Rising unit values of Central and Eastern European exports: Rising quality in transition?

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Abstract: This paper observes rising unit values, prices per kilogram, of Central and Eastern European exports and argues that it is an evidence of actual rising product quality during the transition period. We arrive at this conclusion by applying a number of methods on a best available dataset for the ten countries from 1995 to 2005. On this dataset we also apply two new methods to assess within-product sophistication and both support the results. We further apply methods for estimation of across-product sophistication, which have never been used in this context before and these reinforce our main results.

Keywords: international trade; exports; product quality; unit values; competitiveness; transition; Central and Eastern Europe; European Union.

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1 Introduction

Quality of exported products has proved to be of high importance in international trade and in economic development more generally. Rising export quality is said to make countries more competitive and help them avoid low-quality export trap. Therefore, export quality is naturally a major issue for the ten countries from Central and Eastern Europe that joined the European Union in 2004 and 2007. We focus on the export quality of this group of countries: Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia.

Using the best-available data set of these countries, we observe rising unit values, i.e., price per unit or kilogram, of Central and Eastern European exports between 1995 and 2005. Our main objective is to investigate whether this increase is an evidence of

rising product quality during the transition period. We test this hypothesis by applying two new methods for estimating within-product sophistication. We apply a few other methods such as Market Share Index (MSI) and product penetration for across-product sophistication, which could further explain unit values in terms of product quality; these methods have also never been applied in this context before.

The first new method we apply is based on the assumption that we are able to predict the unit values of exports using a regression model. We run a panel data regression and compare its predictions with the reality. We argue that countries with higher actual unit values than predictions exhibit a higher level of within-product sophistication as well. The second new method is based on the assumption that OECD countries are leaders in high-quality exports. We argue that the higher the unit values relative to OECD, the higher the within-product sophistication.

We review the literature on product quality with focus on Central and Eastern Europe in Section 2. Section 3 describes the data set we use in the empirical analysis. Section 4 introduces the unit values and provides an evidence of rising export unit values in the region. Sections 5 and 6 apply the two new methods for within-product sophistication. Section 7 analyses the across-product sophistication. Section 8 concludes the paper.

2 Literature review

The importance of export quality in international trade and economic development has been widely acknowledged and studied for decades. The same is true for the estimates of export quality. The most popular estimate of export quality has been the unit value, price per unit or kilogram. The history of this measure can be traced at least as back as Maizels (1957). The unit-value-based methods were further developed especially by Aiginger (1997). Aiginger and Landesmann (2002) make use of unit values to estimate the competitiveness of countries and their industries. Schott (2004) employs unit values to analyse and explain the export phenomenon of China in recent decades.

One new method based on quality ladders was recently developed by Khandelwal (2007) and another one based on unit value by Hallak and Schott (2008). The latter build partly on Hallak (2006) and decompose countries' observed export prices, unit values, into quality and quality-adjusted-price components using information from their trade balances. Holding observed export prices constant, countries with surpluses are inferred to offer higher quality than countries running deficits. It is, therefore, similar to our new methods in the sense that it employs additional information, trade balance in the case of Hallak and Schott (2008), model predictions or the most developed countries unit values in our case, to the unit values to estimate export quality.

Unit values and related methods were also relatively often applied in the context of Central and Eastern Europe. Rosati (1998) as well as Aiginger (1998) assess the qualitative performance and competitiveness of the economies in transition. Dulleck et al. (2005), similar to Havlik et al. (2001), analyse three dimensions of quality upgrading: upgrading across industries, across different quality segments within industries and within quality segments inside industries. We take a similar approach in the sense that we distinguish between within-product and across-product sophistications.

3 Data

Data on per-capita gross national income is taken from the World Bank's World Development Indicators, and on the distance from the Centre D'Etudes Prospectives et D'Informations Internationales. The Comtex trade database records the customs value of all EU-15 (the 15 original EU members in 2003) imports by exporting country and year from 1995 to 2005 according to thousands of narrowly defined categories, which we refer to as 'products'. Product-level statistics were drawn according to Combined Nomenclature (CN); some data are also drawn from the one to five-digit Standard International Trade Classification (SITC). One-digit SITC codes are referred to as 'industries'.

