an import share.

Following Khandelwal (2010) I trim the data to exclude observations with unit values that fall below the 5th percentile or exceed the 95th percentile within the industry. The number of observations and products varies widely over the 53 industries in the sample. For instance, there are 6297 observations and 255 products in the industry *Manufacture of basic iron and steel* (industry code 2410) while for the industry *Manufacture of tobacco products* (industry code 1200) there are only 153 observations and 11 products.

4.3 – Verti-zontal method

In order to rank varieties in terms of quality according to (3.16), unit values and estimates of marginal costs (c) or mark-ups (p-c) at firm-product level are needed. I follow Vandenbussche (2014) in using the "price-cost-method" (PCM) to obtain estimates for mark-ups. The PCM builds on the Lerner index, which is given by (turnover-variable costs)/turnover:

$$PCM_i = \frac{p_i q_i - c_i q_i}{p_i q_i} = \frac{p_i - c_i}{p_i} = 1 - \left({}^{c}/_{p}\right)_i \qquad \textbf{(4.3)}$$

The term $\left({}^{c}/_{p}\right)$ represents the fraction of variable costs per each euro of output. Variable costs are here defined as the sum of material costs and costs of employees, which together with data on turnover, p_i, are obtained from the database ORBIS (2015) provided by Bureau Van Dijk. Unfortunately data from ORBIS (2015) is only available from 2006 onwards and therefore the analysis using the verti-zontal method will cover the period 2006-2013.

China has an accounting system that reports neither material cost nor cost of employees and therefore I follow Vandenbussche (2014) and use "cost of goods sold" over turnover when calculating China's mark-ups. Some concerns can be raised about this as cost of goods sold may include, apart from variable costs, fixed costs and hence lead to overestimation of costs. However, Vandenbussche (2014) claims that when comparing China to countries like the US or Japan, which have similar accounting systems as China, there is no systematic bias present in the cost data that influences China's quality ranking and hence this is not a major limitation in the approach.

ORBIS (2015) provide classification of firms according to industries (NACE Rev.2). The mapping of products to industries is done in the same manner as in Khandelwal's (2010) method, described in section 4.2. However, due to lack of variable cost over turnover data, some industries drop out in the application of the verti-zontal method. Table A.4 in the appendix shows the coverage of industries in the verti-zontal method.

It is important to note that the PCM used does not give mark-ups on firm-product level but instead firm level due to the fact that variable costs are reported on firm level and not available at the more detailed firm-product level. However, as this analysis concerns export quality from countries and not firms, I am interested in country-level products. Therefore, I follow Vandenbussche (2014) and use the variable cost over turnover of each country's median firm per industry. This variable cost over turnover is then used for a country's all varieties that correspond to that industry. The median value is used rather than the mean to remedy for the possible bias that there are typically a larger mass of smaller firms that export compared to larger firms, which could skew the mean variable cost over turnover towards that of smaller firms.

As in Khandelwal's (2010) method, the Comext database (2015) is used to obtain export unit values at country – product (variety) level. When multiplying the expression in (4.3) that has been derived based on firm-level data in the varieties country of origin, with the export unit value that is unique for each variety in each destination; a variety mark-up is obtained for each destination market:

$$Markup_{s,i} = p_{s,i}\left(1 - \frac{c_s}{p_{s,i}}\right) = p_{s,i} - c_s \quad \textbf{(4.4)}$$

I identify the products that are exported by all four countries in both 2006 and 2013, and restrict the analysis to cover only these in order to prevent that a country has a larger fraction of its varieties ranked highest simply because they are the only country exporting the product. This results in 4920 observations in the application of the verti-zontal method.

With the result in (4.4) it is now possible to identify the relative quality of varieties and rank them accordingly as explained in section 3.3.

5. Instrument variables

This section only applies to Khandelwal's (2010) method. As pointed out in section 3.1, both the unit price and the nest share are potentially correlated with the error term, a possibility that calls for the use of instrument variables. Berry *et al.* (1995), suggests the use of rival variety characteristics as instruments for the price coefficient in (4.2). However, information on variety characteristics is not available, and even if it was, Khandelwal (2010) highlights the problem regarding the assumption of exogenous characteristics if firms' choice on price and characteristics happens simultaneously, which is the case in this model.

Another possible instrument for price is transport costs but unfortunately Eurostat does not provide variety-specific transport costs that can serve as instrument for price. Instead I follow Khandelwal (2010) and use country level data to acquire unbiased and consistent estimates of $p_{j,t}$. More specifically the bilateral exchange rate, and an interaction term consisting of bilateral country distance and oil prices that serves as a proxy for transportation cost.

The bilateral exchange rates are taken from the database Statistical Data Warehouse (2015) of the European Central Bank (ECB). The data on bilateral country distance are provided by the database CEPII (2015), which among others provide bilateral country distance measures adjusted for population within in a country.[6] The standard distance measure is between the capitals of two countries. I use the population-adjusted measure to account for the distribution of a population within a country as it can be reasoned that the more populated areas within a country account for a larger fraction of the country´s total manufacturing production. Since the distance measure combined with the oil price makes up a proxy for transportation cost, and the population-adjusted distance measure captures the distribution of production in a country, it is more suitable than the standard distance measure when acting as a proxy for transport costs.

As I treat EU15 as a single market, I use the bilateral population-adjusted distances between country *c* and the EU15-countries and take the average in order to get one distance measure from country *c* to the single market EU15. Oil prices are obtained from U.S. Energy Information Administration database (2015).

[6] The adjusted measure assigns weights to regions within a country based on the share of the population living in that region. The result is a country- specific geographic coordinate that adjusts for population density within a country from which the distance measure to another country is based.

In order to obtain consistent and unbiased estimates for σ, the substitution parameter, I instrument the nest term with two count measures, namely the number of products exported by a country and the number of varieties within a product (nest). These instruments will be uncorrelated with the error term $\Delta\xi_{j,t}$ and correlated with the nest term if entry and exit of the variety occur prior to the exporting firms choice of quality (Khandelwal, 2010). According to Khandelwal (2010) this is a standardized assumption in the literature that deals with estimation of discrete choice demand curves.

Using the instruments described above to account for endogeneity, I estimate (4.2) separately for each of the 53 industries in the sample. As there is heteroscedasticity and autocorrelation present in the data I cluster robust standard errors by variety.

6. Results

6.1 – Regression outputs

Table A.5 in the appendix shows the estimation results for the 53 equations estimated with OLS. 68 percent, or 36 of the 53 estimations display a negative price coefficient and 17 of the estimations (32 percent) displays a positive price coefficient. Table A.6 in the appendix shows the estimations with the instruments described in section 5, where 38 of the estimations displayed a negative price coefficient, corresponding to a figure of 72 percent, and 15 display a positive price coefficient (28 percent).

Table 6.1 presents the summary statistics of Table A.5 and Table A.6 for the estimations with a positive price coefficient.

Table 6.1 - Summary of regression output [1]

Output **Positive price coefficient**	**Mean**	**Median**
OLS		
Price coefficient	0.0120	0.0062
Price coefficient, p-value	0.3985	0.4270
Nest coefficient	0.9634	0.9749
Nest coefficient, p-value [2]	0.0000***	0.0000***
IV		
Price coefficient [3]	0.4804	0.0702
Price coefficient p-value	0.4522	0.3130
Nest coefficient [4]	2.3116	1.351745
Nest coefficient, p-value	0.1753	0.0020***
Overidentification restrictions, p-value [5]	0.2486	0.1582
Observations per equation	1304	1117

Notes: (1) For estimations of equation (4.2) with positive price coefficient and standard errors clustered by variety. (2) Significance at 1 %=***, 5 %=**, 10 %= *. (3) Instruments for price: Exchange rate, distance * oil price. (4) Instruments for nest share: Number of varieties in nest, number of products exported by country *c*. (5) P-value for Sargan-Hansen test of valid instruments. Source: Own calculations

The price coefficient in Table 6.1 can be interpreted as semi-elasticity as the price variable from (4.2) is expressed in absolute values, whilst the left-hand side is in logs. Interpreting the mean OLS price coefficient, it means that a price increase of one euro would lead the market share to increase by 1.2 percent ceteris paribus. The median price estimate is about half that of the mean; a price increase of one euro results in 0.6 percent increase of market share, ceteris paribus. When comparing the OLS price coefficient to the price coefficients estimated with instrument variables, it is clear that the IV price is much higher. This suggests that the bias in the OLS price coefficient leads to an underestimation of the effect price has on market share. When taking a closer look at the mean IV price coefficient it seems to have a suspiciously large effect on the market share. This result can be explained by a few regressions with a relatively large price coefficient that inflates the mean. Consulting Table A.6 in the appendix, it can be seen that the price coefficient for the industries 1013, 1712, 2016 and 2815 stand out and display a much greater price coefficient than the other estimated industries with a positive price coefficient. A comparison of the median OLS price coefficient and median IV price coefficient, which are less sensitive to outliers may therefore be more suitable in this situation.

The OLS nest share has an expected positive effect on the left-hand side of equation (4.2) since the nest share is defined as the import share within a product. Intuitively, a higher share of imports in a product market also means a higher share in the EU15 market. The OLS nest share is expressed in logs and so is the market share on the left-hand side in equation (4.2), meaning that a one percent increase in the nest share leads to a mean increase of market share by 0.96 percent, and a median increase of 0.97 percent, ceteris paribus. Further, the OLS nest share is highly significant but is, as previously explained, endogenous. Comparing the OLS to the instrumented nest share it can be seen that the latter share is higher, implying a downward bias of the OLS nest share. The mean p-value of the IV nest share shows no statistical significance while the median p-value does. A possible explanation of this difference is that some observations with high p-value cause the mean to be higher. A closer inspection of Table A.6 gives evidence for such an explanation.

The p-value of the overidentification in Table 6.1 and Table 6.2 refers to the test statistics of the Sargan-Hansen test. The null hypothesis of the Sargan–Hansen test is that the model is correctly specified and has valid overidentifying restrictions. A failure to reject the null hypothesis indicates that the instruments are valid and independent from the error distribution, i.e. exogenous (Baum, 2006).

Table 6.2 - Summary of regression output [1]

Output Negative price coefficient	Mean	Median
OLS		
Price coefficient	-0.0177	-0.0042
Price coefficient, p-value	0.2694	0.1545
Nest coefficient	0.9501	0.9811
Nest coefficient, p-value [2]	0.0000***	0.0000***
IV		
Price coefficient [3]	-0.4622	-0.1030
Price coefficient p-value	0.2793	0.1625
Nest coefficient [4]	1.6115	1.4644
Nest coefficient, p-value	0.0847*	0.0000***
Overidentification restrictions, p-value [5]	0.3358	0.1261
Observations per equation	1452	1223

Notes: (1) For estimations of (4.2) with negative price coefficient and standard errors clustered by variety. (2) Significance at 1 %=***, 5 %=**, 10 %= *. (3) Instruments for price: Exchange rate, distance * oil price. (4) Instruments for nest share: Number of varieties in nest, number of products exported by country *c*. (5) P-value for Sargan-Hansen test of valid instruments. Source: Own calculations

Table 6.2 presents the equivalent statistics to Table 6.1 for estimations with a negative price coefficient, and the findings are quite similar. The mean OLS price coefficient indicates a loss of market share by 1.77 percent after a price increase of one euro. As in the case for the estimations with a positive price coefficient, neither median nor mean OLS price coefficients in Table 6.2 display any statistical significance. It is however worth noting that the p-value of the mean and median price coefficients in Table 6.2 are closer to the significance threshold of 0.1, than those in Table 6.1.The sizes of the OLS nest coefficients in Table 6.2 are of almost identical size as those in Table 6.1, with same high level of significance.

Similar to Table 6.1, the mean IV price coefficient in Table 6.2 has a much greater impact on the market share than the mean OLS price coefficient, though in this case negative, suggesting that the bias in the OLS underestimates the effect price has on market share. However, just as in Table 6.1, the large mean IV price coefficient in Table 6.2 is caused by a few outliers, as can be seen in Table A.6 in the appendix. The median IV price coefficient therefore gives a more just interpretation of the results.

The mean and median instrumented nest shares in Table 6.2 both show statistical significance and the p-value of the overidentification test assures that the instruments are valid also for the regressions with a negative price coefficient.

6.2 - Why does the sign of price coefficient vary across industries?

According to the law of demand and rational consumer behaviour, an increase in a product´s price should lead to a lower consumer demand for that product, yielding a downward sloping demand curve. A price increase is associated with two effects, namely the substitution effect and the income effect. The income effect constitutes that a price increase of a product decreases the purchasing power of the consumer, which will therefore consume less of the product. The substitution effect means that as the price of a product increases, the consumer substitutes away from that towards substitutes with lower price. Both effects results in a decreased demand as a results of a price increase. This holds for the majority of the regressions in the sample but there is however a number of regressions displaying a positive price coefficient, which hence violates the law of demand.

