LATVIJAS BANKA

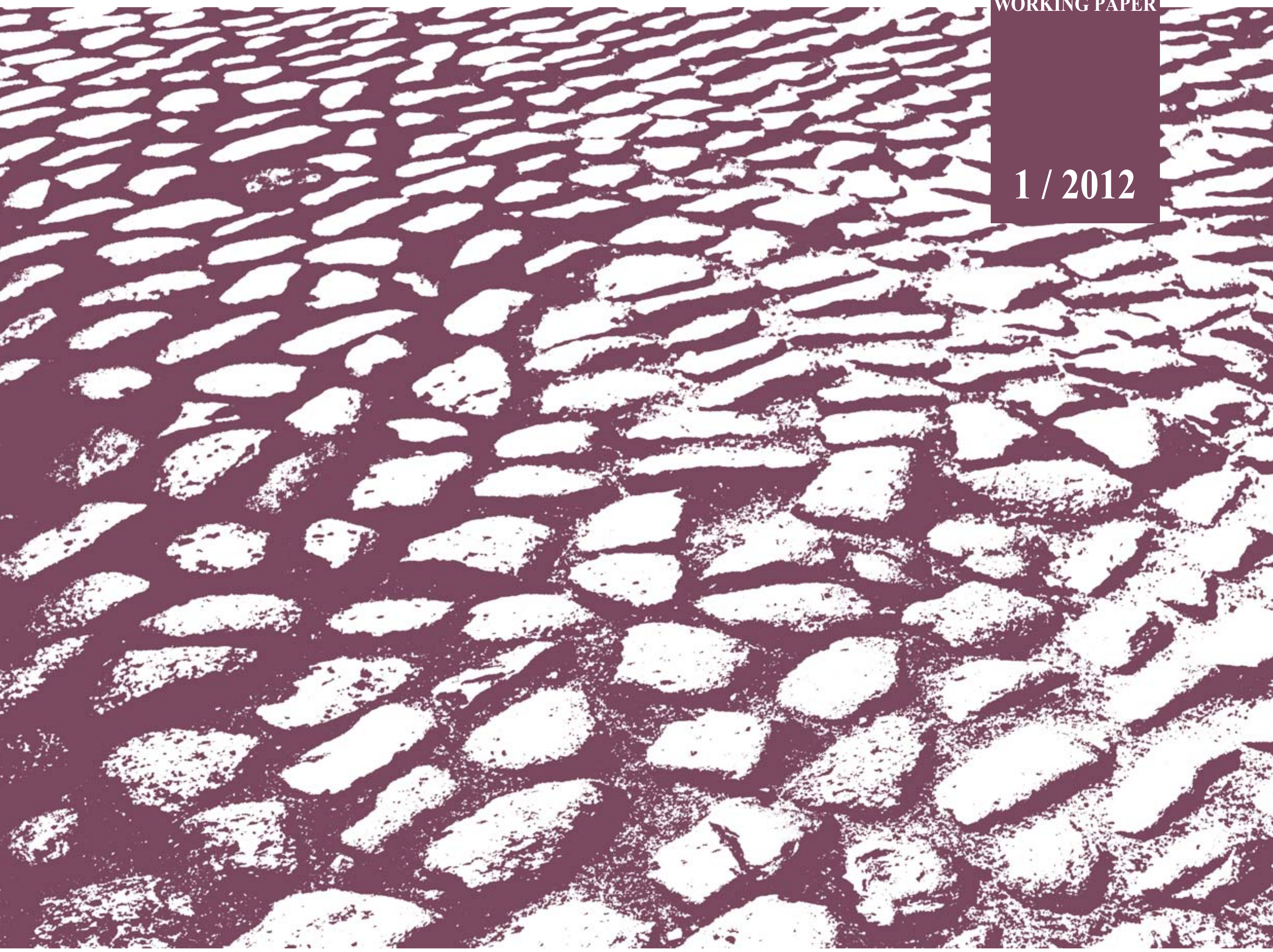
ISBN 978-9984-888-02-6

KONSTANTĪNS BEŅKOVSKIS
JULIA WÖRZ

EVALUATION OF NON-PRICE COMPETITIVENESS OF EXPORTS FROM CENTRAL, EASTERN AND SOUTHEASTERN EUROPEAN COUNTRIES IN THE EU MARKET

WORKING PAPER

1 / 2012



CONTENTS

ABBREVIATIONS

CES – constant elasticity of substitution
CESEE – Central, Eastern and Southeastern Europe
CIS – Commonwealth of Independent States
CN – Combined Nomenclature
Comext – Eurostat database for external trade
CPI – Consumer Price Index
EU – European Union
EU27 – countries of the EU
GMM – Generalised Method of Moments
HTS – Harmonised Tariff Schedule
PPI – Producer Price Index
RXP – relative export price
TSUSA – Tariff Schedule for the United States Annotated
ULC – unit labour costs
UN Comtrade – United Nations Commodity Trade Statistics Database
VAT – value added tax

ABSTRACT

We propose an export price indicator adjusted for non-price factors as a measure of a country's competitiveness. Based on the approach by Broda and Weinstein (2006) who adjust price developments for changes in varieties of imported products, we relax their assumption of unchanged quality over time and apply this index to export prices of the ten CESEE EU Member States which acceded in 2004 and 2007. The index is calculated using data from Comext at the highly disaggregated eight-digit CN product level. Our analysis spans the time period from 1999 to 2010, thus including the recent global recession in 2009. The results show that all CESEE10 countries experienced loss in price competitiveness, although much smaller than is usually suggested by the traditional CPI-based or ULC-based real effective exchange rate measures. Although relative export prices (unit values) increased stronger in CESEE10 countries as compared with their competitors, the average quality of their goods increased even more, thus fully compensating for the rise in prices. These improvements in non-price competitiveness were pronounced in all CESEE10 countries.

JEL codes: C43, F12, F14, L15

Keywords: non-price competitiveness, quality, relative export price

The views expressed in this research are those of the authors (Konstantīns Beņkovskis, Monetary Policy Department, Latvijas Banka, and Julia Wörz, Foreign Research Division, Oesterreichische Nationalbank). The authors assume responsibility for any errors and omissions.

INTRODUCTION

The CESEE countries have demonstrated tremendous gains in international competitiveness during their transition from centrally planned to market economies. Per capita income levels are substantially higher today than twenty years ago, marking impressive improvements in productivity levels. However, their catching-up process implied convergence in both income and price levels towards Western Europe. The convergence process was in fact accompanied by a real appreciation trend of CESEE currencies over the past two decades, which could suggest a loss in price competitiveness as a result of the catching-up progress.

This example demonstrates that the notion of competitiveness is simultaneously a very widely used and an ill-defined concept. In the broadest perspective, a nation's competitiveness is reflected by its relative global ranking in per capita income levels. This broad assessment of competitiveness can be accompanied by an evaluation of taxation policies, regulations, market rigidities and labour market conditions as important explanatory factors which determine competitiveness. Such a perspective reflects the World Economic Forum's definition of competitiveness as ".. the set of institutions, policies, and factors that determine the level of productivity of a country." (Sala-i-Martin (2010)). In a narrower sense, the business community and economic policy discussions alike look at relative prices of goods and services as the outcome of all those determinants which influence competitiveness at the macro level (see De Grauwe (2010) for a comprehensive overview of competitiveness). Very often, the analysis of price and cost measures therefore dominates the policy discussion. In particular, the real effective exchange rate is often used as a general proxy of competitiveness despite the fact that price measures ignore important non-price aspects of competitiveness such as quality improvements or shifts in consumer preferences. Further, price and cost measures may show divergent developments, making it difficult to identify even a single price indicator of competitiveness. Clearly, individual indicators illuminate different aspects of competitiveness, which should also be acknowledged.

In this analysis, we try to incorporate important non-price features of a country's competitiveness, and namely the quality of exported goods as well as changes in the set of competitors, into a measure of price competitiveness. In other words, we correct a country's export price index for any bias, which might arise from non-price factors such as physical quality, variations in consumer tastes, and competitive pressure arising from newly entering competitors. While the proposed measure still neglects many important aspects of competitiveness, we hope that it gives a more unbiased picture of a country's ability to sell goods on a certain market. We apply the proposed corrected export price index to export performance of the CESEE10 countries, which acceded to the EU in 2004 and 2007. We are able to show that according to this measure most CESEE countries unambiguously have showed gains in non-price competitiveness on the EU market since 1999. These competitiveness gains are rather pronounced for all CESEE countries, although less so at the aggregate country level for Slovenia and Hungary.

The next section explains the rationale behind our proposed measure of competitiveness. Section 2 explains the theoretical background, Section 3 describes the database, and Section 4 presents the empirical results. The final section concludes.

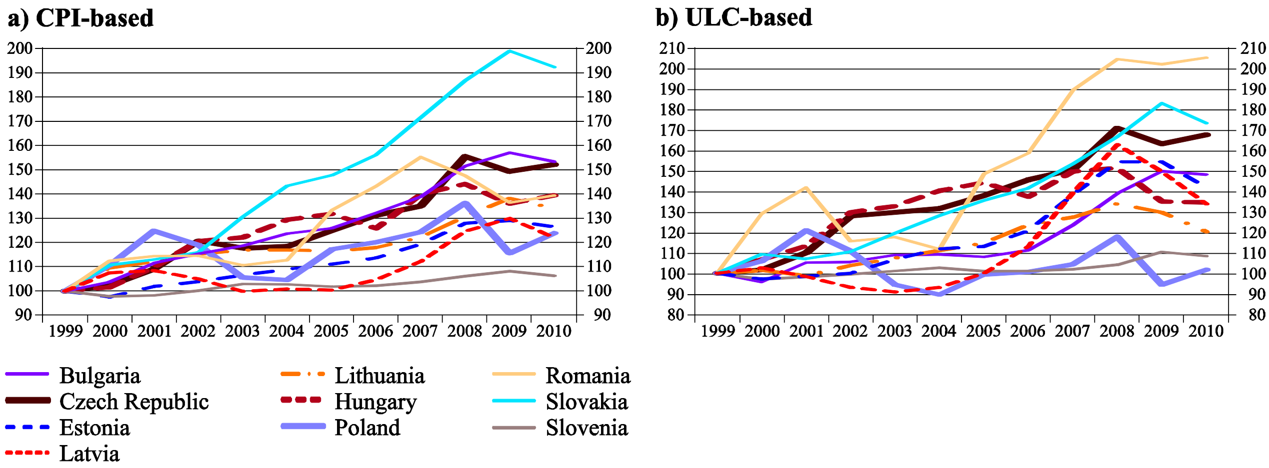
1. FROM PRICE TO NON-PRICE COMPETITIVENESS

The real effective exchange rate is one of the most widely used tools in the analysis of a country's international competitiveness. It reflects relative changes in the prices of a country's export goods due to changes in nominal exchange rates and inflation differentials. Inflation differentials can be captured in various ways, leading to different measures of the real exchange rate. The most popular measure is based on inflation differentials as measured by the CPI. This popularity is obviously explained by data availability and comparability issues due to harmonised CPI measures. Other popular definitions are PPI-based and ULC-based real exchange rates. Figure 1 shows two such measures for the CESEE10 countries, one based on consumer prices and the other one on unit labour costs.