We use the longest available panel data set from 1995 and 2005, which will not grow longer for the trade data over the time. The reason for the missing trade data after 2005 is an administrative decision by the European Union. For the period 1995–2005, the weight in kilograms of exported products was recorded. From 2006 on, this measure is not required, with the aim of easing regulation, from the importers and exporters within the European Union. It follows that with respect to this 2005 limitation, we are using the best-available data set.

Apart from EU-15, we also speak about CEE-10 (ten new EU members from Central and Eastern Europe, who joined in 2004 and 2007, Malta and Cyprus excluded), China (by which mean for the purposes of this paper: The People's Republic of China), Asia (all Asian countries excluding China) and OECD-11 (members of OECD excluding EU members).

4 Within-product sophistication: unit values

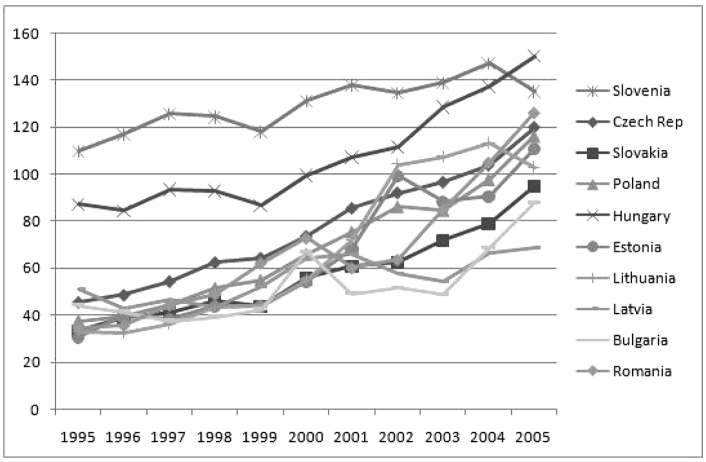
We start with unit values as the first estimation of the relative sophistication of the CEE-10 export varieties within products in terms of relative prices. The unit value u_{pc} of exports of product p from country c is defined as a nominal import value of imports to the importing country divided by some quantity measure, usually weight in kilograms, which we use here. Export unit value is defined as

$$u_{pc} = V_{pc} / Q_{pc}, \tag{1}$$

where V_{pc} stands for the overall value of imports of product p from a country c in a given year and this value is expressed in the chosen currency and Q_{pc} stands for the overall amount of exports of the commodity in a given year expressed in 100 kilograms. The results in Figure 1 shows the unit values for CEE-10 manufacturing exports. The importing region is EU-15, which is an assumed proxy for the world.

The overall trend of export unit values of Central and Eastern European unit values is clear as the unit values increased significantly for all countries. Now, we move beyond simple unit values and try to explain this observation through applying more rigorous methods. By this, we aim to test whether these rising unit values really imply rising export quality as suggested by the existing literature.

Figure 1 Unit values, imports from the CEE-10 countries to EU-15, overall manufacturing (SITC 5 to 8), euro per 100 kilograms imported, 1995–2005



5 Within-product sophistication: relative to the model prediction

Now, we expand on the simple unit-value approach and develop a brand-new method to estimate relative within-product sophistication of the CEE-10 countries. We make use of a regression to assess the unit values of the CEE-10 countries in comparison with countries with similar characteristics. We proceed in two steps. First, we estimate a regression model trying to estimate unit values. Second, we predict the unit values for CEE-10 using the model and compare them with the actual values. We argue that actual values higher than predicted reveal higher export quality that does not show directly in the unit values, but is evaluated by higher price.