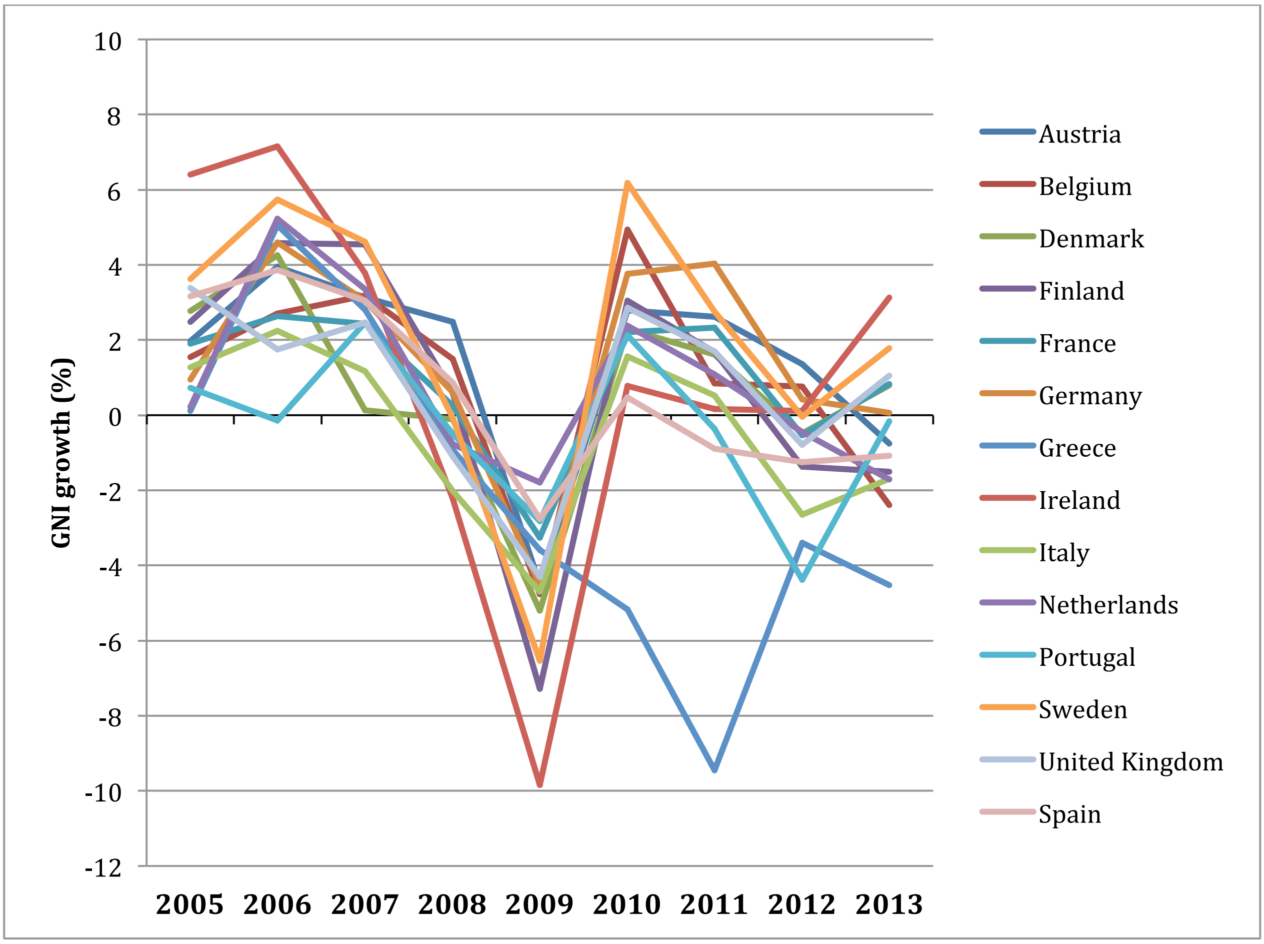
A possible explanation for an upward sloping demand curve is the bandwagon effect proposed by Becker (1991). The bandwagon effect means that a consumer's demand and valuation of a product is higher when that product is highly valued by other consumers, suggesting a mimic consumer behaviour.

Another possible explanation for an observed positive relationship between price and demand, and perhaps the more plausible explanation for this analysis, is the positive effect an increased income has on demand.

Figure 6.1 shows how Gross National Income (GNI) of the EU15 countries developed during the period 2005-2013. The GNI growth is overall positive for the majority of the EU15 countries despite the fact that all experienced a negative GNI growth during the global financial crisis in 2009. The EU15 GNI growth over the considered time period was 0.62 percent[7], which indicates an increasingly higher income in EU15.

[7] The EU15 GNI growth is calculated as the average of all EU15 countries GNI growth (except Luxembourg) over the period 2005-2013.

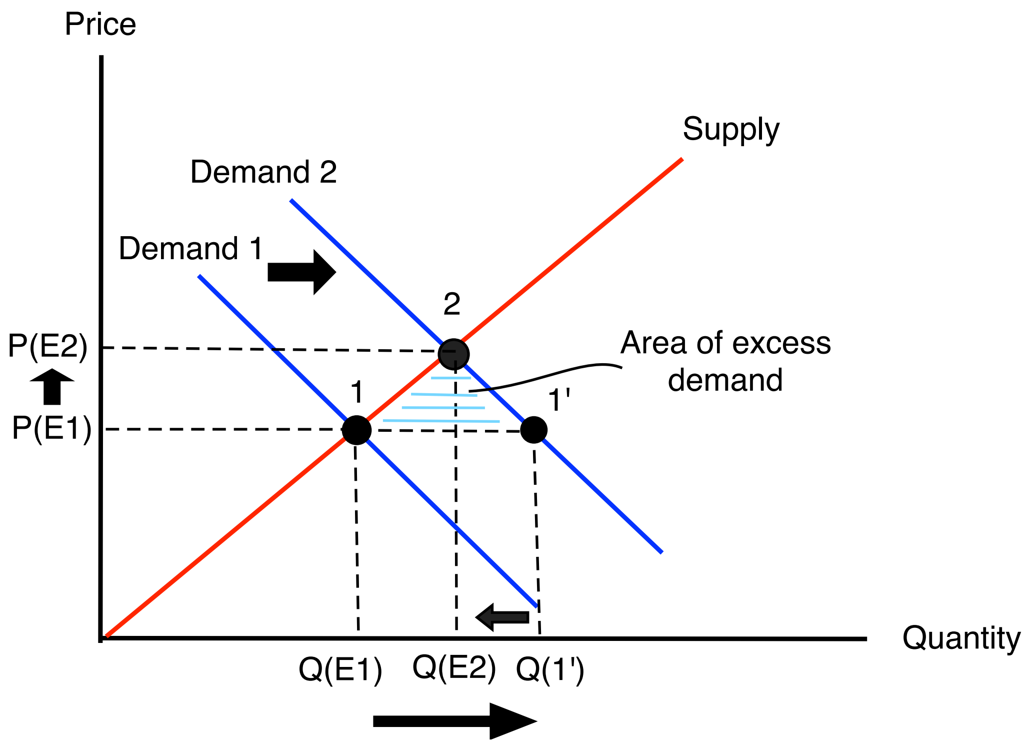
Figure 6.1[1] – EU15 GNI growth



(1) Luxembourg is left out due to lacking data. Source: World Bank Data

Figure 6.2 graphically demonstrates how an increased income shifts the demand curve outwards from an initial equilibrium in point 1. As the demand curve shifts outwards from Demand curve 1 to Demand curve 2, an area of excess demand arises. At price P (E1) the quantity demanded will increase from Q (E1) to Q (1'). Suppliers are not willing to meet the higher demand at price P (E1) and therefore raise the price to the point where equilibrium in point 2 is reached and quantity Q (E2) is demanded at price P (E2). The result of increased income is hence higher price and quantity demanded, which holds for normal products (Black *et al.*, 2012).

Figure 6.2 – Outward demand curve shift



Source: Own illustration

In order to test how the sampled countries market shares react to an increasing EU15 income I add log EU15[8] income to equation (4.2)[9] and find that the average income elasticity for the sampled countries products in industries with an estimated positive price coefficient is 2.05. This means that a one percent increase of EU15 income will lead to an average 2.05 percent higher market share for these products, ceteris paribus. The opposite result is found for products in industries with an estimated negative price coefficient. A one percent increase in EU15 income leads to an average loss in market share of 1.86 percent for these products. The negative income elasticity means that the EU15 consumers consider the products exported by the sampled countries "inferior". These products are hence subject to a combined negative effect on demand due to higher EU15 income and a price increase.

Regarding the "normal" products it seems that the positive effect that a higher EU15 income has on their demand dominates the negative effect of a price increase, yielding a positive relationship between price and demanded quantity for these products.

A third explanation for a positive relationship between a good's demand and price is provided by the theory of a "Giffen good". It is typical for a Giffen good to not have any

[8] Calculated as the average of all 15 countries adjusted net national income, which is provided by World Bank Data (2015).

[9] See column 8 of Table A.6 in the appendix for the income elasticities by industry.

easily available substitutes, resulting in the income effect dominating the substitution effect after a price change. A Giffen good is usually considered as essential, so when the price of the good increase, the consumer must spend a greater fraction of his income to sustain the same level of consumption. A Giffen behavior is expected to be observed among poor consumers that rely heavily on a principal good with few possibilities for substitution (Jensen and Miller, 2008). The situation in which the characteristics of a Giffen behavior arise is far from that in the EU15, which leads the Giffen explanation of a positive relationship between price and demand to be highly implausible in this analysis.

6.3 – Quality estimates

As equation (4.2) is estimated 53 times, one for each industry in the sample, the quality estimates are derived from all of the 53 industries. Table A.7 in the appendix presents the mean and median quality estimates by industry and country for the years 2005 and 2013. On average, all countries in my sample export more products in 2013 than 2005. However, I restrict the analysis of quality estimates to products that are exported by country c in both 2005 and 2013. Hence, I observe the same products in 2013 as in 2005 to investigate how the quality of these export products develop over the considered time period.

A key assumption in the applied method proposed by Khandewahl (2010), is that quality is defined as the sum of three components; a time fixed effect, a variety fixed effect, and a residual. Table A.8 in the appendix presents the statistics of the three components that make up the quality measure by industry and country. The time fixed effect captures effects specific for a year, common to all varieties, which can influence the left-hand side of the equation both positively and negatively. The variety fixed effect is the unique time-invariant intercept for each variety in a linear regression and is given by

$$\widehat{\alpha}_i = \bar{y}_i - \bar{x}_i{}'\hat{\beta}_{FE}, \quad i = 1, \ldots N, \qquad \textbf{(6.1)}$$

where $\bar{y}_i$ is the within-variety mean of y_{it}, $\bar{x}_i{}'$ is the within-variety mean of vector $x_{it}{}'$, and $\hat{\beta}_{FE}$ is the fixed effects estimator, which is obtained after a *within transformation* that transforms observations to deviations from the individual means in the following manner:

$$y_{it} - \bar{y}_i = (x_{it} - \bar{x}_i)'\beta + (u_{it} - \bar{u}_i) \quad \textbf{(6.2)}$$

The transformation in (6.2) leaves out the individual, or variety fixed effects, and gives $\hat{\beta}_{FE}$ that is an unbiased estimate as long as all x_{it} are independent of all u_{it} (Verbeek, 2012), which in this analysis is assured by the use of instrument variables. From (6.1) it is clear that the variety fixed effect may be positive or negative, which can also be seen in the statistics over the quality components in Table A.8 in the appendix.

The residual, which is the final component of the quality measure, is defined as the difference between the observed value and by the model estimated value. This component can also be either positive or negative.

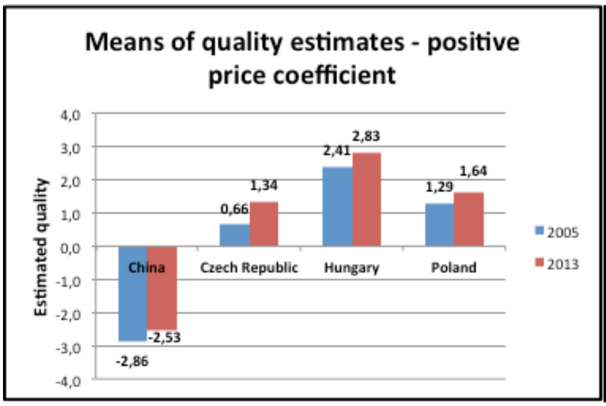
While summing the three components of quality, it is hence clear that the quality estimates can be either negative or positive depending on the values of its components. However, the focus of this analysis is not to estimate absolute values of quality but rather to put a country´s estimated quality in relation to other countries, and to analyse a country´s relative change in estimated quality over time.