Figure 1

Real effective exchange rates of CESEE10 countries

(36 trading partners, 1999 = 100)



Source: Eurostat.

Note: Increase denotes real appreciation of the national currency which can be interpreted as a loss of competitiveness.

Both indicators show a steep increase in export prices of CESEE over the sample period from 1999 to 2010 relative to other exporters, which can be interpreted as a clear loss in price competitiveness. This process was not uniform either across countries or over years: cumulated real exchange rate dynamics were rather heterogeneous in the region. While Slovenia showed almost no deterioration in price competitiveness, Romania, Slovakia and the Czech Republic were severely affected. Over time, the most rapid losses in price competitiveness were observed during the boom years. In 2009, price competitiveness improved in the Czech Republic, Poland and Hungary due to nominal depreciation of the national currency, while in 2009–2010 such an improvement was also observed in countries with fixed exchange rates (in the Baltic States and Bulgaria, CPI-based index shows the improvement only in 2010, which can be explained by inertia of consumer prices and tax rate increases in 2009 in some countries). However, such a simple interpretation of the long-run real appreciation trend in CESEE can be quite misleading for various reasons.

First, the traditional real exchange rates have several drawbacks. The CPI-based index shows the dynamics of relative consumer prices, which can be a rather poor approximation of the dynamics in relative export prices. Domestic and export prices are faced by different demand and supply conditions and can therefore differ greatly. Further, the CPI-based index includes changes in indirect taxes, e.g. VAT, that do not affect export activities directly. Although the PPI-based index is closer to the production side of the economy, it still includes production for the domestic market (data on export-oriented PPI are usually very scarce). The ULC-based index has a similar drawback; moreover, it usually refers to the total economy, including also the services sector. A solution to these shortcomings is to use a relative export price index, i.e. an indicator that is often employed in macroeconomic models when explaining the dynamics of real exports. However, if an aggregate export deflator is used to construct a measure of competitiveness, there is still one serious problem – the structure of exports differs across countries. Therefore, the need arises to conduct the analysis at the most disaggregated level to ensure that similar export products are compared for different countries before aggregating the results at the country level.

Second, the real exchange rate indices measure only price competitiveness of exports while ignoring non-price factors that affect the performance of exports. One such non-price factor emphasised by Flam and Helpman (1987) is connected to vertical differentiation or quality of exported products. Another non-price factor is changes in consumer tastes, which can be driven either objective or by such subjective factors as image or branding.

Finally, as emphasised particularly in the recent empirical trade literature, consumers gain additional utility from increased product variety through international trade. Therefore, a change in the set of rivals can affect the competitiveness of an exporter (a larger number of rivals exporting the same product to one particular market means an increasing variety for consumers). Although several price measures (CPI and PPI) are adjusted for changes in product quality, they do not provide any possibility to incorporate changes in consumer tastes or product variety.

Further, we will propose an adjusted relative export price index, which overcomes many of abovementioned drawbacks and describes both price and non-price competitiveness of exports. Before doing so, let us clearly define quality and variety (set of competitors) in our context. In this analysis, quality will denote both taste and physical quality for the ease of reading. Thus, quality in this broad meaning can be defined as any tangible or intangible attribute of a good that changes consumers' valuation of it (definition by Hallak and Schott (2008)). Hence this parameter encompasses physical attributes of a product (e.g. size, a set of available functions, durability), which can be summarised as quality, and intangible attributes (e.g. product image and brand name), which can be summarised as taste. We identify variety with products imported from different origins within the same product category, i.e. we adopt the Armington (1969) assumption as in Broda and Weinstein (2006).[1] As in this paper we are focusing on export prices, variety means a set of countries (rivals) that are exporting the same product category to a particular market.

[1] The Armington (1969) assumption, although very restrictive, is widely used in empirical research due to data limitations. Obviously, the definition of variety (set of competitors) at a firm or brand level would be more realistic, but this definition would require micro-level data. See Blonigen and Soderbery (2010), and Sheu (2011) for examples of such an approach.

2. THEORETICAL FRAMEWORK

In this section, we briefly describe the theoretical model used in the paper. A more detailed exposition of the theoretical background underlying methodology is given in Benkovskis and Wörz (2011). Although our final goal is to evaluate an adjusted relative *export* price index, we define the theoretical model from the *import* side. There are two reasons for focusing on imports rather than on exports. First, to describe the role of quality and variety in international trade, one primarily needs to understand how consumers value quality and variety. This can be done by using a representative household utility function, which includes domestic and imported products. In this paper, we follow closely the approach developed by Broda and Weinstein (2006), and Feenstra (1994). Second, also in the empirical analysis we will work with imports as a mirror-image of exports because of our choice of the database. Due to the reasons described in Section 3 below, we will work with Comext, as the only way to obtain information on competitors of CESEE from outside the EU (e.g. the US and China) is to use total imports of all EU Member States.

We start by defining nested constant elasticity of substitution (CES), the utility function of a representative household, which consists of three nests as proposed by Broda and Weinstein (2006). In the upper level, a composite import good and a domestic good are consumed:

$$U_t = \left(D_t^{\frac{\kappa-1}{\kappa}} + M_t^{\frac{\kappa-1}{\kappa}} \right)^{\frac{\kappa}{\kappa-1}}; \quad \kappa > 1 \tag{1}$$

where D_t is the domestic good, M_t is composite imports, and κ is the elasticity of substitution between the domestic and foreign good. At the second level of utility function, the composite imported good consists of individual imported products:

$$M_t = \left(\sum_{g \in G} M_{gt}^{\frac{\gamma-1}{\gamma}} \right)^{\frac{\gamma}{\gamma-1}}; \quad \gamma > 1 \tag{2}$$

where M_{gt} is sub-utility from consumption of imported good g, γ is the elasticity of substitution between different import goods, while G denotes a set of imported goods. The third level utility function is the place where variety and quality are introduced into the model. Each imported good consists of various varieties (is imported from different countries of origin, therefore product variety indicates a set of competitors on the particular market). The taste and quality parameter denotes the subjective or objective quality that consumers attach to the product. M_{gt} is defined by a non-symmetric CES function:

$$M_{gt} = \left(\sum_{c \in C} d_{gct}^{\frac{1}{\sigma_g}} m_{gct}^{\frac{\sigma_g-1}{\sigma_g}} \right)^{\frac{\sigma_g}{\sigma_g-1}}; \quad \sigma_g > 1 \quad \forall \quad g \in G \tag{3}$$

where m_{gct} denotes quantity of imports g from country c, C is a set of all partner countries, d_{gct} is the taste and quality parameter, and σ_g is the elasticity of substitution among varieties of good g.

After solving the utility maximisation problem subject to the budget constraint, the minimum unit-cost function of import good g is represented by

$$\phi_{gt} = \left(\sum_{c \in C} d_{gct} \, p_{gct}^{1-\sigma_g} \right)^{\frac{1}{1-\sigma_g}} \tag{4}$$

where ϕ_{gt} denotes minimum unit-cost of import good g and p_{gct} is the price of good g imported from country c.[2] Equation (4) shows that the minimum unit cost of each import good depends not only on prices (or unit values) but also on the quality and taste parameter d_{gct}.

In what follows, we will discuss the import price as well as index and show how it can include changes in quality and variety (set of competitors). Afterwards, we will explain how import price indices can be used to construct an aggregate relative export price index. Our measure of relative export price index depends on relative quality, which is an unobservable parameter. Evaluation of the relative quality is made following the approach by Hummels and Klenow (2005). Finally, the method of estimating elasticities of substitution between varieties is explained.

2.1 Variety and quality adjusted import price index

The price indices for good g can be defined as a ratio of minimum unit costs in current period to minimum unit costs in previous period ($P_g = \phi_{gt} / \phi_{gt-1}$).[3] As shown above, minimum unit costs depend on the price and quality and taste parameter, i.e. an increase in d_{gct} reduces ϕ_{gt}. In addition, we should note that the variety (set of partner countries C) can change over time, and an increase in variety will also reduce ϕ_{gt}. This is quite obvious, as the utility function states that consumers value quality and variety, therefore an increase in any of these parameters will enlarge consumers' utility and decrease minimum unit costs.

The conventional assumption is that quality and taste parameters are constant over time for all varieties and products, ($d_{gct} = d_{gct-1}$), and the price index is calculated over a set of product varieties $C_g = C_{gt} \cap C_{gt-1}$ available in periods t and $t-1$, where $C_{gt} \subset C$ is the subset of all varieties of goods consumed in period t.

2 This approach is based on the famous "duality approach" to modelling international trade in a general equilibrium framework developed by Dixit and Norman (1980). In this approach, consumer behaviour is modelled through expenditure or indirect utility functions and producer behaviour by cost, revenue or profit functions. Cost minimisation can therefore be seen as being equivalent to utility maximisation. From the consumers perspective, the price paid for one unit of utility can be minimised either by choosing a cheaper product or a more qualitative product.

