Univerzita Karlova v Praze

Fakulta sociálních věd

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Bakalářská práce

2008 **Petr Janský**

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Rising Unit Values of Central and Eastern European Manufacturing Exports: Rising Quality?

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Prohlášení

Prohlašuji, že jsem bakalářskou práci vypracoval samostatně a použil pouze uvedené prameny a literaturu.

V Praze dne 18. 5. 2008 Petr Janský

Poděkování

Na tomto místě bych rád poděkoval svému konzultantovi, Doc. Ing. Vladimíru Benáčkovi, CSc., za cenné připomínky a rady.

Všechny chyby a omyly jsou však jen mé vlastní.

Abstrakt

Tato práce se zabývá rostoucími jednotkovými cenami průmyslových exportů z deseti zemí střední a východní Evropy do původních patnácti členských států Evropské Unie mezi lety 1995 a 2005. Tyto rostoucí jednotkové ceny bývají často zdůvodňovány rostoucí kvalitou. Pomocí dat o dovozu pro jednotlivé produkty i odvětví tento výzkum hodnotí, zda je tomu tak. Podobně jako stávající vědecká literatura na téma kvality exportů zemí střední a východní Evropy dochází i tato práce k závěru, že jejich kvalita exportů opravdu roste. Ovšem na rozdíl od stávající literatury využívá tato práce jednu několik jiných a inovativních metod k hodnocení kvality exportů, z nichž některé dosahují spolehlivějších výsledků. Jedna z těchto metod, která je zcela nová a využívá regresní model pro panelová data, je založena na poměru mezi skutečnými jednotkovými cenami a těmi předpovídanými modelem. Další metoda používá poměr mezi jednotkovými cenami zemí střední a východní Evropy a nejvíce rozvinutých zemí. Mezi další aplikované metody patří výpočty penetrace výrobků, podobnost exportů s nejvíce rozvinutými zeměmi, změny tržních podílů a dekompozice růstu exportů. Tato práce využívá několik inovativních metod a jednu zcela novou, které dokazují, že se kvalita průmyslových exportů ze zemí střední a východní Evropy zvyšuje.

JEL klasifikace: F12, F14, F15, L60, O39, P52

Klíčová slova: kvalita exportů, jednotkové ceny, střední a východní Evropa.

Abstract

This paper observes rising unit values of manufacturing exports from ten central and eastern European countries to the original fifteen 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 research employs various methods to assess whether it is so. Similarly to 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, some of them 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 method uses the ratio between unit values of the central and eastern European countries and of the most developed 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.

JEL classifications: F12, F14, F15, L60, O39, P52

Keywords: export quality, unit values, central and eastern Europe.

Contents

1. Introduction

Product quality of exports has proved to be of high importance in international trade and economic development. Peter Mandelson (2005), the current European Union Commissioner for Trade, once1 said that "In truth it's a question of not trying to compete where we can't - but making sure we succeed where we can as a provider of top quality, often highly specialised goods and services in a knowledge based economy."

Export quality is a major issue for both the original and generally more developed fifteen member states of the European Union and ten generally less developed new member states from central and eastern Europe. Throughout this paper I focus on the export quality of the latter group of countries. Therefore, the central and eastern European countries' region, for the purpose of this paper, comprises of Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia.

This paper observes rising unit values of manufacturing exports from ten central and eastern European countries to the original fifteen member states of the European Union between 1995 and 2005. Using product- and industry-level import data, I employ various methods to assess whether the rising prices are the result of rising quality.

Does rising unit values of central and eastern European exports imply rising quality? This is the major question of this paper. On the way to a satisfactory response to this question this paper helps to answer some of the following questions as well. What is the development of quality of the imports to the European Union from the central and eastern Europe? What are the market share gains, product penetration levels? If we decompose the export growth of central and eastern European countries, how large are the intensive and extensive margins? Has the manufacturing export quality of the central and eastern European countries upgraded to the level of the members of the Organisation for Economic Co-operation and Development?