Figure 6.3 shows mean and median quality estimates for the years 2005 and 2013 and provides a graphic presentation of the relative change of each country's estimated quality from 2005 to 2013. Figure 6.3a and 6.3b shows that, irrespective of price coefficient sign, Hungary is the country with highest mean estimated quality in both 2005 and 2013, followed by Poland, Czech Republic and lastly China.

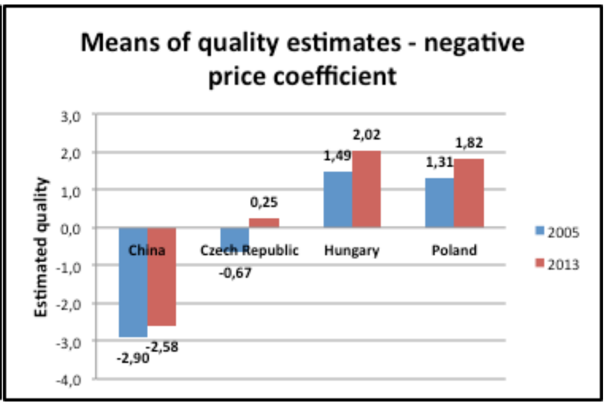
Looking at the means of the quality estimates in Figure 6.3a and Figure 6.3b, Czech Republic is the sampled country with greatest relative quality improvement of both its "inferior" and "normal" products. The same results holds when investigating the median quality estimates in Figure 6.3c and Figure 6.3d.

Figure 6.3 - Distribution of quality estimates

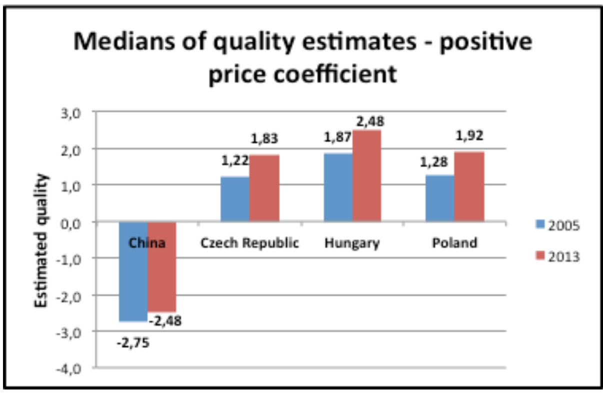
(6.3a)



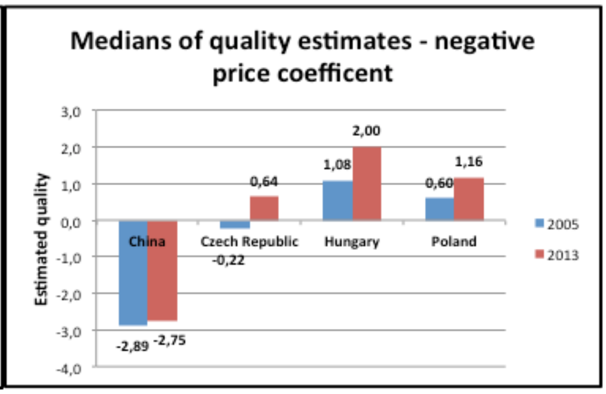
(6.3b)



(6.3c)



(6.3b)



Source: Own calculations

Investigating the mean estimated qualities in Figure 6.3a and 6.3b it is clear that "normal" products from Czech Republic and Hungary are of higher quality than their "inferior" products in both 2005 and 2013. For China there is no real difference and Poland has a slightly higher quality of its "inferior" products in 2013 compared to its "normal" products. When instead looking at the median values in 6.3c and 6.3d, the finding that the countries "normal" products are of higher quality than their "inferior" products is even more accentuated and holds for all four countries. It can hence be reasoned that the "normal" products exported by the sampled countries are considered to be of high enough quality by the EU15 consumers and that this is part of the reason the demand for them increase with EU15 income. This reasoning is supported by Linder (1961), and later confirmed by Hallak (2006), who suggest that richer countries, such as the EU15, demand and consume higher quality products.

The opposite can be argued for the "inferior" products and is supported by an IMF report (2015), which suggests presence of quality gaps in exports from the new EU member states, meaning that the quality of some of their exported products are lower than that demanded by the importers.

Based on the mean quality estimates, the countries "inferior" products display a greater average quality growth from 2005 to 2013 than their "normal" products. This holds for all sampled countries but China, whose average quality growth is 3 percentage points (p.p.) higher for its "normal" products. Czech Republic's average quality growth is 34.8 p.p. higher for its "inferior" products than for its "normal" products. The corresponding figures for Hungary and Poland are 32.7 and 11.9 p.p. respectively. This finding suggest that the sampled new EU member states are focusing more on improving the quality of their "inferior" products than their "normal" products to be able to match the demand in the EU15.

In order to measure the vertical differentiation within a product I construct quality ladders, which are defined as the difference between the highest and lowest quality estimates within a product:

$$Ladder_g = {\xi_g}^{max} - {\xi_g}^{min}. \quad \textbf{(6.3)}$$ [10]

The average ladder length for products in industries with an estimated negative price coefficient is 9.87 while the average ladder length for products in industries with an estimated positive price coefficient is 7.05. As the "inferior" products on average have longer quality ladders than the "normal" products, it suggests that there is more heterogeneity in the quality of the sampled countries exported varieties to EU15 and hence more space for quality improvements.

Due to the trade liberalization it means to join the EU, the new member states get greater access to higher quality inputs from EU15 that has a comparative advantage in producing them as they are more capital abundant. Using higher quality inputs in production will lead to higher quality output (e.g. see Bas and Strauss-Kahn, 2015).

The EU single market also means free movement of capital and labour. Since capital is relatively scarce in the new member states, they will see an inflow of capital from the other member states to meet the demand. According to neoclassical economic theory, capital mobility will result in relatively capital abundant countries allocating capital to relatively labour abundant countries (Bowen *et al.* 2012). The EU15 will hence move capital to the new

[10] Note that *t* does not enter the expression. The quality ladder does not remain fixed over time since countries acquire new technology and/or increases spendings on R&D. Following Khandelwal (2010); I therefore use the ladder length for the first year of observation, i.e. 2005, to mitigate concerns about endogeneity.

EU member states and receive a higher return to capital while the new EU member states labor will move to EU15 to earn higher wages. Eventually these movements will result in factor price equalization.

Since the “inferior” products are of lower quality and have a greater space for quality improvement than the “normal” ones, it follows that upgrading the quality of inputs, acquiring new technology, and inflow of more capital to the new member states will have a larger relative impact on the “inferior” products.

In order to more clearly demonstrate how the sampled countries relate to each other in terms of quality, I rank them for 2005 and 2013, respectively. In Table 6.3 the countries are ranked according to means and medians of the quality estimates for their “normal” products. Table 6.4 shows the equivalent ranking of the countries export quality estimates of their “inferior” products.

Table 6.3 - Quality ranking of “normal” products [1,2]

Ranking	Mean quality 2005	Mean quality 2013	Median quality 2005	Median quality 2013
1.	Hungary	Hungary	Hungary	Hungary
2.	Poland	Poland	Poland	Poland
3.	Czech Republic	Czech Republic	Czech Republic	Czech Republic
4.	China	China	China	China

Notes: (1) Based on the estimated quality measures from equation (4.2) with a positive price coefficient. (2) Rank of 1 means highest quality, rank of 2 means second highest quality etc. Source: Own calculations

The ranking of the sampled countries export quality in Table 6.3 and Table 6.4 are identical and shows that Czech Republic have lowest estimated export quality of the sampled new EU member states while Hungary has the highest. China has the lowest export quality in the sample.

Table 6.4 - Quality ranking of “inferior” products [1,2]

Ranking	Mean quality 2005	Mean quality 2013	Median quality 2005	Median quality 2013
1.	Hungary	Hungary	Hungary	Hungary
2.	Poland	Poland	Poland	Poland
3.	Czech Republic	Czech Republic	Czech Republic	Czech Republic
4.	China	China	China	China

Notes: (1) Based on the estimated quality measures from equation (4.2) with a negative price coefficient. (2) Rank of 1 means highest quality, rank of 2 means second highest quality etc. Source: Own calculations

Tables 6.5 and Table 6.6 shows the ranking of the sampled countries according to relative change in estimated quality. As all considered countries display a positive relative change in estimated quality I call this change *quality upgrading*.

Table 6.5 - Quality upgrade ranking of “normal” products[1, 2]

Ranking	Quality upgrading based on mean quality	Quality upgrading based on median quality
1.	Czech Republic	Czech Republic
2.	Poland	Poland
3.	Hungary	Hungary
4.	China	China

Notes: (1) Ranking of countries in terms of relative change in estimated quality based on the estimations with positive price coefficient. (2) Rank of 1 means greatest quality upgrade, rank of 2 means second highest quality upgrade etc. Source: Own calculations

The findings in Table 6.5 and Table 6.6 are identical. Apart from being ranked as having lowest export quality of both their “normal” and “inferior” products, China also ranks lowest in terms of quality upgrading. Czech Republic, which was ranked as having the third lowest export quality of its products, displays the greatest relative quality upgrade. Hungary has the highest quality of its exported products but the lowest relative quality upgrade of the sampled new member states. Focusing on the sampled new member states, a “catching up” process seems to be taking place during the considered time period, meaning that the country with lowest export quality show the highest quality upgrade and the country with highest quality display lowest relative quality upgrade.

Table 6.6 - Quality upgrade ranking of "inferior" products [1,2]

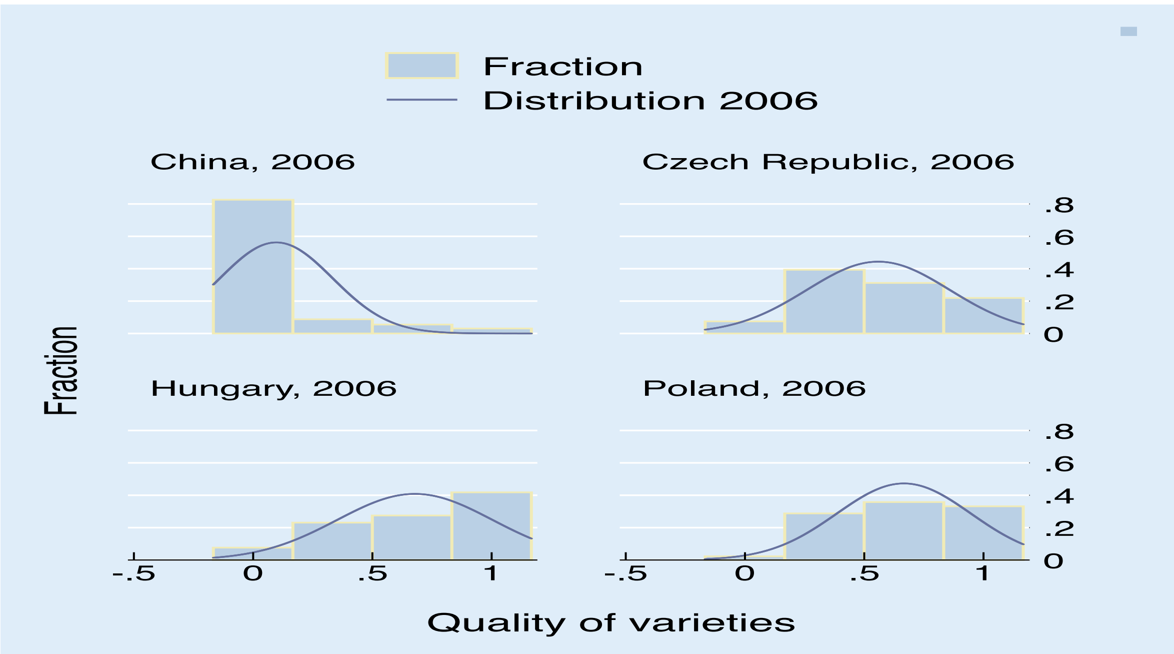
Ranking	Quality upgrading based on mean quality	Quality upgrading based on median quality
1.	Czech Republic	Czech Republic
2.	Poland	Poland
3.	Hungary	Hungary
4.	China	China

Notes: (1) Ranking of countries in terms of relative change in estimated quality based on the estimations with negative price coefficient. (2) Rank of 1 means greatest quality upgrade, rank of 2 means second highest quality upgrade etc. Source: Own calculations

6.4 – Results verti-zontal method

Figure 6.4 shows the distribution of normalized quality ranks for varieties exported by the sampled countries in 2006. The majority of China's products are ranked as having the lowest quality within a product, while Hungary is the country with greatest fraction of its products being ranked as highest. Just over 40 percent of Hungary's exported products are of highest quality. Second after Hungary is Poland with about 35 percent of its exports having the highest quality rank. Third comes Czech Republic and lastly China.