3 See Diewert (1993b) for more details.

Sato (1976) and Vartia (1976) proved that for a CES function the exact price index will be given by

$$P_g^{conv} = \prod_{c \in C_g} \left(\frac{p_{gct}}{p_{gct-1}} \right)^{w_{gct}} \tag{5}$$

where weights w_{gct} are computed using cost shares s_{gct} in the two periods as follows:

$$w_{gct} = \frac{\left(s_{gct} - s_{gct-1}\right) / \left(\ln s_{gct} - \ln s_{gct-1}\right)}{\sum_{c \in C_g} \left(\left(s_{gct} - s_{gct-1}\right) / \left(\ln s_{gct} - \ln s_{gct-1}\right)\right)};\ s_{gct} = \frac{p_{gct} x_{gct}}{\sum_{c \in C_g} p_{gct} x_{gct}}$$

and x_{gct} is the cost-minimising quantity of good g imported from country c.

The import price index in equation (5) ignores possible changes in quality and variety (set of partner countries). The underlying assumption that variety is constant was relaxed by Feenstra (1994), who modified the price index for the case when the set of varieties is different, although overlapping in the two periods. Broda and Weinstein (2006) developed it further, assuming different elasticities of substitution between varieties (see Proposition 1 in their paper). According to them, if $d_{gct} = d_{gct-1}$ for $c \in C_g = \left(C_{gt} \cap C_{gt-1}\right),\ C_g \neq \varnothing$, the exact price index for good g is given by

$$P_g^{bw} = \prod_{c \in C_g} \left(\frac{p_{gct}}{p_{gct-1}} \right)^{w_{gct}} \left(\frac{\lambda_{gt}}{\lambda_{gt-1}} \right)^{\frac{1}{\sigma_g - 1}} = P_g^{conv} \left(\frac{\lambda_{gt}}{\lambda_{gt-1}} \right)^{\frac{1}{\sigma_g - 1}} \tag{6}$$

where $\lambda_{gt} = \dfrac{\sum_{c \in C_g} p_{gct} x_{gct}}{\sum_{c \in C_{gt}} p_{gct} x_{gct}}$ and $\lambda_{gt-1} = \dfrac{\sum_{c \in C_g} p_{gct-1} x_{gct-1}}{\sum_{c \in C_{gt-1}} p_{gct-1} x_{gct-1}}$.

Therefore, the price index derived in equation (5) is multiplied by an additional term, which captures the role of new and disappearing variety. This approach is not limited only to the number of varieties but also takes into account expenditure shares, therefore giving a higher weight to the varieties in the consumption bundle. In case the expenditure share of new varieties exceeds that of disappearing varieties, the additional term is smaller than unity, which lowers the import price index in equation (6). In other words, if a new competitor appears on the market, it increases the utility of consumers and reduces the minimum unit costs. The effect from a changing set of variety depends also on the elasticity of substitution between varieties. That is, if varieties are close substitutes, the additional term is close to unity, and the changes in available varieties do not have a significant effect on the price index in equation (6).

Broda and Weinstein (2006) assume that taste and quality parameters are unchanged for all varieties of all goods ($d_{gct} = d_{gct-1}$), namely, the vertical product differentiation is ignored. This assumption is clearly too unrealistic, taking into account rapid technological changes in many sectors of the economy and variable consumer tastes. Benkovskis and Wörz (2011) introduced an import price index that allows also for changes in taste or quality:

$$P_g^q = \left(\frac{\sum_{c \in C_{gt}} d_{gct} p_{gct}^{1-\sigma_g}}{\sum_{c \in C_{gt-1}} d_{gct-1} p_{gct-1}^{1-\sigma_g}} \right)^{\frac{1}{1-\sigma_g}} = \\ = \prod_{c \in C_g} \left(\frac{p_{gct}}{p_{gct-1}} \left(\frac{d_{gct}}{d_{gct-1}} \right)^{\frac{1}{1-\sigma_g}} \right)^{w_{gct}} \left(\frac{\lambda_{gt}}{\lambda_{gt-1}} \right)^{\frac{1}{\sigma_g - 1}} = P_g^{conv} \left(\frac{\lambda_{gt}}{\lambda_{gt-1}} \right)^{\frac{1}{\sigma_g - 1}} \prod_{c \in C_g} \left(\frac{d_{gct}}{d_{gct-1}} \right)^{\frac{w_{gct}}{1-\sigma_g}} \quad (7).$$

Equation (7) could be seen as a modified version of equation (6), where the additional term captures changes in the quality and taste parameter. This term states that if the aggregate quality of a good increases over time, this gives higher utility to consumers and reduces minimum unit costs (note, that minimum costs in equation (4) are defined as euro per unit of utility). The additional term also depends on the product-specific elasticity of substitution between varieties. If σ_g is high, the term reflecting changes in quality goes to unity. In other words, changes in quality for close substitutes do not have a large effect on import prices and welfare, while quality plays an important role for imperfect substitutes.

2.2 From import to export prices

Our final goal is to evaluate an adjusted relative export price index, while equation (7) gives us a formula for a variety-adjusted and quality-adjusted import price index. So far, the index derived is equal to the one we derive in Benkovskis and Wörz (2011). In what follows, we move from an index for import prices towards an index for export prices. Another distinction is that in order to assess competitiveness, which is a purely relative concept, we do not need to specify a benchmark product here to assess changes in quality. However, we can easily interpret x_{gct}, i.e. imports of product g originating from country *c*, as country's *c* exports of product g to the importing market (for a moment let's assume that for all exporting countries there exists only one destination of exports, i.e. the importing country where the representative household resides).[4] Another problem arises from the need to compare the performance of one particular country relative to its competitors, while equation (7) gives the aggregate import price of all suppliers. We propose to define changes in the adjusted relative export price of good g exported by country k in the following way:

$$RXP_{gkt} = \frac{\phi_{gt}^{k} / \phi_{gt-1}^{k}}{\phi_{gt}^{-k} / \phi_{gt-1}^{-k}} = \frac{\left(p_{gkt} / p_{gkt-1}\right)\left(d_{gkt} / d_{gkt-1}\right)^{\frac{1}{1-\sigma_g}}}{\phi_{gt}^{-k} / \phi_{gt-1}^{-k}} \quad (8)$$

4 We will relax this assumption in equation (10) below.

where ϕ_{gt}^{k} denotes the minimum unit cost of good g when exported by (imported from) country k, while ϕ_{gt}^{-k} is the minimum unit cost of good g when exported by (imported from) all countries except k. In other words, ϕ_{gt}^{k} is obtained by maximising the nested utility function if country k is the only exporter. It is obvious that $\phi_{gt}^{k} = p_{gkt} d_{gkt}^{\frac{1}{1-\sigma_g}}$ and minimum unit costs of good g exported by (imported from) country k depend on the export price (unit value) and quality of the exported product. Analogically, ϕ_{gt}^{-k} is obtained from maximising utility under the assumption that exports from country k are zero.[5] After combining equations (7) and (8) we obtain

$$RXP_{gkt} = \prod_{c \in C_g^{-k}} \left(\frac{p_{gkt}}{p_{gct}} \frac{p_{gct-1}}{p_{gkt-1}} \right)^{w_{gct}^{-k}} \left(\frac{\lambda_{gt}^{-k}}{\lambda_{gt-1}^{-k}} \right)^{\frac{1}{1-\sigma_g}} \prod_{c \in C_g^{-k}} \left(\frac{d_{gkt}}{d_{gct}} \frac{d_{gct-1}}{d_{gkt-1}} \right)^{\frac{w_{gct}^{-k}}{1-\sigma_g}} \tag{9}$$

where C_g^{-k} is a set of product varieties available in both periods, excluding varieties coming from country k, w_{gct}^{-k} and λ_{gt}^{-k} are calculated similar to w_{gct} and λ_{gt}, again excluding country k from the set of exporters (varieties).

The index of adjusted relative export prices in equation (9) can be divided into three parts.

- The first term gives the traditional or conventional definition of changes in relative export prices, which are driven by changes in relative export unit values weighted by the importance of competitors of country k on a given market for a specific product (represented by w_{gct}^{-k}). An increase in relative export unit values is interpreted as a loss of price competitiveness.

- The second term represents Feenstra's (1994) term capturing changes in varieties (i.e. the set of exporters of this product in our case). Different than in equation (6), this term is now calculated excluding exports coming from country k. It can be interpreted as the effect from a changing set of competitors – more competitors for the same product give higher utility and lower minimum unit costs for consumers while at the same time lowering market power of exporters from country k. Therefore, more competitors imply a positive contribution to the adjusted relative export price index and are associated with a loss of non-price competitiveness.

- The third term is simply a change in relative quality of exports. If the quality of country k's exports is rising faster than that of its rivals, the contribution to the adjusted relative export price index is negative, thus signalling improvements in non-price competitiveness.

[5] Note, that excluding exports originating from country k does not affect the optimal structure of remaining trade flows in the utility maximisation problem. This is because the relative quantity of imports coming from two different origins is only determined by relative prices and quality of imports from those origins.

Finally, we need to design an aggregate relative export price, as the index in equation (9) describes relative export prices only for one specific product exported to one particular market. Therefore we relax the assumption of only one destination for exports and allow for various importing countries. In all these countries consumers are maximising their utility. Of course, all parameters and variables entering the three-layer utility function can be different across countries. If we denote the export price, export volume and relative export price index of product g exported by country k to country i as $p(i)_{gkt}$, $x(i)_{gkt}$ and $RXP(i)_{gkt}$ accordingly, the aggregate adjusted relative export price index can be defined as

$$RXP_{kt} = \prod_{i \in I} \prod_{g \in G} RXP(i)_{gkt}^{W_{igt}} \tag{10}$$

where $W_{igt} = \dfrac{(S_{igt} - S_{igt-1}) / (\ln S_{igt} - \ln S_{igt-1})}{\sum_{i \in I} \sum_{g \in G} ((S_{igt} - S_{igt-1}) / (\ln S_{igt} - \ln S_{igt-1}))}$; $S_{igt} = \dfrac{p(i)_{gkt} x(i)_{gkt}}{\sum_{i \in I} \sum_{g \in G} p(i)_{gkt} x(i)_{gkt}}$.

Equation (10) shows that the aggregate index is just another Sato-Vartia index, and its weights are computed using the share of product g exports to country i out of total exports by country k.[6] The reason for using export rather than import shares in equation (10) is straightforward. As RXP_{kt} is designed to describe the price and non-price competitiveness of country k's exports, the importance of various products and markets in this index should be determined by country k's export structure.