To estimate the price of the CEE-10 countries' exports relative to similarly developed countries, we regress country-industry log unit values on two country characteristics, per-capita gross national income and the distance of country's capital city from Brussels, the capital of Belgium as well as, to some extent, the European Union,

$$\log(u_{tic}) = \text{PCGNI}_{tc} + \text{distance}_{c} + \varepsilon_{tic}, \tag{2}$$

where log is natural logarithm, u is unit value, PCGNI is per-capita gross national income, distance is the distance of a capital to Brussels for a year t, industry i and country c, if applicable. An implicit assumption is that these two explanatory variables are the most important to include, which is supported by the regression results here. We run fixed effects regressions for 164 countries, i.e., the whole world for the period 1995–2005. Table 1 reports the results, with the value of coefficients in the respective cell with the values of standard errors in brackets underneath.

In the second step, we make use of the regressions to predict the values of $\log(u_{Act})$ for the CEE-10 countries using the regression model and compare them with actual values of the same variable. We construct the brand-new Regression log Unit Value Ratio (RUVR),

$$\text{RUVR}_{ti} = \log(u_{ti}^{\text{reality}}) / \log(u_{ti}^{\text{prediction}}), \tag{3}$$

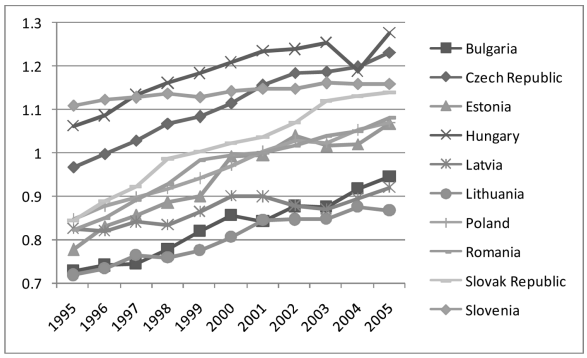
where u_{ti}^{reality} and $u_{ti}^{\text{prediction}}$ are the unit values of industry in year t in reality and according to model prediction, respectively, and log is natural logarithm employed to control for outliers. This enables us to carry out useful comparison for CEE-10 with similarly developed or distanced countries and within the CEE-10 countries themselves.

Table 1 Regression of unit values on country characteristics, manufacturing, 1995–2005

	$Log(u_{Act})$
Log ($PCGNI_{ct}$)	–0.0103603
	(0.0652654)
Log ($Distance_c$)	0.7873043
	(0.1360675)
Constant	–0.4446757
	(1.355205)
Observations	1728
R^2	0.14

The results in Figure 2 show that Slovenia and Hungary were the only countries that had their export unit prices above their predicted values. The same holds for the Czech Republic with the exception of the first two years, the ratio hiked all the way till 2005. But, we argue that crucial is not the exact value of the ratio, but the trend. Importantly, all CEE-10 countries experienced substantial upgrading of their prices in comparison with what the model would predict. As a consequence, it urges us not to reject the hypothesis of rising quality in CEE-10.

Figure 2 Regression log Unit Value Ratios for the CEE-10 countries, aggregate manufacturing, world regression



6 Within-product sophistication: relative to the OECD

In this part, we apply a straightforward new measure to estimate the relative quality of exports of CEE-10, partly inspired by Schott (2004). We compare the CEE-10 and the OECD-11 export unit values according to log unit value ratio,

$$\log(\text{UVR}_{ti}) = \log(u_{ti}^{\text{CEE-10}}/u_{ti}^{\text{OECD-11}}), \tag{4}$$

where $u_{ti}^{\text{CEE}-10}$ and $u_{ti}^{\text{OECD}-11}$ are the unit values of industry in year t for CEE-10 and OECD-11, respectively, and log is natural logarithm to control for outliers. Similarly, we compute log unit value ratios for individual CEE-10 countries. By definition, log unit value ratio that is less than zero signals that the CEE-10 countries export with a discount in comparison with the OECD-11 countries. Value higher than zero might signal that country's manufacturing exports are generally of higher quality than those of the OECD-11 countries. Table 2 reports the results by industry and by country for 1995 and 2005.