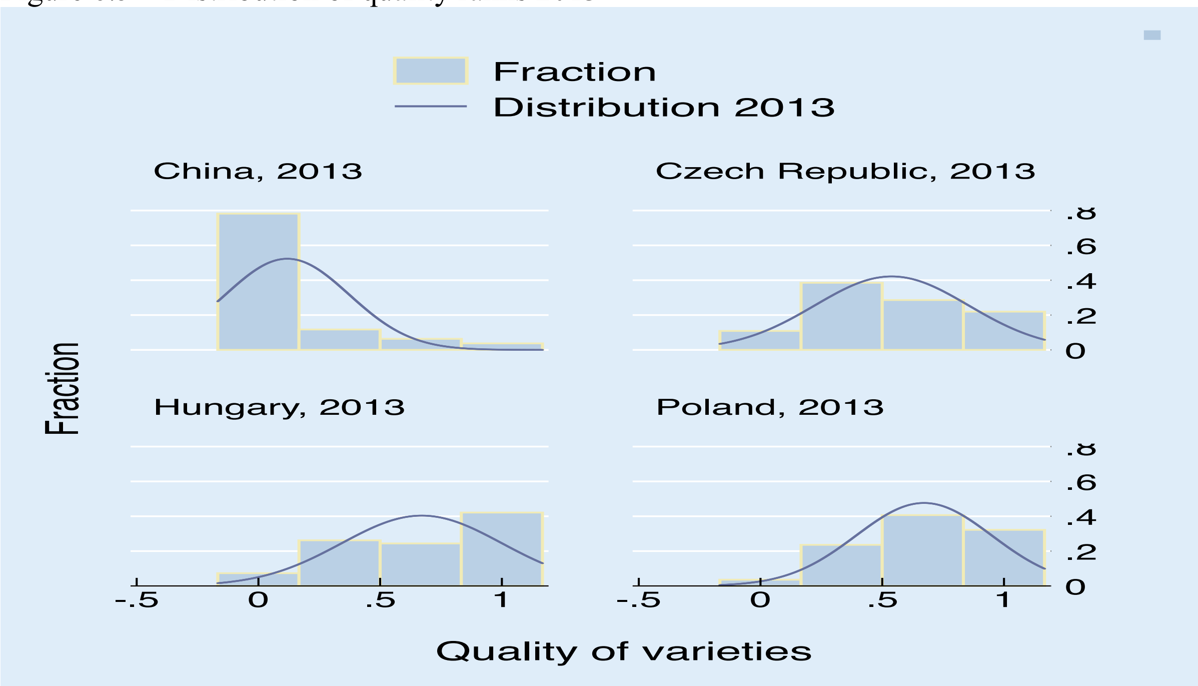
Figure 6.4 – Distribution of quality ranks 2006[1]



Note: (1) Distribution of normalized quality rankings of the sampled countries in 2006. 0 represents the lowest rank while 1 represents the highest rank. The bars represent the fraction of countries exported products with a certain rank. The normal distribution lines further display if a country's export quality rank of its products is skewed more towards high or low quality. Source: Own calculations

Figure 6.5 shows the corresponding findings to Figure 6.4 for year 2013. When comparing the two figures it is hard to observe any real difference between them, indicating that the ranking of the sampled countries export quality have not change remarkably from 2006 to 2013.

Figure 6.5 – Distribution of quality ranks 2013[1]



Note: (1) Distribution of normalized quality rankings of the sampled countries in 2013. 0 represents the lowest rank while 1 represents the highest rank. The bars represent the fraction of countries exported products with a certain rank. The normal distribution lines further display if a country's export quality rank of its products is skewed more towards high or low quality. Source: Own calculations

To more closely investigate how the of export quality rank has developed during the period I compare the countries average quality rank in 2006 and 2013.

Table 6.7 – Quality rankings from the verti-zontal model[1, 2, 3]

Rank\Year	2006	2013
1.	Hungary (.6780)	Poland (.6715)
2.	Poland (.6661)	Hungary (.6710)
3.	Czech Republic (.5588)	Czech Republic (.5388)
4.	China (.0970)	China (.1187)

Notes: (1) Based on average of normalized quality ranks of exported varieties. A ranking of 1 means the country has highest average quality rank and a ranking of 4 means a country has the lowest average quality rank. (2) Average of normalized quality ranks in parenthesis, where 0 is lowest relative quality and 1 is highest relative quality. (3) The ranking covers varieties from all industries with available data, i.e. both industries with estimated positive and negative price coefficient according to Khandelwal's (2010) method. Source: Own calculations

Table 6.7 shows the ranking of countries according to the average of their products quality rankings in 2006 and 2013. It is clear that even though China did improve its quality ranking it is still ranked lowest in terms of quality. In 2006 Hungary had the highest average quality rank, shortly followed by Poland, which by 2013 had passed Hungary and ranked highest with a marginally higher average quality rank. Both Czech Republic and Hungary lost quality rank positions to China and Poland from 2006 to 2013, which can be seen as Czech Republic and Hungary's average quality rank decreased from 2006 to 2013 while China and Poland's average relative quality rank increased. Note that the ranking in 2006 according to the verti-zontal method is the same as the ranking of countries export quality in 2005 when using Khandelwal's (2010) method, which can be seen by comparing Table 6.7 to Table 6.3 and Table 6.4. For 2013 the verti-zontal method assigns Poland a marginally higher average quality rank than Hungary, which means that the ranking of export quality according to the two methods do not fully coincide for this year.

It should be noted that the findings in the verti-zontal model do not tell anything about the magnitude of actual quality upgrading during the period but rather how the sampled countries export quality have changed relative to each other. It implies that a decrease in quality rank not necessarily mean that the quality of country *c'*s exports decreased but that one or several other countries in the sample have increased the quality of their exports to the point where they rank higher, leaving country *c* to loose rank positions despite potential export quality upgrade.

When applying Khandelwal's (2010) method, a division was made between varieties belonging to industries with a positive, respectively negative price coefficient. To be concise and more comprehensively compare the findings from the verti-zontal and Khandelwal's (2010) method I apply the same division here. I rank the quality of the countries exported products by applying the verti-zontal method separately on the industries with positive price coefficient (normal products), and negative price coefficient (inferior products). Table 6.8 and Table 6.9 present these rankings.

Table 6.8 – Ranking of "normal" varieties with the verti-zontal method[1, 2]

Rank\Year	2006	2013
1.	Poland (.6801)	Hungary (.7162)
2.	Czech Republic (.6261)	Poland (.6464)
3.	Hungary (.5541)	Czech Republic (.4752)
4.	China (.1396)	China (.1621)

Notes: (1) Ranking based on average of normalized export quality ranks for countries' products that belong to industries with estimated positive price coefficient according to Khandelwal's (2010) method. Rank of 1 is highest average quality rank and rank of 4 is lowest average quality rank. (2) Average of normalized quality rank is presented in parenthesis where 1 is highest relative quality and 0 is lowest relative quality. Source: Own calculations

As explained in section 4.3, the data needed for the verti-zontal method are first available in 2006, which limits a comparison between the two methods. For this reason I estimate quality also for 2006 according to Khandelwal's (2010) method and find that the ranking of countries according to their export quality has not changed since 2005, which holds for both "normal" and "inferior" varieties, meaning that the rankings in Table 6.3 and Table 6.4 are valid also for 2006. This allows for a comparison between the rankings of the sampled countries according to the two methods.

When contrasting the findings in Table 6.8 to those in 6.3 it is found that the ranking of the countries export quality of "normal" products do not fully coincide for 2006. Both methods rank China at the bottom of the export quality spectra. Hungary, that display highest export quality according to Khandelwal (2010), is ranked third accordingly in the verti-zontal method. This discrepancy could be due to the separation of taste and cost factors from quality in the verti-zontal method. This suggests that Hungary's high estimated quality in 2006 using

Khandelwal's (2010) method could reflect not purely high quality but also high marginal costs and a strong taste for "normal" Hungarian products in EU15 at the time.

In 2013 however, after Hungary climbed in verti-zontal quality rank, the two methods rank the sampled countries export quality the same way. This indicates that Hungary's position as highest quality exporter in 2013 using Khandelwal (2010) is not solely because of cost and taste factors but they do indeed provide highest export quality.

Table 6.9 –Ranking of "inferior" varieties with the vertizontal method[1, 2]

Rank\Year	2006	2013
1.	Hungary (.7173)	Hungary (.6795)
2.	Poland (.6616)	Poland (.6566)
3.	Czech Republic (.5374)	Czech Republic (.5588)
4.	China (.0835)	China (.1049)

Notes: (1) Ranking based on average of normalized export quality ranks for countries' products that belong to industries with estimated negative price coefficient according to Khandelwal's (2010) method. Rank of 1 is highest average quality rank and rank of 4 is lowest average quality rank. (2) Average of normalized quality rank is presented in parenthesis where 1 is highest relative quality and 0 is lowest relative quality. Source: Own calculations

The ranking of countries export quality of "inferior" products according to the two methods is identical for 2006 and 2013, which is seen by comparing Table 6.9 to Table 6.4.[11] Even if Khandelwal (2010) fails to separate cost and taste factors from quality, the verti-zontal method accounts for this and reach the same conclusions in terms of quality rankings. Hence, the results from the verti-zontal method can act as a sort of robustness check for the results obtained from Khandelwal's (2010) method.

[11] The rankings in Table 6.4 for 2005 are valid also for 2006 as previously explained.

7. Conclusion

This paper has tested the hypothesis that Czech Republic, Hungary and Poland have increased the quality of their exported products to EU15 since they joined EU and the European Single Market in May 2004. The method proposed by Khandelwal (2010) has been used to estimate export quality of the considered countries for the period 2005 -2013.

The findings suggest that these three new member states indeed upgraded their export quality to EU15 during this period. Czech Republic, Hungary, and Poland constantly provide higher export quality of their products to EU15 compared to China, which was also included in the analysis to serve as a reference country.

It is found that some products exported by the sampled countries are considered to be of high enough quality in the EU15 market, such that their demand increases with EU15 income. These varieties are referred to as "normal". Other products of lower quality, loose market share as the EU15 income increase. Suggesting that these "inferior" products are not of high enough quality for the EU15 consumers to demand them when their income increases.

However, it is showed that the relative quality upgrading is higher in the "inferior" products than in the "normal" ones for all sampled countries but China. As the "inferior" varieties are of lower quality, the need to upgrade the quality of these is higher in order to match the quality demanded in EU15. Quality upgrading is also a way to avoid cost competition with countries like China, which holds the position as EU's second largest trading partner and are typically specialized in the low-quality segments of products.

A type of "catching up" process seems to be taking place among the three new member states. Czech Republic, which has the lowest estimated quality of both "normal" and "inferior" products in 2005 and 2013, display the greatest relative quality upgrade. On the contrary, Hungary, which have the highest estimated quality in both "normal" and "inferior" products in 2005 and 2013, display the smallest relative quality upgrade.

A second method that builds on a relative quality measure proposed by Di Comite *et al.* (2014), and later used by Vandenbussche (2014), is applied to validate the rankings of the sampled countries export quality according to Khandelwal's (2010) method. However, some discrepancy in ranking is found for "normal" varieties in 2006, which can potentially be explained by taste and cost factors that could influence the quality estimates in Khandelwal's (2010) method.

An interesting way to extend this analysis would be to use a more detailed database at firm level to allow for a separation between exports to EU15 from Multinational Enterprises

(MNE) located in the new EU member states, and exports from domestic firms to contrast the development of their export quality. Possibly, also to investigate if and how MNE's affect the export quality of the domestic firms in the new EU member states.It would also be interesting to see a study of the new EU member states exports to another destination market than EU15 to investigate whether the same rate of quality upgrading is present in exports to both markets.

This paper has not taken into account the trade between the new EU member states. A study of export quality dynamics in trade between these would therefore be interesting to see. It would also be relevant to see how demand for quality in the new EU member states has developed since the entrance of the EU in 2004. These questions remains to be explored in future research.