2.3 Evaluation of relative quality

The calculation of the adjusted relative export price index in equation (9) is a rather challenging task due to the fact that relative quality is unobservable. As in Hummels and Klenow (2005), we evaluate unobserved quality from the utility optimisation problem in the following way: after taking first order conditions and transformation into log-ratios, we can express relative quality in terms of relative prices, volumes and elasticity of substitution between varieties as

$$\ln\left(\frac{d_{gct}}{d_{gkt}}\right) = \sigma_g \ln\left(\frac{p_{gct}}{p_{gkt}}\right) + \ln\left(\frac{x_{gct}}{x_{gkt}}\right) \tag{11}$$

where k denotes a benchmark country. This expression is similar to equation (7) in Hummels and Klenow (2005), except that we allow the elasticity of substitution to differ between varieties of individual goods, and the right hand side is multiplied by the inverted elasticity of substitution due to a slightly different definition of the

[6] In this case the use of Sato-Vartia index cannot be explained by the CES aggregation function as in equation (5). The choice of index was driven by other justifications. The Sato-Vartia index satisfies most of the bilateral index tests except circularity and monotonicity tests (see Diewert (1993a) for description of tests, and Reinsdorf and Dorfman (1999) for discussion on Sato-Vartia index and monotonicity axiom). However, we cannot use the Fisher index, which satisfies also monotonicity test. $RXP(i)_{gkt}$ denotes a change in relative prices, while for the Fisher index one needs an index of changes in terms of absolute export prices. This, in turn, requires the evaluation of absolute quality. Benkovskis and Wörz (2011) showed how to evaluate absolute quality of imported product, although it requires additional assumptions and is much less robust compared with relative quality estimates.

utility function. Equation (11) shows that relative quality is to a large extent indicated by relative prices. If the price of a specific good exported by country c (measured by its unit value) is higher than the price of the same good exported by country k, this is an indication of a higher quality of the former. Moreover, when different varieties are close substitutes, the role of relative prices increases. However, the relative price is not the only indicator of relative quality, as also relative consumed quantity of a single variety gives a contribution to the evaluation of relative quality. A larger amount of consumption is a clear sign of better quality, and relative quantity is a more important indicator of relative quality when the elasticity of substitution between varieties is small.

2.4 Estimation of elasticities

The elasticity of substitution between varieties (σ_g) cannot be directly obtained from statistical data. To derive the elasticity of substitution, one needs to specify the demand and supply equations. The demand equation is defined by re-arranging the minimum unit-cost function in terms of the market shares, taking first differences and ratios to a reference country:

$$\frac{\Delta \ln s_{gct}}{\Delta \ln s_{gkt}} = -(\sigma_g - 1)\frac{\Delta \ln p_{gct}}{\Delta \ln p_{gkt}} + \varepsilon_{gct} \qquad (12)$$

where $\varepsilon_{gct} = \Delta \ln d_{gct}$, therefore we assume that the log of quality is a random walk process. The export supply equation relative to country k is given by

$$\frac{\Delta \ln p_{gct}}{\Delta \ln p_{gkt}} = \frac{\omega_g}{1+\omega_g}\frac{\Delta \ln s_{gct}}{\Delta \ln s_{gkt}} + \delta_{gct} \qquad (13)$$

where $\omega_g \geq 0$ is the inverse supply elasticity assumed to be the same across partner countries. A weakness of the system of equations (12) and (13) is the absence of exogenous variables, which would be needed to identify and estimate elasticities. To get these estimates, one needs to transform the system of two equations into a single equation by exploiting Leamer's (1981) approach and the independence of errors ε_{gct} and δ_{gct}.[7] This is done by multiplying both sides of equations. After such transformations, the following equation is obtained:

$$\left(\frac{\Delta \ln p_{gct}}{\Delta \ln p_{gkt}}\right)^2 = \theta_1\left(\frac{\Delta \ln s_{gct}}{\Delta \ln s_{gkt}}\right)^2 + \theta_2\left(\frac{\Delta \ln p_{gct}}{\Delta \ln p_{gkt}}\right)\left(\frac{\Delta \ln s_{gct}}{\Delta \ln s_{gkt}}\right) + u_{gct} \qquad (14)$$

where

[7] It can be argued, however, that the quality or taste parameter can implicitly enter the residual of both demand and supply equations (12) and (13). This is more likely when the quality reflects tangible properties of a product and as such increases the production costs of high-quality product. This problem cannot be addressed without a well-derived supply side in the model, therefore, we leave this question to further research.

$$\theta_1 = \frac{\omega_g}{(1+\omega_g)(\sigma_g - 1)}; \ \theta_2 = \frac{1-\omega_g(\sigma_g - 2)}{(1+\omega_g)(\sigma_g - 1)};$$

$$u_{gct} = \varepsilon_{gct}\delta_{gct}.$$

It should be noted that the evaluation of θ_1 and θ_2 leads to inconsistent estimates, as the relative price and relative market shares are correlated with the error u_{gct}. However, it is still possible to obtain consistent estimates by exploiting the panel nature of data. Broda and Weinstein (2006) argue that one needs to define a set of moment conditions for each good g by using the independence of unobserved demand and supply disturbances for each country over time:

$$G(\beta_g) = E_t(u_{gct}(\beta_g)) = 0 \quad \forall c$$

where $\beta_g = (\sigma_g, \omega_g)$ represents the vector of estimated elasticities. For each good g the following GMM estimator is obtained:

$$\hat{\beta}_g = \arg\min_{\beta \in B} G^*(\beta_g)' W G^*(\beta_g) \qquad (15)$$

where $G^*(\beta_g)$ is the sample analog of $G(\beta_g)$ and B is a set of economically feasible values of β ($\sigma_g > 1$ and $\omega_g \geq 0$). W is a positive definite weighing matrix, which weighs the data such that the variance depends more on large shipments and becomes less sensitive to measurement error. Broda and Weinstein (2006) first estimate θ_1 and θ_2 by solving an unconstrained minimisation problem and then apply a grid search in case this produces imaginary numbers or the wrong sign for elasticities. We use a direct approach and solve equation (15) as a constrained minimisation problem.

3. DESCRIPTION OF DATABASE

For empirical analysis, we use the trade data available from Comext. While this limits our analysis to the EU market and therefore precludes the evaluation of non-price competitiveness of CESEE exports on other important markets (e.g. Russia or Turkey), it gives a good representation of total export performance, as the EU27 countries is by far the major trading partner for all CESEE10 countries.[8] Further, the Comext provides a very timely data release, with annual figures available approximately three months after the end of the year, which gives us an opportunity to include the recent crisis-years in the analysis. Another advantage over other data sources (e.g. the UN Comtrade) is the disaggregation level. As we need to break down nominal trade flows into prices and volumes, the analysis has been carried out at the most detailed level, which is the eight-digit level of CN classification in Comext yielding approximately 10 000 products each year.

[8] The share of CESEE10 countries exports to the EU27 countries is reasonably high, ranging between 60% and 84% in 2010 (60.3% for Bulgaria, 84.0% for the Czech Republic, 68.6% for Estonia, 77.2% for Hungary, 67.2% for Latvia, 61.0% for Lithuania, 79.1% for Poland, 72.2% for Romania, 84.3% for Slovakia and 71.1% for Slovenia).

Although we analyse the performance of CESEE10 countries on the EU27 market, we cannot simply treat the EU27 as one importer.[9] The EU market is not only large but also heterogeneous, and the performance of exporters in different parts of the market has to be analysed separately (e.g. Latvia's exports to Lithuania have to be distinguished from Germany's exports of the same product to France). Therefore we disaggregate imports not only by product, but also by importing country within the EU27, which represents the most detailed geographical disaggregation. Our dataset contains annual data on imports of all 27 EU Member States at the eight-digit CN level between 1999 and 2010.[10] To avoid calculation burden, we restrict the list of partners to 50 different countries inside and outside the EU27. The list of partner countries includes all EU Member States, several CIS countries (e.g. Russia, Ukraine, Belarus and Kazakhstan) and other important trading partners (e.g. the US, Japan, Canada, Australia, China, India and Brazil).[11] We use the unit value indices (euro per kg) as a proxy for prices and trade volume (mainly in kg) as a proxy for quantities.

The use of the most detailed eight-digit CN classification has one significant drawback that can affect the final results: the CN classification is regularly revised. Each year, a significant amount of CN codes are subject to changes, some are just relabelled, others are split or merged.[12] Pierce and Schott (2009) analysed reclassifications in the ten-digit US Harmonised System and illustrated the importance of tracking these changes when conducting empirical research, and we cannot ignore this issue. The most problematic cases are splits or merges of codes (growing and shrinking family trees in the terminology of Pierce and Schott (2009)). One feasible solution to such cases is to merge values and volumes of respective categories. Although this leads to a broadening of several categories and some problems in interpreting unit values, it helps to retain the consistency of analysis over time while keeping coverage also reasonably high.

During the period from 1999 to 2010, we observe 14 111 different eight-digit CN product codes in our database, however, only 7 376 of them were not subject to reclassification issues. After the implementation of the algorithm described above, we were left with 8 961 product codes. Obviously, some of these codes now refer to more than one product. According to Eurostat information, the total number of eight-digit CN subheadings was 9 443 in 2010. Therefore the problem is not severe, as only 482 products are not observable separately in that year.

We made two further adjustments to our database. First, in many cases we have data for either values or volumes but not for both. In these cases, no unit value index can be calculated. Such incomplete observations were ignored and removed from the database. The second adjustment is related to structural changes within the categories of goods. Although we use the most detailed classification available, it is still possible that sometimes we are comparing apples and oranges within one

9 Such an approach which ignores heterogeneity of the EU27 market was used in Benkovskis and Rimgailaite (2011).

10 The exceptions are Poland and Slovakia, for which the most disaggregated data in terms of products at CN eight-digit level is available only starting from 2004.

11 This sample of partners provides a representative picture of overall imports, as it covers between 84.5% of total imports in Cyprus and 99.2% of total imports in Estonia in 2010.