The remainder of this paper is organised as follows. Section 2 provides a brief description of relevant theoretical as well as empirical research on the subject matter. It also points to the very recent research that fundamentally contributes to the topic of this paper. In Section 3, I describe the data used in the analysis. I explain the reasons for the choice of the

[1] Speech at the Market Access Symposium, European Parliament, Brussels, 19 September 2005.

countries, regions, time period and industry aggregation as well as source of the data. Section 4 presents the evidence of rising export unit values for central and eastern European countries. The remainder of Section 4 and Section 5 provide possible explanations for these rising unit values using a few different methods. Section 6 concludes. Section 7 provides references. Section 8 contains appendix with figures that are not included in the main body of the paper because of their size.

2. Review of recent research

In this section I briefly summarise the research that this paper refer to and is inspired by and based on. In the first part I particularly focus on various methods to estimate export quality. This field of international trade economics has received a lot of deserved attention in recent years and also today new approaches to the estimation of export quality are being developed.

In the second part of this section I comment on the research specifically related to export quality of the central and eastern European countries. I review and comment on the work closely related to the topic of this paper. Fortunately many researchers dealt with both export quality and central and eastern European countries at the same time. A lot of highly related research is therefore available for review and comparison. Of course both parts of this section are by definition intertwined.

2.1. Estimates of export quality

The importance of export quality in international trade and economic development has been widely acknowledged and studied for decades. As is shown in the following paragraph, the research in the field was very intensive in recent years.

2.1.1. Analysis of export quality

Among others, Flam and Helpman (1987) develop a theoretical model of North-South trade in which the North exports high-quality and the South exports low-quality industrial products. Apart from the theoretical research, recent empirical research focuses on the explanation of changes in export quality. Brooks (2006) attempts to do so through export success of companies and shows that product quality is shown to be a significant factor in explaining the tendency for Colombian plants to under-export manufactured goods to the United States. Verhoogen (2007) finds with the Mexican plant-level data that differential quality upgrading induced by the exchange rate shock tends to increase within-industry wage inequality.

Earlier research investigated the link between product quality and quantitative trade restrictions such as quota restraints on Japanese car's imports to the US that, according to Feenstra (1988), resulted into substantial upgrading in Japanese car imports. Using cross-

sectional data from 60 countries in 1995, Hallak (2006) confirms theoretical prediction that rich countries tend to import relatively more from countries that produce high quality goods. Grossman and Helpman (1991) study so called quality ladders and product cycles and develop a two-country model of endogenous innovation and imitation. Hummels and Klenow (2005) explain how large economies export in terms of variety and quality.

2.1.2. Unit value prominence

Although the research work has been very intensive, there are deep variations in researchers' approach to the estimation or measurement of quality. Probably the most popular estimate of export quality for the recent decade has been the so called unit value, in other words, export price per unit or physical weight. The history of this measure can be traced at least as back into the past as the research paper of Maizels (1957). It was later enshrined and labelled as official by the United Nations (1983).

One of the first usages of unit values to distinguish between horizontal and vertical intra-industry trade flows is reported to be Abed-el-Rahman (1991). Aiginger (1997) further developed this idea and struggled to establish it on the theoretical basis. Aiginger (1997, 1998A) makes use of unit values to estimate the competitiveness of countries and their industries. He further employs this approach in various reports on the quality competitiveness such as in Aiginger (1998B, 2001) or Aiginger and Landesmann (2002). Unit values were, in similar way to Aiginger (1997) but often with modifications, widely used in reports and analyses on countries' quality competitiveness regarding the quality of their products by a wide range of authors. For example, Verma (2002) make use of unit values to evaluate the export competitiveness of Indian textile and garment industry, Greenaway, Hine and Milner (1995) to analyse the horizontal and vertical intra-industry trade for the United Kingdom, Brunner (2001) to analyse export manufacturing performance of East Germany, Ianchovichina et al (2003) to estimate the impact of China's accession into WTO on the region in terms of product quality and Chiarlone (2001) to assess intra-industry trade and vertical differentiation in Italian trade. More recently, Schott (2008) employ unit values to analyse and explain the export phenomenon of China in recent decades.

Unit values and their applications are not the best estimates of countries' product quality. On the one hand, they are easily available since the data on value and quantity imported

and exported are so. They are also easy to calculate and to understand what they say. On the other hand, they do have limitations as to what they say. For example, rising unit values might reflect the rising appreciation of their improving characteristics - its quality, but they do not necessarily have to. Rising unit values could, for instance, capture the rising production or transportation costs or appreciating currency.