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Appendix

Table A.1 – Share of exports to EU15 in total exports[1, 2]

Country\Year	2004	2013
Cyprus	0,62	0,51
Czech Republic	0,68	0,61
Estonia	0,63	0,53
Hungary	0,71	0,56
Latvia	0,54	0,29
Lithuania	0,46	0,30
Malta	0,48	0,63
Poland	0,67	0,60
Slovakia	0,60	0,53
Slovenia	0,58	0,52

(1) Calculated as the value of goods exported to EU15 over total value of goods exported. (2) The value of exports to EU15 is calculated as the aggregate value of exports to all the EU15 member states. Source: Own calculations based on data from IMF *Direction of Trade Statistics* database (2015)

Table A.2 - Structure of classification systems [1]

Classification system	Section	2-digit	3-digit	4 –digit	6-digit	8-digit
CN	Section **XIV** – Machinery; electrical equipment; parts thereof, etc.	Chapter **85** – Electrical machinery and parts thereof; sound recorders and reproducers, etc.		**Industry 8527** – Reception apparatus for radio-broadcasting, whether or not combined, in the same housing, with sound recording or reproducing apparatus or a clock	**852792** – Not combined with sound recording or reproducing apparatus but combined with a clock	**85279210** – Alarm clock radios
CPA	**C** – Manufactured products	**26** – Computer, electronics and optical products	**26.4** – Consumer electronics	Industry **26.40** – Consumer electronics		
NACE REV.2	**C** - Manufacturing	**26** – Manufacture of computer, electronic and optical products	**26.4** – Manufacture of consumer electronics	Industry **26.40** – Manufacture of consumer electronics		
Prodcom				Industry **26.40** – Manufacture of consumer electronics	**26.40.11** – Radio broadcast receivers (except for cars), capable of	**26.40.11.00** – Radio broadcast receivers (except for cars), capable of

					operating without an external source of power	operating without an external source of power

Note: (1) Explanation of structure and relationship between the used classification systems by example of alarm clock radios. Source: Ramon – Eurostat´s metadata server

Table A.3 – Coverage of industries[1]

NACE 2-digit (sector)	NACE REV.2 Industry code	Specification of industry
10-Food	1011	Processing and preserving of meat
10-Food	1012	Processing and preserving of poultry meat
10-Food	1013	Production of meat and poultry meat products
10-Food	1041	Manufacture of oils and fats
11 - Beverages	1101	Distilling, rectifying and blending of spirits
11 – Beverages	1102	Manufacture of wine from grape
12 – Tobacco	1200	Manufacture of tobacco products
13 - Textiles	1310	Preparation and spinning of textile fibres
13 - Textiles	1392	Manufacture of made-up textile articles, except apparel
13 – Textiles	1394	Manufacture of cordage, rope, twine and netting
14 – Wearing apparel	1413	Manufacture of other outerwear
14 – Wearing apparel	1414	Manufacture of underwear
15 – Leather and shoes	1520	Manufacture of footwear
16 – Wood	1629	Manufacture of other products of wood; manufacture of articles of cork, straw and plaiting materials
17 – Paper	1712	Manufacture of paper and paperboard
17 – Paper	1722	Manufacture of household and sanitary goods and of toilet requisites
17 – Paper	1723	Manufacture of paper stationery
20 – Chemicals	2012	Manufacture of dyes and pigments
20 – Chemicals	2014	Manufacture of other organic basic chemicals
20 – Chemicals	2016	Manufacture of plastics in primary forms
20 – Chemicals	2060	Manufacture of man-made fibres
21 – Pharmaceutical products	2110	Manufacture of basic pharmaceutical products
22 – Rubber and plastic	2219	Manufacture of other rubber products
22 – Rubber and plastic	2221	Manufacture of plastic plates, sheets, tubes and profiles
22 – Rubber and plastic	2222	Manufacture of plastic packing goods
23 – Non-metallic minerals	2319	Manufacture and processing of other glass, including technical glassware
23 – Non-metallic minerals	2320	Manufacture of refractory products
24 – Basic metals	2410	Manufacture of basic iron and steel and of ferro-alloys
24 – Basic metals	2442	Aluminium production
24 – Basic metals	2445	Other non-ferrous metal production
25 – Fabricated metals	2573	Manufacture of tools
25 – Fabricated metals	2593	Manufacture of wire products, chain and springs
25 – Fabricated metals	2594	Manufacture of fasteners and screw machine products
26 – Computers and electronics	2640	Manufacture of consumer electronics

26 – Computers and electronics	2651	Manufacture of instruments and appliances for measuring, testing and navigation
27 – Electrical equipment	2711	Manufacture of electric motors, generators and transformers
27 – Electrical equipment	2740	Manufacture of electric lighting equipment
27 – Electrical equipment	2751	Manufacture of electric domestic appliances
28 – Machinery	2813	Manufacture of other pumps and compressors
28 – Machinery	2814	Manufacture of other taps and valves
28 – Machinery	2815	Manufacture of bearings, gears, gearing and driving elements
28 – Machinery	2830	Manufacture of agricultural and forestry machinery
28 – Machinery	2841	Manufacture of metal forming machinery
29 – Motor vehicles	2910	Manufacture of motor vehicles
29 – Motor vehicles	2931	Manufacture of electrical and electronic equipment for motor vehicles
29 – Motor vehicles	2932	Manufacture of other parts and accessories for motor vehicles
30 – Transport equipment	3020	Manufacture of railway locomotives and rolling stock
30 – Transport equipment	3030	Manufacture of air and spacecraft and related machinery
31 – Furniture	3100	Manufacture of seats and parts thereof
31 – Furniture	3101	Manufacture of office and shop furniture
32 – Other manufacturing	3220	Manufacture of musical instruments
32 – Other manufacturing	3230	Manufacture of sports goods
32 – Other manufacturing	3250	Manufacture of medical and dental instruments and supplies

Note: (1) Coverage of the analysed industries. Grouped according to sector (2-digit NACE).

Table A.4 – Industry coverage for verti-zontal method[1]

Industry code	Number of products	Observations
1041	1	8
1310	29	232
1392	20	160
1394	8	64
1413	36	288
1414	14	112
1520	16	128
1629	4	32
1712	18	144
1722	5	40
1723	5	40
2012	11	88
2014	10	80
2016	25	200
2060	2	16
2110	2	16
2219	25	200
2221	23	184
2222	5	40

2319	7	56
2320	8	64
2410	66	528
2442	8	64
2445	2	16
2573	35	280
2593	22	176
2594	15	120
2640	5	40
2651	29	232
2711	20	160
2740	19	152
2813	13	104
2814	12	96
2815	20	160
2830	12	96
2841	6	48
2910	7	56
2931	5	40
2932	8	64
3030	3	24
3100	8	64
3101	5	40
3220	2	16
3230	3	24
3250	16	128

Note: (1) List of industries with available variable cost over turnover data used in the verti-zontal method.

Table A.5 – OLS regression output[1, 2]

Industry code	Price coefficient	P-value price	Ln nest share	P-value nest share	Obs.
1011	0.0124	0.3980	0.9482	0.0000***	1571
1012	0.1104	0.0150**	0.9146	0.0000***	1201
1013	-0.0455	0.2730	0.5016	0.0000***	938
1041	-0.0231	0.0420**	0.8991	0.0000***	1210
1101	0.0007	0.8860	0.9637	0.0000***	582
1102	0.0123	0.1180	0.7161	0.0000***	617
1200	-0.0498	0.0560*	0.9628	0.0000***	153
1310	0.0064	0.0630*	0.9631	0.0000***	3704
1392	-0.0047	0.0180**	0.9791	0.0000***	2052
1394	-0.0158	0.0380**	0.9794	0.0000***	620
1413	-0.0012	0.0000***	0.9954	0.0000***	3972
1414	-0.0004	0.2550	0.9912	0.0000***	1783
1520	-0.0025	0.0030***	0.9798	0.0000***	1926
1629	-0.0074	0.1960	0.9825	0.0000***	852

1712	-0.0401	0.0390**	0.9598	0.0000***	2312
1722	0.0087	0.4880	0.9962	0.0000***	492
1723	-0.0148	0.1880	0.9641	0.0000***	451
2012	0.0062	0.1910	0.9788	0.0000***	1113
2014	-0.0039	0.3760	0.9600	0.0000***	3716
2016	0.0110	0.1630	0.9993	0.0000***	2216
2060	-0.0254	0.1460	0.9959	0.0000***	1022
2110	-0.0002	0.6050	0.8897	0.0000***	1236
2219	-0.0032	0.4560	1.0254	0.0000***	1460
2221	-0.0034	0.5020	1.0251	0.0000***	1858
2222	-0.0087	0.9170	0.9907	0.0000***	337
2319	0.0012	0.7300	0.9749	0.0000***	891
2320	0.0169	0.4270	1.0103	0.0000***	404
2410	-0.1274	0.0000***	0.4801	0.0000***	6297
2442	-0.1485	0.0000***	0.9766	0.0000***	893
2445	0.0010	0.0430**	0.9553	0.0000***	1095
2573	-0.0007	0.1630	1.0068	0.0000***	2361
2593	0.0098	0.0050***	1.0162	0.0000***	1494
2594	0.0004	0.9550	0.9904	0.0000***	1129
2640	-0.0032	0.0030***	1.1336	0.0000***	1577
2651	-0.0005	0.0000***	1.0454	0.0000***	2890
2711	-0.0022	0.0570**	1.0064	0.0000***	1641
2740	-0.0012	0.3720	1.0113	0.0000***	1272
2751	-0.0375	0.0000***	0.6187	0.0000***	1579
2813	-0.0055	0.0070***	1.0054	0.0000***	1325
2814	0.0012	0.4510	1.0255	0.0000***	775
2815	0.0028	0.5660	0.9617	0.0000***	1117
2830	-0.0238	0.0000***	1.0103	0.0000***	1552
2841	-0.0002	0.8670	0.9656	0.0000***	1927
2910	-0.0035	0.1010	0.9534	0.0000***	1145
2931	0.0024	0.5750	0.9523	0.0000***	393
2932	-0.0138	0.1090	1.0706	0.0000***	1275
3020	-0.0013	0.8000	0.9077	0.0000***	382
3030	0.0002	0.7010	1.0113	0.0000***	433
3100	-0.0085	0.6740	0.9196	0.0000***	413
3101	-0.0089	0.7280	0.9380	0.0000***	277
3220	-0.0005	0.2920	0.9862	0.0000***	581
3230	-0.0004	0.6010	1.0052	0.0000***	839
3250	0.0000	0.8160	1.0826	0,0000***	1411

Note: (1) OLS regression output of equation (4.2). (2) Significance at 1 %=***. 5 %=**. 10 %= *. Source: Own calculations

Table A.6 - IV regression output[1, 2]

Industry code	Price coeffcient (IV)	P-value price (IV)	Nest share (IV)	P-value Nest share (IV)	Overidentification test. p-value	Obs.	Income elasticity
1011	0.0048	0.9750	0.9559	0.0000***	0.0006***	1571	1.9868
1012	0.5290	0.3900	-0.0036	0.9920	0.0000***	1201	1.0449*
1013	1.0192	0.0000***	0.3137	0.0350**	0.0163**	938	2.6331***
1041	-0.0606	0.8390	0.5551	0.0080***	0.3354	1210	-2.5220
1101	-0.0911	0.0590**	1.1364	0.0000***	0.8571	582	-0.7752
1102	0.2396	0.0210**	-0.9456	0.0140**	0.2910	617	3.6097
1200	0.1436	0.9520	15.1740	0.8280	0.9409	153	3.1285
1310	-0.0327	0.7040	1.6508	0.0000***	0.0000***	3704	-0.1958
1392	-0.1155	0.0590*	-0.0832	0.8730	0.0000***	2052	0.0894*
1394	-0.3961	0.5000	0.1160	0.0000***	0.0019**	620	-4.7651***
1413	-0.0112	0.0000***	1.8024	0.0000***	0.0000***	3972	2.8621***
1414	-0.0060	0.0740*	1.5969	0.0000***	0.7958	1783	-2.0830***
1520	-0.0275	0.0000***	1.2040	0.0000***	0.0025***	1926	-1.0363
1629	-0.9593	0.2300	0.5591	0.5660	0.5995	852	-0.0053**
1712	2.1499	0.0890*	0.8343	0.0000***	0.0017***	2312	0.9235
1722	-0.4354	0.1650	0.6316	0.1500	0.8069	492	-0.9170**
1723	-0.4280	0.0360**	0.9758	0.0280**	0.8845	451	-2.0268
2012	0.0703	0.2980	1.0553	0.0000***	0.2314	1113	3.0263***
2014	-0.6899	0.1600	2.0303	0.0000***	0.3424	3716	0.3678
2016	1.2660	0.2710	2.2667	0.0000***	0.4088	2216	0.7347
2060	-2.8812	0.1110	4.7996	0.0160**	0.1701	1022	-3.2215
2110	-0.0052	0.3250	1.2580	0.0000***	0.0057***	1236	-0.5820**
2219	-0.1009	0.1790	2.3893	0.0000***	0.6998	1460	-5.0207**
2221	0.0659	0.4930	2.2480	0.0000***	0.9293	1858	2.6030
2222	-0.0608	0.7660	1.9426	0.0020**	0.4207	337	3.1731
2319	0.0232	0.8850	2.6731	0.0020**	0.0836*	891	3.6863***
2320	-1.6954	0.4930	1.6412	0.0140**	0.9146	404	-2.1147**
2410	-4.4630	0.0010***	0.7139	0.0000***	0.6219	6297	-7.7184**
2442	-0.9743	0.0000***	1.0910	0.0000***	0.0000***	893	-1.0729***
2445	-0.0144	0.2140	1.5164	0.0000***	0.0378**	1095	-4.7234***
2573	-0.0671	0.0020***	3.1735	0.0000***	0.8893	2361	-0.0247
2593	-0.0396	0.8990	2.7624	0.0000***	0.7674	1494	-2.7188
2594	-0.0012	0.9790	0.6016	0.0000***	0.0000***	1129	-6.0962***
2640	-0.0511	0.0000***	2.9350	0.0000***	0.0001***	1577	-8.7809***
2651	0.0006	0.9310	2.9277	0.0000***	0.1582	2890	4.0178***
2711	-0.0664	0.0020***	2.8340	0.0000***	0.9167	1641	0.8611
2740	-0.1485	0.0810*	4.2064	0.0040***	0.4085	1272	-3.9993**
2751	-0.1904	0.4040	-3.3276	0.0090***	0.0223**	1579	-6.9971*
2813	-0.1724	0.0680*	1.5921	0.0010***	0.0187**	1325	0.0531
2814	-0.0662	0.7710	3.8683	0.0490**	0.9999	775	0.5725**
2815	1.6116	0.2770	1.3517	0.4290	0.3649	1117	0.4561
2830	-0.8179	0.0280**	2.1564	0.0010***	0.0092***	1552	-4.7068
2841	-0.0050	0.7840	1.2660	0.0000***	0.0000***	1927	3.6415***