Table 2 CEE-10/OECD-11 log unit value ratios, individually for the CEE-10 countries

	Bulgaria		*Czech Rep*		*Estonia*		*Hungary*		*Lithuania*	
SITC1 industry	*1995*	*2005*	*1995*	*2005*	*1995*	*2005*	*1995*	*2005*	*1995*	*2005*
5 Chemicals	–2.5	–2.5	–1.6	–1.5	–2.5	–2.2	–1.3	–1.2	–2.5	–3.0
6 Manuf. materials	–1.3	–0.6	–1.2	–0.3	–1.6	–0.3	–0.6	0.0	–1.6	–0.4
7 Machinery	–2.1	–0.9	–1.6	–0.3	–1.0	0.3	–1.1	0.2	–1.7	–0.3
8 Misc. manufacturing	–1.0	–0.6	–1.6	–1.2	–1.5	–1.4	–1.1	–0.5	–1.3	–1.8
Overall manufacturing	–2.4	–1.3	–1.8	–0.6	–2.2	–0.7	–1.0	0.1	–2.6	–1.8
	Latvia		*Poland*		*Romania*		*Slovenia*		*Slovakia*	
SITC1 industry	*1995*	*2005*	*1995*	*2005*	*1995*	*2005*	*1995*	*2005*	*1995*	*2005*
5 Chemicals	–1.6	–2.4	–2.1	–2.1	–2.0	–2.4	–1.3	–1.5	–1.9	–1.9
6 Manuf. materials	–1.1	–0.8	–1.4	–0.3	–1.5	–0.2	–0.4	–0.1	–1.5	–0.5
7 Machinery	–2.1	–0.3	–1.9	–0.5	–2.0	–0.4	–1.4	–0.6	–1.6	–0.2
8 Misc. manufacturing	–1.4	–1.5	–1.6	–1.6	–1.4	–0.6	–1.2	–0.9	–1.5	–1.2
Overall manufacturing	–2.0	–1.5	–2.0	–0.9	–1.9	–0.5	–0.9	–0.7	–2.2	–0.8

Overall trend in all CEE-10 countries across all industries is clear and the unit value ratios in relation to the OECD-11 are increasing between 1995 and 2005. We consider this to be a supporting evidence of the hypothesis that rising unit values do mean rising quality for the Central and Eastern European countries. This table also makes a point that this higher sophistication is taking place basically across all the countries and industries. Some of the countries, such as Hungary, have even caught up with OECD-11.

7 Across-product sophistication

In this section, we look for further evidence of rising quality of export from the Central and Eastern European countries that would explain the rising unit value of their exports in terms of quality. We compare the range of manufacturing product categories CEE-10 exports with the EU-15 between 1995 and 2005 with the range of manufacturing product categories exported by other countries, notably the developed economies in the OECD. We assume in the line with Schott (2004) that the more similar CEE-10 exports are to the OECD-10, the more sophisticated its exports are revealed to be in the across-product dimension. To compute the market shares of region, we employ the MSI. The market

share of region r in year t and industry is the sum of the regions' exports to the EU-15 as a share of all countries exports to the EU-15,

$$\text{MSI}_{tri} = 100 \times \sum_{c \in r} V_{tci} \Big/ \sum_{c} V_{tci}, \tag{5}$$

where c indexes countries, $c \in r$ captures the set of countries in region r and V is import value.

The market shares in Table 3 show, first, that exports from the world's most developed economies, approximated here by the OECD-10, dominate the EU-15 market, although less so over time, similar to findings on the US market by Schott (2004). While the OECD-10 accounted for 53% of manufacturing imports in 1995, this share falls to 38% by 2005. Second, after China, CEE-10 was the region with the second highest increase in manufacturing imports to the EU-15 over the period. Importantly, CEE-10's share of manufacturing imports to the EU-15 increased steadily from 9% in 1995 to 15% in 2005, driven especially by relatively large gain in Machinery.