Unit values reflect product quality only when the assumption that products possess only vertical attributes for which all consumers agree to pay more (Schott, 2008) hold. The problem is export products to the European Union from different countries and producers are not perfect substitutes. Therefore the above mentioned assumption does not hold in reality. There are generally two ways how to assess the quality rigorously (Schott, 2008): through hedonic theory or, more promisingly the approach taken by Hallak and Schott (2008), which is discussed in detail in the following section, or Khandelwal (2007) that extends the theory of quality ladders.

2.1.3. Alternative approaches

These drawbacks of unit values were, to differing extents, acknowledged by the promoters of the usage of unit values as proxies for export quality, e.g. Aiginger (1997) and Schott (2008), as well as highlighted by other researchers struggling to develop new methods to estimate the export quality, e.g. Hallak and Schott (2008). In response to these drawbacks, more than before, new alternatives to and variations and modifications of unit value approach to quality were developed.

Among others, Martínez-Zarzoso and Burguet (2000) applied the theory of index numbers[2] to the construction of industry-level export price indices and export quality indices. They then use these indices to make comparisons of export prices and qualities. They found that quality change over time is an important phenomenon in explaining the variation of unit value indices over time and across countries and applied this theory on Spanish exports from the European Union.

Probably the most consistent method, which is, necessarily as well as fortunately, both applicable to available data and theoretically rooted, to estimate product quality was

[2] This was not the first time the theory of index numbers helpe out with the estimation of product quality. Earlier it was used, among others, by Diewert (1976) and later by Hallak and Schott (2008).

developed by Hallak and Schott (2008)[3]. Their method decomposes countries' observed export prices into quality and quality-adjusted-price components using information from their trade balances. Holding observed export prices (i.e. unit values) constant, countries with surpluses are inferred to offer higher quality than countries running deficits, an idea taken from index numbers theory. They applied this method on the world's top exporters to the US to examine their manufacturing product quality. Among other results, they find that the initial quality gap between high and low income countries is smaller than their initial income gap, and that the former narrows considerably faster over time. In contrast to many other methods used in the same context and also based on the concept of unit values, this method is theoretically proved and accounts for variation in trade balances induced by horizontal and vertical differentiation, which is the main caveat of other methods based on unit values as estimation for export quality in general. Unfortunately, it was not possible to apply this newly developed method in this paper since the calculations are too complex[4].

This paper makes use of some of these modifications, for example those made by Schott (2008), and struggles to keep practical application in line with the economic theory as well as common sense. I describe the empirical use of unit values to measure export quality in more detail in the following section describing the literature related to the central and eastern European region.

2.2. Estimates of export quality for central and eastern European countries

A number of researchers concerned with estimates of export quality have devoted themselves to the region of central and eastern Europe. They mostly dealt with countries in transition because they were undergoing a rapid development phase and it is interesting to observe how the country's quality trade patterns develop over time as well as in comparison to both its peers and the developed countries.

[3] This idea was firstly theoretically proved by Hallak and Schott (2008). However, similar analysis was carried out before. Similar ideas were expressed, for instance, by Fontagne and Freudenberg (1997).

[4] But with the help from researchers Hallak and Schott, which was promised after they officially publish the paper, I hope to apply the method to the central and eastern European countries in relation to the European Union.

Aiginger (1998A) assesses the qualitative competitiveness of the economies in transition (similar sample of countries as mine), mostly using the concept of unit values. He develops a country specific segmentation of the markets into price and quality sensitive markets leading to four segments for each country according to the concept of revealed price elasticity (Aiginger, 1998A as well as Aiginger, 1995A, 1995B, 1995C, 1996). Aiginger (1998A) draws conclusions on countries' competitiveness from calculated indicators, trade surpluses, export and import unit values as well as other measures. He focuses on the performance of individual countries and compares them with each other, he does not specifically address the question of how the central and eastern European countries compare to the more developed nations.

Dulleck, Foster, Stehrer and Woerz (2005) analyse three dimensions of quality upgrading; upgrading across industries, across different quality segments within industries and within quality segments inside industries. They analyse the product quality of ten central and eastern European countries (the same sample as mine) on the basis of their imports to the fifteen members of the European Union before 2004 and for the period between 1995 and 2000[5]. Their results reveal differences both across countries and across the three different notions of quality upgrading. According to Dulleck, Foster, Stehrer and Woerz (2005), low quality specialisation may be applicable within the high-tech industries to the performance of Baltic and south east European countries, surely not to the rest of the region's countries. Havlik, Landesmann and Steher (2001) provide an earlier analysis of similar patterns, period and country sample as Dulleck, Foster, Stehrer and Woerz (2005).