2910	-0.1052	0.0330**	1.4125	0.0250**	0.0506*	1145	-1.4254
2931	-0.1528	0.6070	5.2602	0.2340	0.3812	393	-3.2034
2932	-0.3228	0.0000***	1.8129	0.0000***	0.6843	1275	-3.9243**
3020	-0.0502	0.2400	1.0878	0.0000***	0.0001***	382	-1.1089
3030	0.0115	0.2740	1.3273	0.3260	0.0003***	433	1.0275
3100	-1.5591	0.1490	0.8661	0.5250	0.0821*	413	-4.0927
3101	-0.2973	0.4810	0.1726	0.7150	0.0011***	277	2.9289
3220	-0.0036	0.1720	1.0310	0.0000***	0.0330**	581	0.5027
3230	0.0698	0.3130	2.2430	0.0040***	0.2128	839	2.7313
3250	0.0016	0.6150	2.2531	0.0000***	0.0900*	1411	-0.9905

Note: (1) Regression output of equation (4.2) using instrument variables. (2) Significance at 1 %=***, 5 %=**, 10 %= *. Source: Own calculations

Table A.7 - Quality distributions[1]

Industry code	Country	Mean quality 2005	Median quality 2005	Mean quality 2013	Median quality 2013	Number of observations
1011	China	1.0858	0.7649	0.9762	0.8490	6
	Czech Republic	1.9048	1.3074	2.1956	2.4265	50
	Hungary	0.8297	0.7042	0.8769	0.6047	72
	Poland	-0.7940	-1.1702	-0.5642	-1.1589	110
1012	China	4.1706	3.4708	4.2257	4.2554	6
	Czech Republic	0.2250	-0.5589	0.9161	2.0238	26
	Hungary	-0.3913	-0.3909	0.3817	0.4868	64
	Poland	2.5374	2.7466	3.9798	4.1121	82
1013	China	0.8498	0.8498	5.6325	5.6325	2
	Czech Republic	-1.1090	-2.9943	-1.7282	-0.6297	26
	Hungary	0.3821	1.0551	0.8138	1.5874	42
	Poland	2.3938	3.7785	2.9837	4.0392	68
1041	China	0.5894	-0.0317	0.9538	0.2927	40
	Czech Republic	1.2813	1.0380	1.9658	2.9437	22
	Hungary	2.5751	2.4349	2.7650	1.4047	24
	Poland	2.5983	3.1332	3.3482	3.2044	36
1101	China	1.1563	1.2142	2.1315	1.7563	16
	Czech Republic	0.9467	0.5691	1.0210	0.0446	28
	Hungary	0.6666	1.2843	1.1718	1.2982	22
	Poland	0.5079	0.9987	1.3854	0.7314	26
1102	China	-3.5120	-4.0146	-7.9945	-8.3469	12
	Czech Republic	-5.0853	-3.5855	-3.2013	-1.5581	10
	Hungary	9.0220	9.5768	8.3875	7.7702	40
	Poland	-5.5301	-3.1606	-6.9661	-4.9668	12
1200	China	28.6441	5.2524	29.6326	2.9853	6
	Czech Republic	-	-	-	-	0
	Hungary	22.9188	22.9188	6.3171	6.3171	4
	Poland	-23.8078	-54.2659	-13.5520	-29.9324	8

1310	China	-2.3120	-1.9319	-1.8534	-1.7373	242
	Czech Republic	-0.1243	0.1450	1.1274	1.0860	162
	Hungary	1.6434	1.6877	3.0353	3.4044	108
	Poland	1.2909	1.3784	2.0752	2.0190	122
1392	China	3.7656	4.0040	4.6923	5.1512	122
	Czech Republic	-1.5207	-1.0272	-1.0447	-0.5123	94
	Hungary	-3.0025	-2.5972	-2.1545	-3.0305	62
	Poland	0.0184	0.9287	1.5540	1.4822	102
1394	China	-1.4859	-1.7252	-0.9602	-1.0457	34
	Czech Republic	0.9201	1.3312	1.7648	1.6199	26
	Hungary	0.5883	-0.0119	1.7719	1.1571	22
	Poland	-0.3686	-0.8440	0.6878	-0.0702	24
1413	China	-6.3579	-6.2807	-5.4330	-5.1919	208
	Czech Republic	2.5290	2.8104	4.2980	4.9132	172
	Hungary	0.9511	0.9558	2.7153	2.8282	210
	Poland	-0.4006	-0.1898	0.3099	0.7474	226
1414	China	-4.2897	-4.7241	-3.5504	-4.1141	486
	Czech Republic	2.0003	1.7965	2.8365	2.9080	78
	Hungary	1.4815	1.4603	2.5072	2.4556	86
	Poland	0.1075	0.0578	0.5580	0.2583	98
1520	China	-2.1948	-1.8691	-1.8850	-1.8204	100
	Czech Republic	1.7366	2.1111	1.4511	1.7822	76
	Hungary	1.6967	2.2612	1.9563	2.3064	80
	Poland	1.0100	1.1627	1.3035	1.5898	86
1629	China	1.1687	1.4810	0.3860	0.7266	44
	Czech Republic	1.5875	0.6683	1.7461	0.3601	19
	Hungary	6.4490	4.0390	5.4920	3.3679	14
	Poland	-0.1531	-0.4155	-0.2083	-0.3186	26
1712	China	-3.4018	-3.5285	-1.6836	-0.9814	112
	Czech Republic	0.8876	1.6968	0.8872	2.0947	158
	Hungary	-0.8686	0.1572	-0.0036	0.1820	58
	Poland	0.9387	1.2815	1.6073	1.3809	104
1722	China	0.3975	0.3161	0.7756	0.8641	26
	Czech Republic	-0.9293	-0.8705	-0.4217	-0.2963	20
	Hungary	-1.3369	-1.1700	-0.4817	-0.2812	18
	Poland	0.2960	0.5269	1.2195	0.9840	20
1723	China	-0.2423	-0.2891	-0.1366	-0.1016	26
	Czech Republic	-0.2049	-0.5634	0.3059	-0.0112	22
	Hungary	-0.3433	0.1599	0.3676	0.5839	14
	Poland	-0.7560	-0.9055	-0.2091	-0.6210	22
2012	China	-0.2835	0.1726	-0.2686	-0.0781	70
	Czech Republic	0.6801	1.3525	0.6414	1.2935	40
	Hungary	2.0751	1.8438	1.8882	2.3086	30
	Poland	1.0394	1.4777	1.0470	1.6150	44
2014	China	-4.4831	-6.4079	-5.0100	-6.5517	216
	Czech Republic	-0.7380	-2.0427	0.4699	-0.4885	98

	Hungary	2.1928	2.3885	2.3628	2.5917	48
	Poland	0.2716	0.7134	-0.8163	0.0644	104
2016	China	-1.9024	-0.6610	-1.4246	-0.4104	144
	Czech Republic	1.0346	2.1270	1.6396	0.8478	96
	Hungary	3.5359	3.3359	3.3897	4.1920	66
	Poland	1.4571	1.2639	1.0341	0.8700	94
2060	China	-11.2269	-16.6742	-15.0454	-13.8385	44
	Czech Republic	-2.1449	-1.2055	1.9821	-4.9490	30
	Hungary	25.4345	28.0327	21.3581	24.9399	12
	Poland	-4.3637	-0.3885	-0.0176	0.5370	28
2110	China	-2.4568	-2.5146	-2.9814	-3.3365	106
	Czech Republic	3.4936	3.2603	3.0809	2.3231	28
	Hungary	3.1203	4.2852	2.9290	3.6377	24
	Poland	3.3482	3.6133	2.8684	2.9788	30
2219	China	-2.5108	-1.3600	-2.9727	-3.6599	58
	Czech Republic	0.4192	-0.6965	1.2308	-0.2077	50
	Hungary	3.3097	3.0132	3.9680	3.6405	50
	Poland	-2.2665	-2.4302	-1.8679	-2.0185	62
2221	China	-0.8627	-0.4782	-1.0461	-0.6210	84
	Czech Republic	0.8900	1.2783	0.2897	0.9572	70
	Hungary	3.0542	2.2042	2.7728	2.1500	58
	Poland	-0.3119	-0.0016	-1.0874	-0.7213	72
2222	China	-3.0117	-1.3259	-3.2143	-1.0921	16
	Czech Republic	0.4177	1.1535	0.9569	1.5766	16
	Hungary	1.9158	2.0567	2.1139	1.2958	18
	Poland	-0.0907	0.1993	-0.3073	-0.0210	12
2319	China	-6.2266	-6.2842	-5.0276	-5.2898	66
	Czech Republic	-0.4582	-0.5271	2.9356	3.3413	48
	Hungary	7.0552	6.6110	9.7400	9.2956	26
	Poland	2.3741	3.1045	4.5986	4.9687	30
2320	China	-2.4704	-4.8021	-2.8460	-4.3686	20
	Czech Republic	-0.8894	-2.5287	-0.2657	-1.5475	18
	Hungary	3.1252	1.9444	2.1130	0.6957	20
	Poland	0.0400	-1.8385	0.8811	0.4881	20
2410	China	-1.8656	-4.9862	-2.0184	-5.4158	262
	Czech Republic	-6.3903	-9.4095	-5.4615	-8.8628	306
	Hungary	-2.3048	-8.5076	-3.1149	-8.4727	180
	Poland	8.0791	2.7309	8.1214	3.2701	260
2442	China	-1.0337	-0.6651	-0.1443	-0.4628	28
	Czech Republic	-0.3016	-0.0370	1.0563	0.9835	32
	Hungary	-0.9366	-1.0529	-0.0206	0.4258	32
	Poland	-0.8164	-1.3865	0.3643	0.6808	34
2445	China	-1.8655	-2.6079	-1.9194	-2.4365	86
	Czech Republic	2.7463	2.4950	2.5945	1.8726	32
	Hungary	5.2234	4.4568	3.8529	2.7620	12
	Poland	4.7644	5.0399	4.5747	4.4916	20