Table 3 EU-15 import value market share by region and year

	OECD-10		*Asia*		*China*		*CEE-10*	
SITC1 industry	*1995*	*2005*	*1995*	*2005*	*1995*	*2005*	*1995*	*2005*
5 Chemicals	65	64	13	20	3	5	7	7
6 Manufactured materials	35	24	29	29	4	12	15	18
7 Machinery	66	42	18	17	4	16	6	17
8 Misc. manufacturing	35	25	26	20	15	29	12	14
Overall manufacturing	53	38	21	20	6	17	9	15

There are generally two ways how to increase market share, either through increasing exports of incumbent products or an increase in the number of products exported. In the next two parts, we focus on the latter. In this section, we look at the so-called product penetration, a measure that answers the question what the share of products in which the country exports to another country is among all products. In the following section, we decompose the export growth into the intensive margin, which is characterised by larger export quantities of each good, and the extensive margin, which means a wider set of products is exported.

Table 4 shows that product penetration of the OECD-11 stagnated on average around 67%. Despite this stagnation, the region secured the highest product penetration across all industries and both years in comparison with three other regions. Although not as substantially as for Asia and China, the product penetration increased significantly for CEE-10, further supporting the hypothesis of rising export quality.

In this section, we further analyse in which way the regions' and countries' market shares increased or declined. We decompose the export growth into the intensive margin, which is characterised by larger export quantities of each good, and the extensive margin, which means a wider set of products is exported. This decomposition enables us to assess the relative importance of product penetration for the CEE-10 countries and also compare it with other regions. Table 5 examines the intensive margin according to CN product categories. The larger the intensive margin, the larger the share of the export growth or

decline happened between 1995 and 2005 owing to larger quantities of each good in contrast to wider set of products.

Table 4 Product penetration by region and year

	OECD-11		*Asia*		*China*		*CEE-10*	
SITC1 industry	*1995*	*2005*	*1995*	*2005*	*1995*	*2005*	*1995*	*2005*
5 Chemicals	69	70	56	60	39	52	51	55
6 Manufactured materials	67	65	59	63	41	60	63	63
7 Machinery	66	66	61	62	45	60	60	62
8 Misc manufacturing	71	77	68	76	63	75	65	74
Overall manufacturing	67	67	60	63	43	59	59	61

Table 5 Decomposition of the export growth or decline by regions, intensive margin, 1995–2005

SITC1 industry	*OECD-11*	*Asia*	*China*	*CEE-10*
5 Chemicals	71	61	65	70
6 Manufactured materials	79	75	75	67
7 Machinery	78	38	39	66
8 Misc. manufacturing	83	90	97	89
Overall manufacturing	77	54	51	67

It is clear from that the relative contribution of the intensive margin to the change in exports varies across countries and industries. On average, intensive margin is most important for Miscellaneous Manufacturing (SITC 8). Regarding countries' intensive margins, the largest intensive margin in manufacturing on average is in OECD-11, the lowest in Asia and China. CEE-10's intensive margin is roughly between these two extremes and might signal the relative maturity of manufacturing in 1995 in comparison with Asia and China and therefore less opportunity for gains through extensive margin.

Now, we estimate the export similarity of the CEE-10 region and its countries with the OECD-11 by employing the Export Similarity Index (ESI), developed by Finger and Kreinin (1979) and used recently for instance by Schott (2004). For any two EU-15's trading partners *c* and *d* in year *t*, this index is the sum of the two countries' minimum presence in each good,

$$\mathrm{ESI}_t^{cd} = \sum_p \min(S_{tp}^c, S_{tp}^d), \tag{6}$$

where presence S_{tp}^c is the share of country *c*'s export value in manufacturing product *p* relative to all of its exports in year *t*. ESI_t^{cd} equals zero if countries *c* and *d* have no products in common in year *t* and ESI_t^{cd} equals unity if their exports are distributed identically across products. In real world, ESI_t^{cd} is usually between zero and unity.