Horáková (2005) deals with the quality of Czech exports and imports with the European Union and Germany. She concludes that the increased trade flows with these regions are caused by the rising competitiveness of Czech exporters, in other words, by the rising quality of Czech exported products. To reach these conclusions, she employs the concept of unit values based on Aiginger (1997, 2000) as well as the notions from Fontagné and Freudenberg (1997). Benáček (2006) employs unit values in a trade model and also mentions some of the limitations of the unit value approach.

[5] Although I use the same sample of countries, I do include the years up to 2005 to draw conclusions in the subsequent parts of this paper.

Kandogan (2006) observes differences between as well as among the countries of central and eastern Europe[6] and the countries of Commonwealth of Independent States. He analyses and explains these differences as well as the overall growth of export from transition economies to the developed ones. Rosati (1998) makes similar observations and also tries to find what lies behind the different performance of transition countries. Nielsen (2000) employs unit values to analyse the changes in the price-quality competitiveness of exports from the central and eastern European countries.

Fabrizio, Igan and Mody (2007) highlight that central and eastern European countries' exports and shares of world markets grow regardless the appreciation of their exchange rates. Their analysis suggests that countries benefit from higher product quality of their exports.

One of the objectives of this paper is to provide an analysis on the quality of exports of the central and eastern European countries, with the most current data using the most relevant and suitable methods. The most close papers from the above mentioned research to this one are, as far as the applied methods are concerned, Schott (2008) and, in their scope, Aiginger (1998A), Dulleck, Foster, Stehrer and Woerz (2005), Horáková (2005), Benáček (2006), Fabrizio, Igan and Mody (2007).

[6] Similarly to Dulleck, Foster, Stehrer and Woerz (2005).

3. Trade data

To estimate the quality of manufacturing exports from the central and eastern European countries, I widely make use of statistical data on trade flows between numerous countries and regions. This section describes the data used, its source as well as characteristics and limitations.

3.1. Product and industry data

In the empirical section below I make heavily use of trade flow data. The data in this paper are completely drawn from Eurostat, the Statistical Office of the European Communities, which is the statistical arm of the European Commission, producing official data for the European Union including external trade.

The Comtex trade database, which I particularly make use of, records the customs value[7] of all EU-15 imports by exporting country and year from 1995 to 2005 according to thousands of narrowly defined categories, which I refer to as 'products'[8]. Product level statistics were drawn according to the one to eight-digit system, Combined Nomenclature (NC)[9]; some data are also drawn from the one to five-digit system[10] Standard International Trade Classification (SITC). Imports in my sample are in majority of cases classified according to one-digit SITC codes, which I refer to as 'industries'.

SITC codes beginning with 0 through 4 comprise resource products that are not the focus of this paper and are therefore not dealt with. Also, I exclude products from SITC 9 (Not Elsewhere Classified) because of their idiosyncrasy[11]. SITC codes beginning with 5 through 8 encompass manufacturing goods, which are the focus of this paper. Machinery (SITC 7) accounts for the largest share of products for the majority of countries and years among the manufacturing industries. Table 1 lists the number of product categories by one-

[7] So called CIF values are recorded, CIF stands for cost, instance and freight.
[8] Descriptive language as well as the overall approach is in the line with Schott (2008) and other unit value literature.
[9] It is important to point out that, although the data were handled with extreme care, minor mistakes might occur while working with data at the least aggregated level of eight-digit CN product data.
[10] I use only SITC revision 3 that was in effect from 1988 to 2006, when the revision 4 was introduced.
[11] This exclusion is almost a rule in trade literature, see, for example Dulleck, Foster, Stehrer and Woerz (2005) or Horáková (2005).

digit SITC industry and the average number[12] of products according to eight-digit Combined Nomenclature (CN) for manufacturing industries between 1995 and 2005.

Table 1. One-digit SITC industries

One-digit SITC	Number of five-digit SITC	Average number eight-digit CN
5 Chemicals	251	1411
6 Manufactured Materials	445	2632
7 Machinery	298	1957
8 Miscellaneous Manufacturing	258	1363

Source: Eurostat data and author's calculations.