2573	China	-9.6399	-10.1246	-10.0066	-10.3130	126
	Czech Republic	-0.7209	-1.1756	-0.3363	-0.8971	118
	Hungary	6.8487	4.4262	7.1892	5.7368	98
	Poland	3.6419	4.1581	2.1700	2.7032	98
2593	China	-4.6771	-5.9614	-4.4962	-6.3270	64
	Czech Republic	-2.1945	-2.2526	-2.0245	-1.7522	52
	Hungary	5.5715	4.9570	4.9007	4.6369	52
	Poland	-0.1192	-1.3592	0.9235	0.7408	44
2594	China	0.6293	-0.0743	1.7030	1.4023	54
	Czech Republic	-0.6743	-0.7239	0.9596	0.6152	62
	Hungary	-1.8605	-2.2580	-0.0640	-0.6820	50
	Poland	-0.8297	-1.0202	0.9147	0.8218	56
2640	China	-15.1496	-14.6465	-12.5286	-13.5290	34
	Czech Republic	4.1814	2.6317	2.4909	-1.0584	18
	Hungary	3.5938	3.2403	4.1643	2.2219	20
	Poland	9.7656	12.1122	8.6485	11.6153	18
2651	China	-5.7261	-4.0958	-5.7909	-4.2248	92
	Czech Republic	3.3986	3.4854	5.7244	6.5614	46
	Hungary	1.5622	1.4918	2.8440	3.1052	36
	Poland	3.4073	2.7058	3.4773	3.1352	46
2711	China	-5.4711	-5.5535	-4.7330	-4.1554	38
	Czech Republic	0.4288	1.2744	1.9063	3.4130	26
	Hungary	2.8888	-0.0918	4.6373	3.2676	30
	Poland	-1.1923	-0.8057	0.1314	2.2056	26
2740	China	-16.8554	-19.1186	-16.3022	-18.0021	62
	Czech Republic	11.1091	12.2048	12.4745	14.0293	52
	Hungary	6.7116	7.2169	8.1174	6.7602	54
	Poland	1.4722	0.4273	2.1860	1.1984	56
2751	China	20.1163	21.7653	25.0030	27.3125	68
	Czech Republic	-11.5880	-13.2702	-11.6071	-8.7118	60
	Hungary	-14.0772	-15.1088	-12.6377	-14.5510	58
	Poland	-33.4537	-33.4537	-18.8019	-18.8019	2
2813	China	-8.7705	-9.6332	-5.4288	-6.2268	16
	Czech Republic	-2.6241	-2.8077	2.6939	2.2245	14
	Hungary	-3.7729	-4.7735	0.3181	-2.7030	10
	Poland	-1.0499	-1.5558	0.9131	0.0951	16
2814	China	-10.0160	-8.8953	-9.7186	-9.1627	36
	Czech Republic	0.9943	1.6503	1.7274	3.6343	48
	Hungary	8.6189	8.4949	9.2454	9.0550	38
	Poland	1.6236	2.0513	0.5222	1.6536	40
2815	China	7.9519	9.8954	8.3475	11.6830	22
	Czech Republic	-11.7927	-6.2151	-7.6508	-4.4580	24
	Hungary	0.6850	1.3751	3.4143	8.1377	20
	Poland	-1.4057	2.2638	-0.5494	6.7798	26
2830	China	-5.4024	-7.0936	-5.5781	-7.9374	86
	Czech Republic	0.9119	0.0833	2.9417	1.2900	74

	Hungary	2.6025	0.3379	4.2695	2.5397	54
	Poland	-1.2080	-4.8415	-0.0249	-4.0063	82
2841	China	-1.0977	-1.1851	-0.9400	-1.1048	138
	Czech Republic	-0.1574	-0.1826	0.3474	0.3699	98
	Hungary	1.5021	1.2177	1.6340	1.4321	28
	Poland	0.6299	0.5751	0.9932	0.9425	72
2910	China	-0.7326	-0.5079	0.6335	0.8884	66
	Czech Republic	1.0635	1.1236	2.6657	4.0953	48
	Hungary	2.5282	2.7759	3.5486	3.2194	44
	Poland	-0.7849	-0.4656	0.7901	0.2466	62
2931	China	-22.5063	-22.5063	-21.7843	-21.7843	4
	Czech Republic	14.9597	1.5739	10.9291	9.4507	6
	Hungary	11.0439	3.8837	8.5047	5.1894	6
	Poland	-3.3753	-8.2378	-1.7142	-7.5784	6
2932	China	2.6400	0.9876	2.6785	1.9537	20
	Czech Republic	-1.8256	-1.0963	-1.0337	-0.4505	26
	Hungary	0.6646	0.7707	1.1323	1.5876	22
	Poland	-2.0695	-2.2480	-1.3273	-0.9460	24
3020	China	-1.2903	-0.6341	-1.3137	-0.2117	10
	Czech Republic	-0.8083	0.3036	-0.4686	0.6979	12
	Hungary	0.9741	0.9741	2.1386	2.1386	4
	Poland	0.5881	1.0318	1.1272	1.2161	6
3030	China	-16.1165	-16.1165	-11.1381	-11.1381	2
	Czech Republic	-2.4856	-2.4856	4.9288	4.9288	2
	Hungary	-3.4678	-3.4678	5.6342	5.6342	2
	Poland	---	---	---	---	0
3100	China	-2.4945	-3.0486	-1.5682	-1.9577	20
	Czech Republic	-0.9131	-2.8799	0.2739	0.9749	18
	Hungary	1.7034	0.6113	3.1709	2.8682	18
	Poland	-0.3594	-1.3579	0.6362	-0.5529	18
3101	China	0.3790	1.1723	1.5314	1.8960	14
	Czech Republic	-0.2377	-0.4102	0.1391	-0.1393	16
	Hungary	-2.0323	-2.0107	-1.3225	-1.3728	10
	Poland	0.4909	0.7319	1.6428	2.0906	14
3220	China	-0.3422	-0.5791	0.0090	0.0599	38
	Czech Republic	0.2712	0.4713	0.3810	0.8812	26
	Hungary	0.9412	2.7482	1.0763	2.6533	10
	Poland	1.1385	1.1569	1.4522	1.5002	16
3230	China	-8.3568	-8.9939	-7.6608	-8.1759	58
	Czech Republic	1.9781	1.8811	3.1419	4.3901	42
	Hungary	2.7350	3.8730	4.6409	5.6318	28
	Poland	3.2980	3.3792	4.0953	4.9042	32
3250	China	-4.4192	-4.5036	-4.6407	-4.1978	82
	Czech Republic	0.5726	0.2116	1.5432	2.2717	60
	Hungary	3.9448	4.1465	4.1678	4.9400	42
	Poland	2.2080	2.0609	2.2104	2.3455	60

Note: (1) Quality distributions by country, industry and year, which are estimated using Khandelwal's (2010) method. Source: Own calculations

Table A.8 - Quality Components[1]

Industry code	Country	Time effect 2005	Time effect 2013	Variety fixed effect mean	Variety fixed effect median	Residual mean	Residual median
1011	China	-0.0321	0.1003	0.5756	0.3589	0.4213	0.4587
	Czech Republic	-0.0321	0.1003	1.0361	0.9408	0.9800	1.1789
	Hungary	-0.0321	0.1003	0.4027	0.4644	0.4165	0.3125
	Poland	-0.0321	0.1003	-0.3937	-0.8367	-0.3195	-0.6048
1012	China	-0.3074	0.6187	2.0686	1.9503	1.9739	1.8544
	Czech Republic	-0.3074	0.6187	0.2709	0.4682	0.1440	0.6696
	Hungary	-0.3074	0.6187	-0.1522	-0.2837	-0.0083	0.0032
	Poland	-0.3074	0.6187	1.6188	1.5319	1.4842	1.7297
1013	China	0.0828	0.2695	1.3214	1.3214	1.7436	1.7436
	Czech Republic	0.0828	0.2695	-0.7405	-1.1433	-0.8542	-0.8596
	Hungary	0.0828	0.2695	0.1696	0.5710	0.2522	0.2305
	Poland	0.0828	0.2695	1.2171	1.8790	1.2955	1.8384
1041	China	-0.0175	0.5016	0.3116	-0.1502	0.2180	0.0829
	Czech Republic	-0.0175	0.5016	0.6801	0.8462	0.7013	1.3996
	Hungary	-0.0175	0.5016	1.2799	1.0266	1.1480	1.2423
	Poland	-0.0175	0.5016	1.5024	1.5711	1.2288	1.4163
1101	China	-0.1607	0.3104	0.6672	0.7602	0.9018	0.6147
	Czech Republic	-0.1607	0.3104	0.5049	0.0922	0.4041	0.4946
	Hungary	-0.1607	0.3104	0.4566	0.4631	0.3877	0.6499
	Poland	-0.1607	0.3104	0.4612	0.3803	0.4106	0.2899
1102	China	0.2549	-0.2598	-2.2776	-2.7434	-3.4732	-4.6304
	Czech Republic	0.2549	-0.2598	-2.2825	-2.0411	-1.8584	-1.4192
	Hungary	0.2549	-0.2598	3.8562	3.3152	4.8510	5.5420
	Poland	0.2549	-0.2598	-2.9366	-1.6226	-3.3090	-2.4676
1200	China	8.1941	9.3558	11.8236	3.9333	8.5398	-8.5893
	Czech Republic	8.1941	9.3558	-27.9319	-27.9319	-39.9041	-38.8424
	Hungary	8.1941	9.3558	1.7919	1.7919	4.0511	6.6627
	Poland	8.1941	9.3558	-16.8920	-25.8122	-10.5628	-16.3770
1310	China	-0.7128	0.2304	-0.9584	-0.9467	-0.8831	-0.8102
	Czech Republic	-0.7128	0.2304	0.4024	0.4855	0.3404	0.2730
	Hungary	-0.7128	0.2304	1.2436	1.2938	1.3370	1.3173
	Poland	-0.7128	0.2304	0.9409	0.8956	0.9834	0.8302
1392	China	-0.4165	0.4659	2.1324	2.2797	2.0719	2.3300
	Czech Republic	-0.4165	0.4659	-0.6591	-0.5375	-0.6483	-0.3216
	Hungary	-0.4165	0.4659	-1.2473	-1.5071	-1.3559	-1.7367
	Poland	-0.4165	0.4659	0.3794	0.3448	0.3821	0.7128
1394	China	-0.3376	0.3586	-0.6419	-0.6286	-0.5916	-0.6518
	Czech Republic	-0.3376	0.3586	0.6763	1.0775	0.6557	0.3592
	Hungary	-0.3376	0.3586	0.5518	0.3278	0.6178	0.3288

	Poland	-0.3376	0.3586	0.0570	-0.2620	0.0921	-0.1024
1413	China	-1.3817	-0.1847	-2.6573	-2.6116	-2.4550	-2.3650
	Czech Republic	-1.3817	-0.1847	2.1327	2.4103	2.0640	2.2373
	Hungary	-1.3817	-0.1847	1.4213	1.4351	1.1950	1.1825
	Poland	-1.3817	-0.1847	0.3590	0.4336	0.3788	0.5924
1414	China	-0.8364	-0.0713	-1.7919	-2.0224	-1.6744	-1.9253
	Czech Republic	-0.8364	-0.0713	1.4611	1.4759	1.4111	1.4612
	Hungary	-0.8364	-0.0713	1.2573	1.3596	1.1909	0.9988
	Poland	-0.8364	-0.0713	0.3744	0.2527	0.4122	0.3151
1520	China	-0.2704	-0.0702	-0.9580	-0.8897	-0.9116	-0.7576
	Czech Republic	-0.2704	-0.0702	0.8928	0.9762	0.8714	1.0192
	Hungary	-0.2704	-0.0702	1.0208	1.3450	0.9760	1.1717
	Poland	-0.2704	-0.0702	0.6849	0.6867	0.6422	0.6342
1629	China	0.3661	0.0466	0.4443	0.5468	0.1267	0.0349
	Czech Republic	0.3661	0.0466	0.4897	0.1525	0.9708	0.3492
	Hungary	0.3661	0.0466	2.8925	1.8579	2.8716	1.6672
	Poland	0.3661	0.0466	0.0997	0.9062	-0.4868	-0.2755
1712	China	-0.6452	0.1020	-0.9729	-0.8713	-1.2983	-0.7950
	Czech Republic	-0.6452	0.1020	0.4558	0.8439	0.7032	1.2467
	Hungary	-0.6452	0.1020	0.0213	0.1802	-0.1858	0.5049
	Poland	-0.6452	0.1020	0.6466	0.7167	0.8980	1.1017
1722	China	-0.3259	0.2782	0.3107	0.2339	0.2997	0.3847
	Czech Republic	-0.3259	0.2782	-0.4188	-0.3406	-0.2328	-0.2231
	Hungary	-0.3259	0.2782	-0.3860	-0.4862	-0.4995	-0.3801
	Poland	-0.3259	0.2782	0.3868	0.4011	0.3948	0.5421
1723	China	-0.3534	0.1279	-0.0384	-0.0994	-0.0383	0.1800
	Czech Republic	-0.3534	0.1279	0.0342	0.1101	0.1291	0.0961
	Hungary	-0.3534	0.1279	0.0605	-0.0902	0.0644	0.3154
	Poland	-0.3534	0.1279	-0.1449	-0.2055	-0.2249	-0.1898
2012	China	-0.0694	-0.0489	-0.1089	-0.0065	-0.1080	0.0201
	Czech Republic	-0.0694	-0.0489	0.3784	0.7396	0.3415	0.6823
	Hungary	-0.0694	-0.0489	0.9788	1.1390	1.0620	1.0829
	Poland	-0.0694	-0.0489	0.5689	0.7699	0.5334	0.7680
2014	China	-0.2738	-0.2499	-2.4205	-2.9107	-2.0642	-3.2047
	Czech Republic	-0.2738	-0.2499	0.1126	-0.6084	0.0152	-0.5098
	Hungary	-0.2738	-0.2499	1.3480	1.2644	1.1917	1.0220
	Poland	-0.2738	-0.2499	0.0551	0.1859	-0.0656	-0.2654
2016	China	-0.1772	0.1642	-0.8742	-0.5435	-0.7828	-0.7355
	Czech Republic	-0.1772	0.1642	0.7019	0.7933	0.6416	0.9954
	Hungary	-0.1772	0.1642	1.8607	1.9214	1.6086	1.8566
	Poland	-0.1772	0.1642	0.5579	0.8216	0.6942	0.9944
2060	China	0.5638	0.9242	-7.0336	-8.1848	-6.8465	-7.2031
	Czech Republic	0.5638	0.9242	0.1849	-0.8641	-1.0103	-4.2114
	Hungary	0.5638	0.9242	12.2290	13.5504	10.4233	12.4129
	Poland	0.5638	0.9242	-1.6768	-2.0667	-1.2578	0.3113
2110	China	0.1094	-0.3617	-1.3183	-1.4410	-1.2746	-1.2299