12 More information on reclassifications of CN could be found at http://ec.europa.eu/eurostat/ramon/nomenclatures.

particular category. One indication of such a problem is the large price level differences within a product code. Consequently, all observations with outlying unit value indices were excluded from the database.[13]

4. RESULTS

At first, we need to estimate the elasticities of substitution between varieties in all EU countries. After that, we are able to calculate the variety-adjusted and quality-adjusted relative export price indices for CESEE10 exports and make inferences about their non-price competitiveness. We make these calculations for total CESEE10 exports to the EU27 and for the main export categories and destinations.

4.1 Elasticities of substitution in EU countries

The elasticity of substitution between varieties is estimated using equation (15) for all products where data on at least three countries of origin were available.[14] Table displays the main characteristics of estimated elasticities of substitution between varieties. The mean elasticities are very high, in the range between 22 and 36, although this is not very informative, as the distribution is skewed to the right. Therefore, the main focus could be on the median elasticity of substitution between varieties. For easier interpretation, one can calculate the median mark-up which equals $\sigma_g / (\sigma_g - 1)$. The median elasticity of substitution lies within the range of 4–7. This gives quite a plausible range between 15% and 30% for median mark-ups. Cyprus is a clear outlier, perhaps due to the small number of estimated elasticities.

The estimates in Table are generally higher compared with the estimated results reported in Broda and Weinstein (2006) for the US imports. The median elasticity was estimated to be 3.7 for the period between 1972 and 1988 for seven-digit (TSUSA) goods and 3.1 for the period between 1990 and 2001 for ten-digit (HTS) goods. To our knowledge, the only paper which reports similar estimates for all EU27 countries is by Mohler and Seitz (2010). Again, our estimates are roughly one third higher than theirs. This could be attributed to some differences in the estimation methodology[15] as well as to the different sample period. Mohler and Seitz (2010) cover the period between 1999 and 2008, so 2009, i.e. the year of significant trade collapse due to the financial crisis, was not analysed. Nevertheless, our results provide a similar ordering with low elasticities for Greece, Luxembourg, Portugal, Spain and the UK, and high elasticities for Germany, Hungary, Latvia, Lithuania and Romania.

[13] An observation is treated as an outlier if the absolute difference between the unit value and the mean unit value of the product category in the particular year exceeds three standard deviations. The exclusion of outliers does not significantly reduce the coverage of the database. For example, in 2010 outliers accounted for 0.2% of total import value in Finland and 4.0% in Slovakia.

[14] The number of products for which this condition was met is indicated in the first column of Table. Although the coverage is reduced, it still remains reasonably high. Even taking into account that we restricted ourselves only to 50 partner countries, excluded outliers and need at least 3 countries of origin, the coverage in 2010 is between 63.1% of total aggregated imports for Bulgaria and 86.0% for the Czech Republic.

[15] Mohler and Seitz (2010) follow Feenstra's (1994) methodology, which provides estimates of σ_g only as long as $\theta_1 > 0$ and use a regression on sample means over t.

Table

Elasticities of substitution between varieties

	Elasticities estimated	Mean	Standard Deviation	Maximum	Minimum	**Median**	**Median mark-up**
Austria	5941	26.84	94.8	3381.6	1.04	**5.08**	**24.5**
Belgium	6559	23.54	74.6	3460.5	1.03	**5.32**	**23.1**
Bulgaria	4500	28.39	66.6	1816.0	1.02	**6.84**	**17.1**
Cyprus	3480	35.15	58.4	1081.5	1.02	**10.70**	**10.3**
Czech Republic	5802	27.90	75.3	1915.6	1.00	**6.08**	**19.7**
Denmark	5452	24.26	64.6	2040.5	1.03	**5.42**	**22.6**
Estonia	3888	27.24	68.1	1375.3	1.01	**6.19**	**19.3**
Finland	5005	27.02	66.9	1322.3	1.00	**5.75**	**21.1**
France	7156	23.70	61.1	2197.3	1.01	**5.39**	**22.8**
Germany	7078	23.24	62.8	3172.3	1.05	**6.19**	**19.3**
Greece	5212	25.34	86.5	4014.5	1.03	**4.62**	**27.6**
Hungary	5455	27.88	92.4	5160.4	1.01	**6.66**	**17.7**
Ireland	4664	28.73	132.2	5554.7	1.01	**5.40**	**22.7**
Italy	6793	23.46	73.7	3401.2	1.02	**5.76**	**21.0**
Latvia	3882	27.93	75.2	2235.7	1.01	**6.09**	**19.6**
Lithuania	4232	26.14	56.2	1108.7	1.03	**6.39**	**18.6**
Luxembourg	3552	34.41	173.8	4541.7	1.01	**4.27**	**30.6**
Malta	2415	33.43	89.0	1825.9	1.02	**5.36**	**22.9**
Netherlands	6253	25.03	70.6	2771.9	1.07	**5.82**	**20.7**
Poland	5699	22.45	60.1	1992.4	1.02	**5.23**	**23.6**
Portugal	5386	26.55	110.8	4789.5	1.02	**4.57**	**28.0**
Romania	5358	25.02	46.9	695.0	1.02	**6.80**	**17.2**
Slovakia	4139	33.15	106.8	4639.9	1.01	**4.79**	**26.4**
Slovenia	4822	26.94	67.8	2204.3	1.02	**5.85**	**20.6**
Spain	6510	22.93	71.4	3283.4	1.01	**4.91**	**25.6**
Sweden	5600	25.65	55.4	1269.4	1.02	**5.69**	**21.3**
UK	6783	23.03	66.7	2578.7	1.01	**4.91**	**25.6**

Sources: Comext and authors' calculations.

Note: Elasticities of substitutions are estimated using equation (15) for all products where data on at least three countries of origin were available.

4.2 Relative export prices adjusted for non-price factors

Finally, we can calculate the adjusted relative export price index for CESEE10 exports to the EU27, which will take into account several non-price factors like the quality of exports and changes in the set of rivals. This is done using equations (9) and (10), while the unobserved relative quality is evaluated by equation (11). Figure 2 shows three different relative export price indices for every country. The first one is the conventional relative export price (RXP) index, which does not take into account changes in quality and set of competitors and is calculated using the first term in equation (9). This index can serve as a benchmark denoting pure price competitiveness of CESEE10 exports. The second index also takes into account changes in the composition of competitors on the market. It is calculated using the first two terms of equation (9). The comparison with the conventional export price index indicates the contribution of changes in the set of rivals to competitiveness. Finally, the relative export price index adjusted for non-price factors is calculated using all three terms of equation (9). This index includes all non-price competitiveness factors analysed in this paper. By comparing it with the RXP index adjusted for the set of rivals, we can highlight the role of quality and taste in export competitiveness.

Before analysing the role of these different factors for export competitiveness, we shall contrast our relative export price index based on trade data to the more frequently used exchange rate based indices reported in Figure 1. As both CPI-based and ULC-based real exchange rates describe price competitiveness, we must compare them with the conventional relative export price index. There are some differences in the scope between these traditional measures and our index. Figure 1 reflects price competitiveness of exports to the world, while our calculations are limited to exports to the EU market. Still, the EU represents by far the most important trading partner for all countries, thus this limitation should not pose a major problem. On the other hand, our indicator compares competitiveness of the CESEE countries relative to 49 competitors (including all other 26 EU Member States, the most important CIS countries and other important trading partners like the US, Japan and China), while the traditional indicators in Figure 1 are calculated with respect to 36 trading partners.

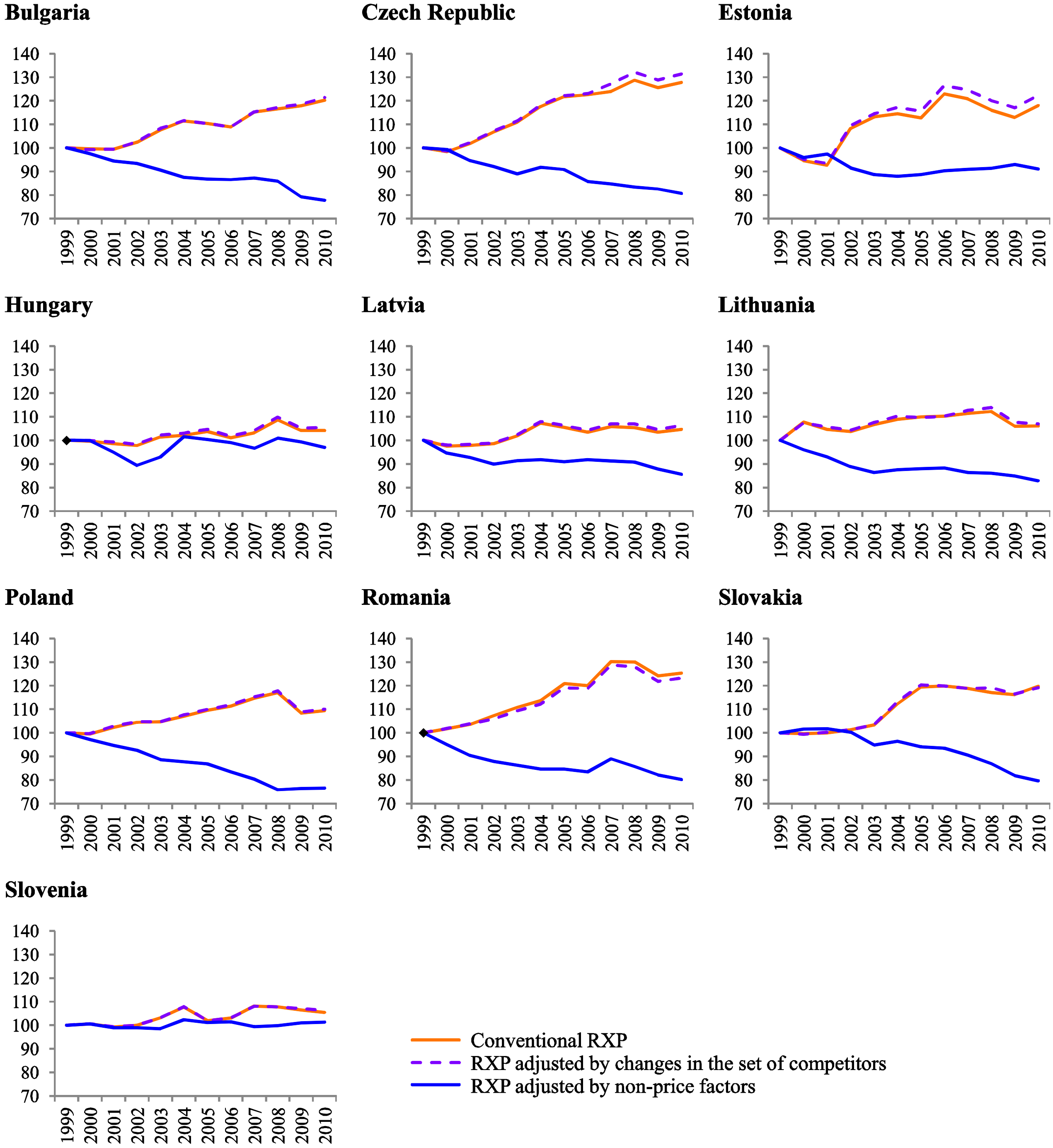
All indicators are signalling losses in price competitiveness between 1999 and 2010 for all CESEE10 countries. Moreover, the ranking is very similar, with almost no losses for Slovenia and the highest relative price increases for Romania and the Czech Republic. The time pattern of the conventional RXP index also leads to similar conclusions, with the most rapid increase during the boom years and a decrease in 2009. The difference of the CPI-based index for the Baltic States can be explained by an increase in indirect taxes in that year. However, there is an important distinction between the results in Figures 1 and 2. The scale of price competitiveness losses is significantly smaller when measured by the conventional relative export prices. This could be on account of various factors, including structural differences among the economies which are not taken into account in Figure 1, increasing indirect tax rates in the case of the CPI-based index, or more rapid productivity improvements in export-oriented sectors of economies in the case of the ULC-based index. The comparison of the RXP index adjusted for changes in the set of competitors with the conventional RXP index shows no worthwhile effect from changes in the set of rivals. In other words, a rising or falling number of rivals is not an important driver of CESEE's export competitiveness. In all cases, the difference between two indices is marginal. The most pronounced effects are observed for the Czech Republic and Estonia, where the second index is a bit higher, indicating an increasing number of competitors and a slight loss of market power. The opposite effect, although also marginal, is observed for Romania whose exporters seem to be facing fewer rivals and thus experienced a gain in market power compared with the beginning of the sample period.