3.2. The time period

The period that I analyse in this paper is from 1995 to 2005. As noted for instance by Dulleck, Foster, Stehrer and Woerz (2005), beginning with 1995 has the advantage that the central and eastern European countries had already started trade integration with the European Union and most of them had already been through the transformational recession.

Even more importantly, from 1995 onwards data for the fifteen members of the European Union are available. In particular, data for the European Union since 1995 includes important trading partners for the central and eastern European countries such as Austria for the Czech Republic, Slovakia, Slovenia and Hungary, and Finland and Sweden for Estonia, Lithuania and Latvia. Also, in the Comtex database, the data begins with the year of 1995.

Although at the moment there are some data on trade flows available for the year of 2006 or even 2007, there are a few reasons, which I list below, why I do end the sample period with 2005. For the same reasons, it is quite likely that also other research papers to come will refrain from the analysis of the post-2005 period.

First and crucial reason is the missing data for the period from 2006 on. For the purpose of the analysis in this paper, the concept of unit value is crucial. To compute unit values, however, a quantity measure is needed. For the period 1995 to 2005, the weight in kilograms was used. From 2006 on, this measure is not required, with the aim of easing

[12] It is a very rough average since due to the variations in eight-digit CN, it is quite demanding to work with the data.

regulation, from the importers and exporters within the European Union; in other words, it takes effect for countries in so called Intrastat. For Extrastat, system focused countries not in the European Union, the quantity measure is still required. However, the majority of countries in my sample joined the European Union in 2004 and are therefore classified under the Intrastat regime for 2006 and 2007.

Second, from 2006 on, SITC classification system was changed. New Revision number 4 has replaced the Revision number 3 which was in effect throughout my sample period of 1995 to 2005. Naturally, it is comfortable and easier to analyse data that were reported under the same revision.

In theory, the inclusion of the data for 2006 and, possibly, for 2007 would be possible through adding missing information and estimation since not all quantities went unreported in 2006 and the new revision can be handled. However, such process would be hardly manageable, surely not in the scope of this paper.

It is important to acknowledge that even without including 2006 and 2007 there are concerns over the accuracy of the data. For the eight central and eastern European countries that joined the European Union in 2004, the trade data have been computed by combining Intrastat and Extrastat systems. Therefore the data for 2004 and 2005 are not fully comparable to those before the enlargement in 2004.[13]

3.3. Regions and countries

In the analysis of exports and quality of exports from the central and eastern European countries, I make comparisons between countries as well as regions. To facilitate the comparison of countries' exports and unit values, I make use of the country and region assignments provided in Table 2, if not stated elsewhere in the paper.

[13] However, it is widely believed that for the analysis that follows, the accuracy of data is sufficient. The problem with data accuracy might be larger if data from national statistical offices were used rather than from Eurostat, as in my case, because of stronger unification processes within Eurostat. The fears of Horáková (2005) are thus acknowledgeable, although this paper similarly to Fabrizio, Igan and Mody (2007) makes of the post-enlargement data.

Table 2. EU-15 trading partners, by region

Country	Region	Country	Region
Austria	EU-15	Lithuania	CEE-10
Belgium	EU-15	Poland	CEE-10
Denmark	EU-15	Slovakia	CEE-10
Finland	EU-15	Slovenia	CEE-10
France	EU-15	Romania	CEE-10
Germany	EU-15	Australia	OECD-11
Greece	EU-15	Canada	OECD-11
Ireland	EU-15	Iceland	OECD-11
Italy	EU-15	Japan	OECD-11
Luxembourg	EU-15	South Korea	OECD-11
Netherlands	EU-15	Mexico	OECD-11
Portugal	EU-15	New Zealand	OECD-11
Spain	EU-15	Norway	OECD-11
Sweden	EU-15	Switzerland	OECD-11
United Kingdom	EU-15	Turkey	OECD-11
Bulgaria	CEE-10	United States	OECD-11
Czech Republic	CEE-10	China	China
Estonia	CEE-10	Asian non-OECD countries excl. China	Asia
Hungary	CEE-10	Commonwealth of Independent States	Asia
Latvia	CEE-10		

Notes: Countries sorted alphabetically by region. Region affiliations are mutually exclusive. EU-15=fifteen countries of the European Union before the enlargement in 2004. CEE-10=ten central and eastern European countries that joined the European Union in 2004 and 2007. OECD-11=eleven members of the OECD that are included in neither EU-15 nor CEE-10. China=China. Asia= all Asian countries excluding China and the OECD member countries.