Using import product data according to CN for the EU-15 for 1995 and 2005, we computed ESI of Asia, China and CEE-10 for export similarity with the OECD-11, reported in Table 6. Rising ESI for China and CEE-10 with OECD-11 can be interpreted as rising similarity in their exports with the most developed countries. CEE-10 reached

overall ESI level of 0.42 almost the value for Asia, and thus demonstrated its relative export maturity. Even more importantly, the overall increase in ESI for CEE-10 over the period signals rising export quality.

Table 6 Regions' export similarity with the OECD-11

	Asia		*China*		*CEE-10*	
SITC1 industry	*1995*	*2005*	*1995*	*2005*	*1995*	*2005*
5 Chemicals	0.29	0.29	0.27	0.33	0.27	0.29
6 Manufactured materials	0.37	0.40	0.20	0.32	0.40	0.43
7 Machinery	0.51	0.49	0.35	0.39	0.36	0.44
8 Misc. manufacturing	0.41	0.44	0.21	0.24	0.38	0.37
Overall manufacturing	0.43	0.43	0.27	0.36	0.37	0.42

8 Conclusion

This paper attempts to fill an important gap in the literature on export quality of Central and Eastern European countries by employing new methods that have never been implemented in this context before. This research also led to methodological innovation by applying two new methods to assess export quality. This paper investigates the link between rising unit values and rising product quality of Central and Eastern European exports. Export quality is of major importance to an economic development and, as we document, evidently played an important role also in the transition period of the former Communist countries.

We start by observing the increase in unit values of manufacturing exports from ten Central and Eastern European countries to the original 15 member states of the European Union between 1995 and 2005. These rising unit values are often explained as the result of rising quality. Using product- and industry-level import data, this paper employs various methods to assess whether it is so. Similar to the existing research literature on export quality of the Central and Eastern European countries, this paper concludes that their export quality is really rising. However, in contrast to the literature, this research employs several different and innovative methods to assess export quality, therefore delivering more reliable results.

One brand-new method, which employs a regression model for panel data, is based on the ratio between real unit values and those predicted by the model. Another newly developed method uses the ratio between unit values of the Central and Eastern European countries and of the most applied countries. Other applied methods include calculations of product penetration, export similarity with the most developed countries, gains in market share and decomposition of export growth. This paper employs several innovative methods and one brand-new, all of them provide evidence that quality of the Central and Eastern European manufacturing exports is rising.

The results have a few interesting policy implications. First, we have shown that unit values are on average good estimates of product quality. As a consequence, unit values can be employed as important industrial policy benchmarks if the policy makers are concerned about the export quality. As unit values are relatively easy to compute and are therefore generally easily available, this should be good news to policy makers who

focus on trade and quality improvements. Furthermore, the results tentatively support the often-held view that successful development is interlinked with increasing export quality as we showed that the Central and Eastern European countries exhibited both.

Another policy recommendation is stemming from the fact that the export quality rose in all countries and only differed in the extent across countries. Assuming that each of the transition economies implemented different policies affecting the export quality, it should be surprising to learn that export quality increased on average in each of the countries. One lesson could be that export quality improves with overall development regardless of the government policies. Interestingly, it might follow that the policy makers should not pay too much attention to export quality, as it will improve regardless.

The results in this paper provide insight into how the export quality of Central and Eastern European countries is rising. At the same time, it raises a few interesting questions requiring further research. For example, to our knowledge, there is no theoretically correct method available that could be empirically implemented to estimate the export quality, with Hallak and Schott (2008) or Khandelwal (2007) researching in the right direction. This paper attempts to make the best possible from the unit values approach by applying new methods and implementing existing innovate ones. All of them provide consistent evidence that the quality of the Central and Eastern European manufacturing exports is rising.

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