Finally, when we look at the RXP index adjusted for non-price factors, we observe a rather strong impact of changes in quality on export competitiveness. Figure 2 shows that this index has notably decreased for all CESEE10 countries. The decreases were particularly steep for Poland, Slovakia and the Czech Republic and far less pronounced for Slovenia and Hungary. This indicates that all CESEE10 countries covered here were gaining in non-price competitiveness. Although their export unit values were increasing faster than those of their main rivals, the quality of their exports was rising even faster. This, of course, includes tangible as well as intangible components of quality, as our methodology does not allow disentangling of the two. Most probably, the CESEE10 countries were able to improve both the physical quality of their output and its image, branding and market placement.

This finding is corroborated by earlier literature. Aturupane et al. (1999) and Landesmann and Stehrer (2002) give early evidence for increasing unit value ratios of CESEE10 country exports. Dulleck et al. (2005) consider three dimensions of quality upgrading (across industries, across different quality segments within industries and within quality segments inside industries), where their third notion of quality upgrading (inside products) refers directly to our definition of quality. For the period from 1995 to 2000, i.e. just prior to our observation period, they find evidence for quality increases in CESEE10 exports, where five Central European countries (Poland, the Czech Republic, Slovakia, Hungary, and Slovenia) show higher initial levels of quality and exhibit a faster upgrading process compared with the Southeastern European and Baltic countries. Further, only for those countries the quality upgrading in this period was associated with improvements in both physical and non-tangible properties such as the image of products, while for the remaining five countries evidence for technological and physical upgrading was found. Finally, Fabrizio et al. (2007) state that the gains in market shares of CESEE countries, despite the pronounced appreciation trend of their currencies, can be ascribed to an impressive shift in the quality of their exports. However, they also caution that this process and the positive development effects arising from it may attenuate soon.

As mentioned above, the contribution of changes in taste and quality to export competitiveness can be inferred from the difference between the RXP index adjusted for non-price factors and the RXP index adjusted only for changes in the set of competitors. The negative gap between these two indices in all 10 countries suggests a positive contribution of quality to these countries' export performance and hence competitiveness. The strongest quality improvements were observed in Poland, Bulgaria, the Czech Republic and Romania; the lowest improvements were recorded by Hungary and Slovenia, while the Baltic States' performance was in the middle. Very clearly, the disadvantage of Southeastern European countries in terms of quality, which was observed by Dulleck et al. (2005), had diminished considerably. In some countries like the Czech Republic or Latvia, the relative quality improvements occurred gradually, while in other countries like Estonia, large improvements happened in specific years.

Figure 2
CESEE10 export prices relative to their competitors' export prices
(exports to EU market, 1999 = 100)



Sources: Comext and authors' calculations.

Notes: Relative export prices are calculated by cumulating RXP changes from equations (9), (10) and (11). The increase denotes losses in competitiveness.

Our methodology is based on highly disaggregated data, which enables us to identify changes in relative quality within different product groups and in individual importing countries inside the EU market. The results of this detailed analysis are reported in Tables A1–A10 of Appendix, where relative quality improvements are calculated for four main sections of exports as well as four main partner countries in the EU. A brief summary of the results over the entire period, including the recent crisis years, reveals that quality improvements were strongest for almost all countries (with the exception of Hungary and Lithuania) in machinery and mechanical appliances, followed by vehicles and other transport equipment (notably here for the Czech Republic, Hungary, Poland and Romania). Similar to Lithuania, Hungary also showed impressive quality improvements in chemicals (certainly related to strong foreign direct investment in this industry). Lithuania and Poland also recorded large improvements in plastics. In regional terms, most countries showed the strongest quality improvements on the German market and in France as well. Further results point towards strong mutual trade ties and/or proximity that exert an upward pressure on quality. We can identify a couple of neighbouring country pairs with notable quality improvements in bilateral trade. For example, Slovakia and Slovenia recorded strong improvements on the Austrian market, and Bulgaria experienced large gains in the relative export quality in Greece. Furthermore, Latvia showed strong quality upgrading on the Lithuanian market, and *vice versa*. Latvia could further strongly raise the average quality of its export products also on the Estonian market, while Estonian export products gained in relative quality in Sweden. In turn, the quality of Slovak exports to the Czech Republic rose notably.

CONCLUSIONS

Despite a seminal trend of real appreciation, which was temporarily reverted during the crisis, the CESEE10 countries showed an impressive export performance over the past decade and a half. This apparent puzzle, i.e. a real appreciation of the currency very broadly associated with a loss of price competitiveness, can be resolved by focusing attention on the non-price aspects of competitiveness. In this paper, we develop a relative export price index, which allows us to disentangle the impact of changes in relative quality from those in price competitiveness. This index is calculated using data from the Comext at the highly disaggregated eight-digit CN product level for imports of all EU Member States from 50 main trading partners inside and outside the EU. We used annual data over the period from 1999 to 2010, thus including also the most recent episode of the global trade collapse at the beginning of 2009.

Our relative export price index is derived from theoretically well-founded variety-adjusted and quality-adjusted relative import price index as proposed by Benkovskis and Wörz (2011). This index builds on the seminal work by Feenstra (1994) and Broda and Weinstein (2006) who incorporate changes in product variety in the measurement of import price developments. Benkovskis and Wörz (2011) enlarge their methodology and additionally include changes in product quality. Both factors appear to matter for consumers' valuation of imports and thus influence utility. The relative export price index, which we use as a competitiveness measure in this analysis, is also based on maximisation of consumer utility in the importing market. We are working with exports as a mirror-image of imports and aggregate relative price changes while accounting for changes in the set of competitors and quality at the product level. Doing so, we obtain a comprehensive measure of export price developments. This adjusted relative export price index can be divided into three parts: first, the traditional definition of relative export prices, which is driven by changes in relative export unit values weighed by the importance of both competitors on a particular market and share of a particular market in the respective country's exports; second, Feenstra's (1994) term capturing changes in the set of rivals exporting a particular product; third, the change in relative quality of the exported product compared with the average quality of the same product when exported by all competitors.

Our results show that all CESEE10 countries experienced a loss in pure price competitiveness over sample period. Thus, our pure price index reflects the results obtained from traditional measures of price competitiveness, i.e. the CPI-based or ULC-based real effective exchange rate, although our pure price index signals that losses in price competitiveness were somewhat smaller than suggested by the exchange rate based measures. This could be driven by various factors, including changes in indirect tax rates, differences in export structures and more rapid productivity improvements in export-oriented sectors of CESEE10 countries. We further find that the changes in the set of competitors (which could be interpreted as changes in variety for consumers in the importing market) do not affect competitiveness. Our interpretation of this finding is that the changes in market power were too small to affect the export competitiveness of any of CESEE10 economies over sample period.

Finally, we enlarge our index, which allows us to take the quality changes into account. With this new index we are able to show that improvements in the relative quality of exports (making comparison of 49 rivals, including all other 26 EU Member States, the most important CIS countries and other important trading partners like the US, Japan and China) have greatly influenced the competitive position of the CESEE10 countries and added positively to their export performance. In line with earlier findings in the literature (Aturupane et al. (1999), Landesmann and Stehrer (2002), Dulleck et al. (2005), and Fabrizio et al. (2007)), we find substantial quality improvements of CESEE10 exports. Over the past decade, quality improvements were particularly pronounced in Bulgaria and Romania as well as Poland and the Czech Republic. Lithuania and Latvia also showed strong and continuous quality improvements.

In a sectoral perspective, quality improvements were most pronounced in those industries, which represent the region's major export goods. Almost all countries showed strong quality gains in machinery and mechanical goods, in many countries followed by improvements in vehicles and other transport equipment. This underlines the positive effects of outward orientation for domestic developments. Foreign direct investment is likely to have played an important role in this quality upgrading process, although our results do not allow for such conclusions. However, rapid quality gains by Hungary's export goods in the chemical industry process point towards a positive correlation between the two.