A few aspects of how countries are assigned to regions deserve attention. First, EU-15 includes all fifteen countries that were part of the European Union before the enlargement in 2004. Throughout this paper, I take EU-15 as the importer against which I evaluate the export performance of other regions and countries. In this paper I consider the EU-15 countries as a single importer – as it was a single country, though it is not true – to facilitate the analysis. EU-15 is taken as the importer because of its highly developed economy, relative openness for manufacturing imports. Another reason for choosing EU-15 as the importing and also the benchmark region is its proximity to the region of central and eastern Europe that is the main focus of this study[14]. Furthermore, almost all the CEE-

[14] Similar explanations can be find in Horáková (2005), Dulleck, Foster, Stehrer and Woerz (2005) or Fabrizio, Igan and Mody (2007).

10 countries in almost all industries export majority of their products to the European Union, of which EU-15 is the core.

The ten countries of central and eastern Europe that are the focus of this paper are labelled throughout the paper as CEE-10. CEE-10 comprises of eight central and eastern European countries that joined the European Union in 2004, e.g. all that joined in 2004 apart from Cyprus and Malta, and two eastern European countries, Bulgaria and Romania that joined the European Union in 2007. CEE-10 therefore consists of the most important and developed countries in central and eastern Europe that are not part of the EU-15. The CEE-10 countries share a lot of characteristics ranging from common history to similar language and economic development. They were all rapidly developing between 1995 and 2005 and the majority is successfully catching up with the EU-15 after Communist rule in the most of the second half of twentieth century and subsequent transformation from central planned economy to market economy.

OECD-11 includes all member countries of the OECD that are neither part of EU-15 nor CEE-10 as of 2007. OECD-11 represents a group of countries that are relatively high-wage and developed economies, although the group also includes countries such as Turkey, Mexico and South Korea. In a few sections of this paper, the OECD-11 is going to be considered as developed economy benchmark against which it is possible to assess the performance of less developed economies such as those of the CEE-10 region.

For its importance, I exclude China from the region Asia and establish China as a single region. Apart from China, Asia includes all Asian countries that are not members of the OECD, from Indonesia to Georgia. In the region Asia, for purpose of this paper, I also include all the members of the Commonwealth of Independent States. Countries that are not elsewhere included such as Balkan, African and Latin American countries are not of high importance from the trading point of view of the CEE-10 as well as the EU-15 countries.

At some stages of the analysis, I take advantage of an assumption, similar to the one used by Schott (2008), while comparing CEE-10's and other regions' and countries' exports to the EU-15. The assumption states that EU-15 trading partners' exports to the EU-15 accurately reflect their domestic production as well as their exports to other markets, particularly in terms of product quality.

This assumption is partially justified by the relative openness of the EU-15 economy and its attractiveness as an export destination[15]. Furthermore, for the CEE-10 exporters, is also justified by the relative proximity to the EU-15 market, relatively high integration[16] and, more generally, low transportation costs. The assumption is also supported by the findings of Hallak (2006) who, using cross-sectional data from 60 countries in 1995, confirms theoretical prediction that rich countries tend to import relatively more from countries that produce high quality goods.

Nonetheless, the existence of tariff and non-tariff barriers, variation in countries' demand and also general trade costs such as transportation[17] can influence which of a country's goods are exported or to which trading partner they are sent. More generally, the assumption helps me to draw general conclusion regarding the quality of exports or products of the CEE-10 countries.

[15] Similar case as Schott(2008) makes for the US economy.
[16] Eight out of the ten CEE-10 countries were part of the single EU market and, furthermore, all of them were for substantial part of the period between 1995 and 2005 in a special pre-accession relationship to the EU.
[17] For instance, the extreme proximity of the CEE-10 region to the EU-15 in contrast to other regions might be very important in determining the trade patterns.

4. Unit values as estimates of export quality

In this paper, I use EU-15 import data to assess the relative sophistication of the CEE-10 exports both within and across products over a time period of 1995 – 2005. In this part I focus on the former. I estimate the relative sophistication of the CEE-10 export varieties within products in terms of relative prices.