	Czech Republic	0.1094	-0.3617	1.6803	1.2413	1.7331	1.5897
	Hungary	0.1094	-0.3617	1.6136	2.1838	1.5372	1.8669
	Poland	0.1094	-0.3617	1.5533	1.6119	1.6812	1.7926
2219	China	-0.2237	0.1404	-1.3635	-1.0351	-1.3366	-1.1058
	Czech Republic	-0.2237	0.1404	0.4204	-0.0554	0.4463	0.0113
	Hungary	-0.2237	0.1404	1.9345	1.8088	1.7460	1.6380
	Poland	-0.2237	0.1404	-1.0613	-1.1662	-0.9642	-1.1071
2221	China	0.3279	-0.1046	-0.5383	-0.4142	-0.5278	-0.4000
	Czech Republic	0.3279	-0.1046	0.2597	0.2708	0.2185	0.2144
	Hungary	0.3279	-0.1046	1.4994	1.2295	1.3024	0.9020
	Poland	0.3279	-0.1046	-0.4949	-0.1494	-0.3164	-0.3978
2222	China	0.1933	0.0421	-1.5956	-0.6268	-1.6351	-0.6958
	Czech Republic	0.1933	0.0421	0.3193	0.7656	0.2503	0.4842
	Hungary	0.1933	0.0421	1.0826	0.8050	0.8146	0.9149
	Poland	0.1933	0.0421	-0.1707	-0.0111	-0.1459	0.0300
2319	China	-0.3030	1.7783	-3.3073	-3.5438	-3.0575	-3.0027
	Czech Republic	-0.3030	1.7783	0.2831	0.8533	0.2179	-0.1591
	Hungary	-0.3030	1.7783	4.0931	4.3902	3.5668	3.4789
	Poland	-0.3030	1.7783	1.2013	0.7026	1.5474	1.3880
2320	China	0.1659	0.0653	-1.4400	-2.3627	-1.3338	-2.1434
	Czech Republic	0.1659	0.0653	-0.2510	-1.0797	-0.4422	-0.7142
	Hungary	0.1659	0.0653	1.4332	1.5231	1.0703	0.3324
	Poland	0.1659	0.0653	0.2375	-0.7589	0.1074	-1.0287
2410	China	0.1463	0.2748	-1.0669	-2.6588	-1.0857	-3.1973
	Czech Republic	0.1463	0.2748	-3.0745	-4.5846	-3.0620	-4.9975
	Hungary	0.1463	0.2748	-1.1530	-4.1930	-1.7674	-4.9232
	Poland	0.1463	0.2748	4.0564	1.4724	3.8333	1.1385
2442	China	-0.6925	0.3136	-0.2600	-0.3246	-0.1396	0.0669
	Czech Republic	-0.6925	0.3136	0.2845	0.2588	0.2824	0.4613
	Hungary	-0.6925	0.3136	-0.1057	-0.1462	-0.1834	-0.2576
	Poland	-0.6925	0.3136	0.0391	-0.1058	-0.0757	-0.0186
2445	China	0.1090	-0.0250	-0.9408	-1.2806	-0.9936	-1.2035
	Czech Republic	0.1090	-0.0250	1.3783	1.4500	1.2502	0.7747
	Hungary	0.1090	-0.0250	2.2518	1.8119	2.2444	2.2079
	Poland	0.1090	-0.0250	2.1663	2.1411	2.4613	2.8121
2573	China	0.0529	-0.2278	-4.8465	-5.0744	-4.8893	-5.0395
	Czech Republic	0.0529	-0.2278	-0.2163	-0.4767	-0.2249	-0.4031
	Hungary	0.0529	-0.2278	3.5518	3.3171	3.5546	2.7954
	Poland	0.0529	-0.2278	1.4788	1.8455	1.5146	1.1779
2593	China	-0.0993	0.0788	-2.3664	-3.2958	-2.2100	-2.7672
	Czech Republic	-0.0993	0.0788	-1.0313	-1.1140	-1.0680	-1.4992
	Hungary	-0.0993	0.0788	2.7278	2.7825	2.5186	1.9648
	Poland	-0.0993	0.0788	0.1163	-0.2313	0.2960	-0.4081
2594	China	-0.8676	0.6865	0.6449	0.3833	0.6118	0.3678
	Czech Republic	-0.8676	0.6865	0.1043	-0.0927	0.1288	0.0890
	Hungary	-0.8676	0.6865	-0.4459	-0.7318	-0.4259	-0.6377

	Poland	-0.8676	0.6865	0.0634	0.0062	0.0697	-0.0676
2640	China	-1.0246	-0.3487	-6.7795	-6.8485	-6.3730	-6.1794
	Czech Republic	-1.0246	-0.3487	1.4936	-0.7946	2.5292	2.1537
	Hungary	-1.0246	-0.3487	2.5981	2.7365	1.9676	1.0314
	Poland	-1.0246	-0.3487	5.2917	6.3301	4.6019	5.1327
2651	China	-0.9103	-0.0010	-2.7515	-2.1939	-2.5513	-1.9089
	Czech Republic	-0.9103	-0.0010	2.6924	3.0639	2.3247	2.9759
	Hungary	-0.9103	-0.0010	1.5171	1.4959	1.1416	1.3967
	Poland	-0.9103	-0.0010	1.9307	2.2276	1.9672	2.1525
2711	China	-0.8255	0.3889	-2.5939	-2.3806	-2.2899	-2.3832
	Czech Republic	-0.8255	0.3889	0.7518	1.6376	0.6341	0.2451
	Hungary	-0.8255	0.3889	1.7871	0.7787	2.1942	0.8002
	Poland	-0.8255	0.3889	-0.1098	0.5104	-0.2024	0.0577
2740	China	-0.8546	0.3383	-8.2911	-9.2778	-8.0295	-9.2405
	Czech Republic	-0.8546	0.3383	5.9909	6.2967	6.0590	5.8980
	Hungary	-0.8546	0.3383	3.7263	3.0071	3.9464	2.4283
	Poland	-0.8546	0.3383	1.1874	0.2708	0.8999	0.7421
2751	China	-1.4357	1.7398	10.8676	11.8783	11.5400	12.9054
	Czech Republic	-1.4357	1.7398	-5.8212	-5.2437	-5.9284	-5.6359
	Hungary	-1.4357	1.7398	-7.0165	-7.0270	-6.4930	-3.9223
	Poland	-1.4357	1.7398	-14.7788	-14.7788	-11.5011	-11.5011
2813	China	-2.5587	0.7629	-3.3994	-3.5085	-2.8024	-3.3249
	Czech Republic	-2.5587	0.7629	0.6954	-0.1372	0.2374	-0.0381
	Hungary	-2.5587	0.7629	-0.4349	-1.8115	-0.3946	-0.8692
	Poland	-2.5587	0.7629	0.3031	0.2956	0.5264	-0.0355
2814	China	0.1666	0.2706	-5.2037	-4.7909	-4.8822	-4.6242
	Czech Republic	0.1666	0.2706	0.6939	1.4127	0.4483	1.0461
	Hungary	0.1666	0.2706	4.4836	4.2160	4.2299	4.4261
	Poland	0.1666	0.2706	0.1955	0.7891	0.6587	1.1256
2815	China	-0.4114	0.3849	4.1274	5.2970	4.0355	4.7354
	Czech Republic	-0.4114	0.3849	-4.4248	-2.8240	-5.2837	-2.9130
	Hungary	-0.4114	0.3849	0.3038	1.7960	1.7591	4.2123
	Poland	-0.4114	0.3849	-0.7155	2.2608	-0.2487	2.5343
2830	China	-0.9812	-0.0265	-2.6870	-3.5868	-2.2994	-3.4563
	Czech Republic	-0.9812	-0.0265	1.4192	0.9591	1.0114	-0.2058
	Hungary	-0.9812	-0.0265	1.5874	0.8823	2.3525	0.8029
	Poland	-0.9812	-0.0265	0.0947	-1.8284	-0.2073	-1.7229
2841	China	-0.2016	0.1218	-0.5439	-0.6133	-0.4350	-0.4927
	Czech Republic	-0.2016	0.1218	0.0827	0.2338	0.0522	0.0166
	Hungary	-0.2016	0.1218	0.8282	0.6262	0.7798	0.6729
	Poland	-0.2016	0.1218	0.4428	0.2737	0.4087	0.4331
2910	China	-0.5857	0.9915	-0.2043	0.1504	-0.0482	0.0463
	Czech Republic	-0.5857	0.9915	0.8688	1.2614	0.7929	1.5199
	Hungary	-0.5857	0.9915	1.5049	1.6329	1.3307	1.2431
	Poland	-0.5857	0.9915	-0.0462	-0.2899	-0.1542	-0.4007
2931	China	-0.5704	-0.5784	-11.1836	-11.1836	-10.3874	-10.0224

	Czech Republic	-0.5704	-0.5784	7.5049	4.2640	6.0138	1.8227
	Hungary	-0.5704	-0.5784	5.3985	2.4594	4.9501	2.6515
	Poland	-0.5704	-0.5784	-0.5900	-3.8455	-1.3804	-3.4882
2932	China	-0.2233	0.3493	1.2436	0.5354	1.3527	0.6016
	Czech Republic	-0.2233	0.3493	-0.7105	-0.4504	-0.7822	-0.4481
	Hungary	-0.2233	0.3493	0.4652	0.5409	0.3703	0.5149
	Poland	-0.2233	0.3493	-0.8622	-0.7226	-0.8992	-0.9463
3020	China	-0.4527	-0.2360	-0.5778	-0.5686	-0.3798	0.1723
	Czech Republic	-0.4527	-0.2360	-0.1951	0.2901	-0.0989	0.5827
	Hungary	-0.4527	-0.2360	0.8626	0.8626	1.0381	1.0213
	Poland	-0.4527	-0.2360	0.6435	0.6677	0.5586	0.7207
3030	China	-6.8431	0.4347	-4.9919	-4.9919	-5.4311	-5.4311
	Czech Republic	-6.8431	0.4347	2.1634	2.1634	2.2624	2.2624
	Hungary	-6.8431	0.4347	2.2504	2.2504	2.0371	2.0371
	Poland	-6.8431	0.4347	-	-	-	-
3100	China	-0.5515	0.3059	-0.9956	-1.1491	-0.9130	-1.4958
	Czech Republic	-0.5515	0.3059	-0.0676	-0.0971	-0.1292	-0.1039
	Hungary	-0.5515	0.3059	1.1914	0.5775	1.3686	0.6930
	Poland	-0.5515	0.3059	-0.0543	-0.6031	0.3155	-0.2429
3101	China	-0.5571	0.2702	0.6313	0.8294	0.4673	0.7768
	Czech Republic	-0.5571	0.2702	0.0494	0.0126	0.0448	0.0298
	Hungary	-0.5571	0.2702	-0.8050	-0.5197	-0.7289	-0.9160
	Poland	-0.5571	0.2702	0.5982	0.7768	0.6121	0.6653
3220	China	-0.3070	-0.0408	-0.0108	-0.0684	0.0181	0.0199
	Czech Republic	-0.3070	-0.0408	0.2797	0.4029	0.2204	0.4473
	Hungary	-0.3070	-0.0408	0.6101	1.4461	0.5725	1.3173
	Poland	-0.3070	-0.0408	0.7243	0.7441	0.7450	0.7869
3230	China	-0.6755	0.4465	-4.0054	-4.0595	-3.8890	-4.1078
	Czech Republic	-0.6755	0.4465	1.2170	1.2767	1.4575	1.6708
	Hungary	-0.6755	0.4465	1.9643	2.3703	1.8382	2.4628
	Poland	-0.6755	0.4465	2.0092	2.4620	1.8019	1.3994
3250	China	0.0526	0.2630	-2.3783	-2.5771	-2.3095	-2.3332
	Czech Republic	0.0526	0.2630	0.4211	0.5465	0.4790	0.4308
	Hungary	0.0526	0.2630	2.0263	2.4843	1.8721	2.1891
	Poland	0.0526	0.2630	0.9904	1.0920	1.0610	1.0032

Note: (1) Summary of the three components that make up the quality measure according to Khandelwal’s (2010) method. Source: Own calculations.