Our analysis illustrates that quality improvements in CESEE10 export goods were not only substantial over the past decade but also large enough to comfortably offset the negative developments in price competitiveness of these countries. Clearly, the loss of price competitiveness is a result of the convergence process, which has characterised the economic development of these countries up to date. Along with income convergence, also price and wage levels experienced an upward trend, resulting in trend-appreciation of the currencies. However, improvements in quality (by quality we always refer to physical properties as well as intangible aspects related to labelling and consumer tastes) were considerably stronger over the observation period. As a result, CESEE10 competitiveness has increased over time, thus explaining the large gains in market shares on the European market. In general, these gains were felt most strongly in Western European destination countries. However, there were also quality improvements of some CESEE10 countries in peer markets, for example Latvia and Lithuania showed strong mutual quality improvements, which may be influenced by similar consumer tastes present in those two countries.

Another important result points towards differences in the speed of quality upgrading between countries. Unlike earlier studies, we find no evidence that peripheral economies (i.e. the Baltic States and Southeastern European countries) are closing the quality gap slower than Central and Eastern European countries. The process of quality upgrading still appears to be heterogeneous throughout the region, with Slovenia and Hungary, potentially starting from a much higher level, showing rather weak improvements at the economy-wide level compared to other countries. But, nevertheless, at the sectoral level in particular, all countries show unambiguous evidence about quality upgrading of important export goods.

APPENDIX
CHANGES IN RELATIVE QUALITY: ANALYSIS OF MAIN SECTORS AND MARKETS OF CESEE10 COUNTRIES

Table A1

Cumulated contribution of relative quality to competitiveness of Bulgaria's exports by main sectors and markets

(1999 = 100)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Sections:												
Base metals and articles of base metals	100.0	105.1	101.6	108.5	121.0	136.4	124.2	121.9	114.9	119.6	125.4	120.2
Machinery and mechanical appliances	100.0	93.4	101.7	116.2	128.2	145.8	150.1	142.8	176.3	170.3	165.7	182.0
Textiles and textile articles	100.0	105.8	111.6	115.5	131.7	140.0	144.2	144.1	172.9	165.5	154.8	146.7
Vegetable products	100.0	93.1	104.9	115.5	102.5	105.3	106.9	110.3	101.6	98.3	108.2	124.7
EU markets:												
Germany	100.0	96.3	108.7	121.2	140.1	157.9	163.8	179.2	170.5	175.8	180.2	191.3
Italy	100.0	105.7	108.4	117.8	123.9	133.5	133.5	120.1	127.5	122.2	138.3	137.7
Romania	100.0	98.4	97.0	96.0	96.9	101.1	99.8	106.1	111.4	123.6	127.3	140.8
Greece	100.0	103.7	97.2	83.9	90.2	102.7	113.3	103.9	124.5	146.2	163.2	176.4

Sources: Comext and authors' calculations.

Note: Four largest export sectors and EU markets were chosen using 2010 export data.

Table A2

Cumulated contribution of relative quality to competitiveness of Czech Republic's exports by main sectors and markets

(1999 = 100)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Sections:												
Machinery and mechanical appliances	100.0	96.6	102.7	115.7	131.3	133.5	139.8	143.3	158.3	169.3	163.5	166.1
Vehicles and other transport equipment	100.0	103.8	109.7	113.6	116.3	116.8	130.8	141.1	137.8	146.5	146.6	145.6
Base metals and articles of base metals	100.0	100.5	108.5	114.4	117.3	117.4	124.1	122.8	125.9	132.9	128.2	128.8
Plastics and articles thereof	100.0	103.2	108.6	112.9	115.0	121.3	124.1	128.6	128.8	131.0	132.6	136.6
EU markets:												
Germany	100.0	98.8	107.7	117.9	129.6	131.4	128.4	142.8	150.9	164.7	162.4	177.2
Slovakia	–	–	–	–	–	100.0	114.3	116.2	110.9	123.1	130.2	122.3
Poland	–	–	–	–	–	100.0	100.7	104.3	111.4	88.6	83.3	80.8
France	100.0	101.2	99.9	114.0	112.2	112.9	151.3	181.9	210.1	233.3	230.4	264.3

Sources: Comext and authors' calculations.

Notes: Four largest export sectors and EU markets were chosen using 2010 export data. Data for Slovakia and Poland are available only from 2004 (2004 = 100 for these markets).

Table A3

Cumulated contribution of relative quality to competitiveness of Estonia's exports by main sectors and markets

(1999 = 100)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Sections:												
Machinery and mechanical appliances	100.0	82.1	67.8	118.8	131.9	111.4	119.0	151.8	133.7	120.1	111.9	130.1
Wood and articles of wood	100.0	94.5	95.9	98.4	102.5	100.9	99.2	98.2	112.3	101.9	89.2	93.9
Mineral products	100.0	131.3	119.6	193.9	229.8	311.6	264.1	292.3	244.3	203.1	228.4	267.3
Base metals and articles of base metals	100.0	125.6	104.9	116.9	132.5	124.7	121.6	117.7	123.3	116.8	116.1	118.8
EU markets:												
Finland	100.0	77.0	72.1	102.7	107.1	99.8	102.0	125.6	108.3	99.3	95.0	94.4
Sweden	100.0	115.2	113.7	129.5	145.1	141.0	146.8	156.5	162.3	151.8	153.9	209.4
Latvia	100.0	108.5	107.3	85.2	82.1	86.3	82.4	82.5	82.2	88.8	87.5	87.7
Germany	100.0	123.6	114.8	241.1	332.3	542.5	498.8	474.0	501.4	538.5	515.3	578.1

Sources: Comext and authors' calculations.

Note: Four largest export sectors and EU markets were chosen using 2010 export data.

Table A4

Cumulated contribution of relative quality to competitiveness of Hungary's exports by main sectors and markets

(1999 = 100)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Sections:												
Machinery and mechanical appliances	100.0	106.4	114.0	106.2	115.8	115.2	106.9	99.4	108.5	124.3	112.2	110.8
Vehicles and other transport equipment	100.0	111.9	121.0	113.5	114.9	111.4	115.1	125.1	135.7	129.8	129.8	135.3
Products of the chemical or allied industries	100.0	146.2	142.6	139.6	156.4	150.9	162.0	167.8	192.5	199.9	186.3	204.7
Base metals and articles of base metals	100.0	109.4	110.3	112.7	108.3	101.4	108.2	110.1	110.4	108.9	106.6	102.9
EU markets:												
Germany	100.0	87.8	88.1	110.5	104.2	95.4	107.9	103.7	108.7	98.8	105.9	112.1
Italy	100.0	96.1	105.5	107.8	110.5	109.0	124.0	144.5	149.4	191.1	184.7	179.2
UK	100.0	98.5	97.7	106.3	116.5	104.1	105.1	103.2	87.0	91.8	86.2	88.9
Romania	100.0	98.8	97.0	95.0	94.7	95.2	91.4	89.2	128.9	129.4	123.7	114.7

Sources: Comext and authors' calculations.

Note: Four largest export sectors and EU markets were chosen using 2010 export data.

Table A5

Cumulated contribution of relative quality to competitiveness of Latvia's exports by main sectors and markets

(1999 = 100)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Sections:												
Wood and articles of wood	100.0	101.0	101.1	107.0	116.3	117.0	113.8	108.8	122.3	111.0	107.2	114.3
Base metals and articles of base metals	100.0	100.9	104.6	106.9	108.6	116.4	115.3	107.2	106.6	112.2	101.2	113.0
Machinery and mechanical appliances	100.0	114.0	123.7	135.9	140.2	151.6	171.8	164.4	218.7	225.0	248.4	234.1
Products of the chemical or allied industries	100.0	122.7	91.7	95.5	100.7	144.4	156.3	135.3	80.0	86.8	101.6	120.8
EU markets:												
Lithuania	100.0	106.8	100.8	95.6	90.8	122.4	121.3	115.9	103.5	111.3	125.0	133.8
Estonia	100.0	113.0	93.7	96.5	96.8	112.0	124.5	131.7	144.6	147.4	155.2	154.5
Germany	100.0	97.0	105.8	107.0	111.2	104.5	109.7	111.9	122.7	123.6	117.3	127.7
Sweden	100.0	102.9	103.0	108.0	117.2	112.8	108.9	105.6	116.2	114.4	119.1	124.0

Sources: Comext and authors' calculations.

Note: Four largest export sectors and EU markets were chosen using 2010 export data.

Table A6

Cumulated contribution of relative quality to competitiveness of Lithuania's exports by main sectors and markets

(1999 = 100)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Sections:												
Mineral products	100.0	106.0	127.2	139.9	141.6	142.1	131.1	128.0	122.1	133.6	115.9	120.0
Plastics and articles thereof	100.0	101.9	98.5	100.5	107.4	125.9	156.9	170.5	196.2	194.4	189.5	203.3
Products of the chemical or allied industries	100.0	128.5	107.7	129.1	151.2	174.2	160.2	150.4	177.5	176.9	172.2	145.2
Prepared foodstuff	100.0	100.7	104.8	98.5	101.2	97.6	86.3	93.3	103.6	100.3	101.2	97.5
EU markets:												
Germany	100.0	101.3	113.4	118.8	127.0	132.7	132.2	127.8	146.8	142.7	150.8	147.2
Latvia	100.0	100.4	100.2	110.3	112.9	131.5	132.0	140.3	147.3	163.6	142.1	141.4
Poland	–	–	–	–	–	100.0	103.8	91.9	95.1	92.3	90.4	94.4
Netherlands	100.0	95.1	107.2	115.5	118.4	95.5	65.7	65.9	73.6	63.2	72.1	82.2

Sources: Comext and authors' calculations.

Notes: Four largest export sectors and EU markets were chosen using 2010 export data. Data for Poland is available only from 2004 (2004 = 100 for this market).

Table A7
Cumulated contribution of relative quality to competitiveness of Poland's exports by main sectors and markets
(1999 = 100)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Sections:												
Machinery and mechanical appliances	100.0	101.0	109.6	120.8	132.1	133.2	138.6	156.0	166.3	175.6	156.3	153.1
Vehicles and other transport equipment	100.0	106.7	113.5	121.1	118.2	127.6	135.0	139.6	151.6	151.5	143.7	150.7
Base metals and articles of base metals	100.0	110.3	105.3	111.7	114.7	120.0	120.4	127.8	128.5	130.6	130.7	133.3
Plastics and articles thereof	100.0	112.3	119.2	125.4	132.0	134.7	146.4	156.2	161.0	172.7	165.6	174.9
EU markets:												
Germany	100.0	103.3	109.5	116.1	119.3	122.0	125.0	132.4	148.9	168.6	148.1	148.2
France	100.0	103.1	108.4	123.5	128.9	133.2	153.5	154.4	163.3	173.0	175.0	178.8
UK	100.0	103.2	97.0	98.0	107.4	102.9	102.1	123.0	124.1	134.4	133.2	127.4
Czech Republic	100.0	104.0	112.9	86.7	103.5	119.7	106.9	113.2	110.3	120.8	104.4	109.0

Sources: Comext and authors' calculations.

Note: Four largest export sectors and EU markets were chosen using 2010 export data.

Table A8
Cumulated contribution of relative quality to competitiveness of Romania's exports by main sectors and markets
(1999 = 100)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Sections:												
Machinery and mechanical appliances	100.0	110.8	127.6	132.4	139.7	146.7	170.8	188.8	188.2	204.0	194.2	208.2
Vehicles and other transport equipment	100.0	115.7	131.2	162.0	167.2	141.7	152.8	164.7	197.5	201.3	230.2	225.3
Textiles and textile articles	100.0	104.8	117.0	127.9	137.1	142.7	145.8	136.2	137.2	128.6	114.2	113.3
Base metals and articles of base metals	100.0	106.0	107.8	105.1	102.5	103.0	99.3	104.2	103.3	109.1	98.5	106.0
EU markets:												
Germany	100.0	98.3	101.4	100.1	106.0	120.3	132.0	149.6	147.0	155.5	160.2	164.2
Italy	100.0	105.3	114.8	123.9	131.4	133.7	138.4	126.6	135.6	131.7	133.5	123.2
France	100.0	129.8	150.1	167.6	171.6	185.1	181.2	178.6	189.0	213.0	224.2	210.3
Hungary	100.0	126.9	109.6	113.6	117.9	104.7	127.2	141.7	140.8	137.0	133.7	136.0

Sources: Comext and authors' calculations.

Note: Four largest export sectors and EU markets were chosen using 2010 export data.

Table A9

Cumulated contribution of relative quality to competitiveness of Slovakia's exports by main sectors and markets

(1999 = 100)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Sections:												
Machinery and mechanical appliances	100.0	96.9	96.0	101.4	109.0	120.9	144.2	150.6	161.1	169.6	192.0	213.0
Vehicles and other transport equipment	100.0	100.6	104.0	114.6	130.6	145.0	150.9	137.0	136.5	136.8	122.0	116.6
Base metals and articles of base metals	100.0	98.9	94.5	95.4	97.3	101.3	107.4	101.4	105.5	127.1	152.3	142.2
Mineral products	100.0	84.6	82.6	73.6	87.3	98.5	111.3	127.6	123.6	132.2	137.3	163.9
EU markets:												
Germany	100.0	92.2	99.1	102.5	117.0	125.9	127.3	125.3	128.8	132.1	121.5	122.8
Czech Republic	100.0	98.9	95.2	90.4	96.6	105.6	122.6	121.0	126.2	132.8	139.0	157.1
Poland	–	–	–	–	–	100.0	104.2	117.2	106.0	107.2	116.8	131.5
Austria	100.0	103.6	103.6	121.6	118.3	122.0	114.4	106.5	122.0	133.3	156.9	184.9

Sources: Comext and authors' calculations.

Note: Four largest export sectors and EU markets were chosen using 2010 export data.

Table A10

Cumulated contribution of relative quality to competitiveness of Slovenia's exports by main sectors and markets

(1999 = 100)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Sections:												
Machinery and mechanical appliances	100.0	97.6	101.3	105.9	113.4	107.9	115.1	116.8	117.1	116.6	119.4	121.6
Vehicles and other transport equipment	100.0	101.3	99.8	100.5	99.1	100.1	98.7	116.7	123.0	118.0	111.5	106.6
Base metals and articles of base metals	100.0	103.9	105.9	105.5	104.6	104.2	106.5	109.3	112.0	110.9	100.1	102.6
Products of the chemical or allied industries	100.0	96.2	93.4	91.1	92.6	104.8	66.1	60.9	80.9	85.8	83.8	84.7
EU markets:												
Germany	100.0	97.9	96.5	95.1	99.3	104.0	106.4	104.5	107.7	108.8	107.7	107.1
Italy	100.0	100.3	99.0	103.7	106.1	98.1	101.7	106.7	105.3	113.9	121.1	117.1
Austria	100.0	101.6	107.2	114.8	123.2	133.8	120.7	134.5	144.3	135.7	124.4	132.2
France	100.0	101.4	95.7	95.2	92.6	87.2	90.6	92.0	109.5	104.1	101.9	98.9

Sources: Comext and authors' calculations.

Notes: Four largest export sectors and EU markets were chosen using 2010 export data. Data for Poland is available only from 2004 (2004 = 100 for this market).

BIBLIOGRAPHY

1. ARMINGTON, Paul Stanley (1969) – *A Theory of Demand for Products Distinguished by Place of Production*. International Monetary Fund Staff Papers, vol. 16, No. 1, March, pp. 159–178.

2. ATURUPANE, Chonira, DJANKOV, Simeon, HOEKMAN, Bernard (1999) – Horizontal and Vertical Intra-industry Trade between Eastern Europe and the European Union. *Weltwirtschaftliches Archiv*, vol. 135, No. 1, March, pp. 62–81.

3. BENKOVSKIS, Konstantins, RIMGAILAITE, Ramune (2011) – The Quality and Variety of Exports from the New EU Member States: Evidence from Very Disaggregated Data. *Economics of Transition*, vol. 19, No. 4, October, pp. 723–747.

4. BENKOVSKIS, Konstantins, WÖRZ, Julia (2011) – *How Does Quality Impact on Import Prices?* OeNB Working Paper, No. 175, December, 45 p.

5. BLONIGEN, Bruce A., SODERBERY, Anson (2010) – Measuring the Benefits of Foreign Product Variety with an Accurate Variety Set. *Journal of International Economics*, vol. 82, No. 2, November, pp. 168–180.

6. BRODA, Christian, WEINSTEIN, David E. (2006) – Globalization and the Gains from Variety. *Quarterly Journal of Economics*, vol. 121, No. 2, pp. 541–585.

7. DE GRAUWE, Paul (ed.; 2010) – *Dimensions of Competitiveness*. CESifo Seminar Series, The MIT Press, Cambridge Massachusetts, 304 p.

8. DIEWERT, Erwin W. (1993a) – Index Numbers. ***In:*** *Essays in Index Number Theory, Volume I*. Edited by Diewert, E. W. and Nakamura, A. O., Chapter 5, Elsevier Science Publishers B. V., pp. 71–108.

9. DIEWERT, Erwin W. (1993b) – The Economic Theory of Index Numbers: A Survey. ***In:*** *Essays in Index Number Theory, Volume I*. Edited by Diewert, E. W. and Nakamura, A. O., Chapter 7, Elsevier Science Publishers B. V., pp. 177–228.

10. DIXIT, Avinash K., NORMAN, Victor (1980) – *Theory of International Trade: A Dual, General Equilibrium Approach*. Cambridge : Cambridge University Press, 339 p.

11. DULLECK, Uwe, FOSTER, Neil, STEHRER, Robert, WÖRZ, Julia (2005) – Dimensions of Quality Upgrading – Evidence for CEECs. *Economics of Transition*, vol. 13, No. 1, January, pp. 51–76.

12. FABRIZIO, Stefania, IGAN, Deniz, MODY, Ashoka (2007) – *The Dynamics of Product Quality and International Competitiveness*. IMF Working Paper, No. WP/07/97, 35 p.

13. FEENSTRA, Robert C. (1994) – New Product Varieties and the Measurement of International Prices. *American Economic Review*, vol. 84, No. 1, March, pp. 157–177.

14. FLAM, Harry, HELPMAN, Elhanan (1987) – Vertical Product Differentiation and North-South Trade. *American Economic Review*, vol. 77, No. 5, December, pp. 810–822.

15. HALLAK, Juan Carlos, SCHOTT, Peter K. (2008) – *Estimating Cross-Country Differences in Product Quality*. NBER Working Paper, No. 13807, February, 57 p.

16. HUMMELS, David, KLENOW, Peter J. (2005) – The Variety and Quality of a Nation's Exports. *American Economic Review*, vol. 95, No. 3, pp. 704–723.

17. LANDESMANN, Michael A., STEHRER, Robert (2002) – Evolving Competitiveness of CEECs in an Enlarged Europe. *Rivista di Politica Economia*, vol. 92, No. 1, pp. 23–87.

18. LEAMER, Edward E. (1981) – Is it a Demand Curve, or is it a Supply Curve? Partial Identification through Inequality Constraints. *Review of Economics and Statistics*, vol. 63, No. 3, pp. 319–327.

19. MOHLER, Lucas, SEITZ, Michael (2010) – *The Gains from Variety in the European Union*. Munich Discussion Paper, No. 2010-24, April, 27 p.

20. PIERCE, Justin R., SCHOTT, Peter K. (2009) – *Concording U. S. Harmonized System Categories over Time*. NBER Working Paper, No. 14837, April, 20 p.

21. REINSDORF, Marshall B., DORFMAN, Alan H. (1999) – The Sato-Vartia Index and the Monotonicity Axiom. *Journal of Econometrics*, vol. 90, No. 1, May, pp. 45–61.

22. SALA-i-MARTIN, Xavier (2010) – The Economics behind the World Economic Forum's Global Competitiveness Index. ***In:*** *Dimensions of Competitiveness*. Ed. by De Grauwe, P., Chapter 1, CESifo Seminar Series, The MIT Press, Cambridge Massachusetts, pp. 1–18.

23. SATO, Kazuo. The Ideal Log-Change Index Number. *Review of Economics and Statistics*, vol. 58, No. 2, May 1976, pp. 223–228.

24. SHEU, Gloria (2011) – *Price, Quality, and Variety: Measuring the Gains from Trade in Differentiated Products*. Unpublished Manuscript, US Department of Justice, September.

25. VARTIA, Yrjö O. Ideal Log-Change Index Numbers. *Scandinavian Journal of Statistics*, vol. 3, No. 3, 1976, pp. 121–126.