In the first two parts of this section I introduce the concept of unit value and compute the unit values for CEE-10 for the period 1995 to 2005. The results enclosed in the appendix reveal an increasing trend of unit values in nearly all countries and industries. I consider these results as a hint that quality upgrading might be going on in the sample countries for the period. In the third part of Section 4 I employ other methods based directly on unit values to assess whether the rising unit values could be really explained by quality as has been suggest by recent research[18]. In subsequent Section 5, I employ other methods, not based on unit values, to assess the possible quality upgrading of the CEE-10 countries' exports.

4.1. The concept of unit value

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 their weight in kilograms (Aiginger, 1998). In other words, export unit value can be written as

$$u_{pc} = V_{pc}/Q_{pc}, \quad (1)$$

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 physical units such as kilograms.

In this paper, physical units, in which the amount of product is expressed, are one hundred kilograms. The importing region is EU-15 and the currency is euro. As in the whole paper, I consider the data for the period 1995 to 2005.

[18] For recent research that draw similar conclusions, see, for instance, Aiginger (1998A), Dulleck, Foster, Stehrer and Woerz (2005), Horáková (2005), and Fabrizio, Igan and Mody (2007).

4.2. The use of unit values to estimate export quality

As mentioned in chapter 2.1. of this paper, unit values has been used as prominent estimates of export quality and, at the same time, in this respect suffer from their inherent deficiencies, depending also on the modification of the unit value approach applied.

Figures 5 to 9 in Appendix include unit values for the CEE-10 countries and manufacturing industries for imports to EU-15. The overall trend is clear, unit values are rising for almost all countries and industries.

4.2.1. Problems with using unit values to estimate export quality

There are a few problems while using the unit values as estimates of export quality, as dealt with in detail in the chapter 2.1. of this paper. It is important to keep these caveats in mind while interpreting the results achieved through the use of unit values. I struggle to do so in this paper and, for example, to smooth some of the drawbacks I very often use relative measures based on the concept of unit values to confirm increasing export quality.

4.3. Relative within-product sophistication

In this part I use two methods to estimate relative within-product sophistication of the CEE-10 countries. Firstly, I make use of regression technique to assess the unit values of the CEE-10 countries in comparison to countries with similar characteristics. Secondly, I make use of the relationship between unit values of the CEE-10 countries and OECD-11 to draw conclusions about the relative sophistication of the CEE-10 exports.

4.3.1. Within-product sophistication relative to similar countries

In order to estimate the price of the CEE-10 countries' exports relative to similarly developed countries, similarly to Schott (2008), I 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,

$$\log(u_{tic}) = PCGNI_{tc} + distance_{c} + \varepsilon_{tic}, \qquad (2)$$

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. As above, I computed data for unit values on the basis of the data from Eurostat. Data on per capita gross national income is taken from the World Bank's World Development Indicators database. Data for the distance from Brussels are taken from the Centre D'Etudes Prospectives et D'Informations Internationales (CEPII) website.

I calculated regressions using various sets of countries and regions. Results of two regressions19 deserve attention. Firstly, I use dataset for 164 worldwide countries and territories with almost complete values for all of the variables for the period 1995 to 2005, in total I employ 1728 observations for the regression. Table 13 reports the result, with the value of coefficients in the respective cell with the values of standard errors just below, a row lower.

Table 3. Regression of unit values on country characteristics, world, 1995 – 2005, manufacturing industries

Industry (SITC)	**Chemicals (5)**	**Manuf. Materials (6)**	**Machinery (7)**	**Misc. Manuf. (8)**	**Aggregate (A)**
	$Log(u_{5ct})$	$Log(u_{6ct})$	$Log(u_{7ct})$	$Log(u_{8ct})$	$Log(u_{Act})$
Log ($PCGNI_{ct}$)	-0.0116938	-0.1989912	0.1401572	0.0553059	-0.0103603
	0.0740745	0.0741203	0.0582865	0.1025776	0.0652654
Log ($Distance_c$)	0.9315456	0.6835267	0.5761457	-0.1548898	0.7873043
	0.1394437	0.1515111	0.1081626	0.4607848	0.1360675
Constant	-2.631196	1.485681	1.413469	8.209662	-0.4446757
	1.42803	1.516752	1.112354	3.835708	1.355205
Observations	1604	1704	1717	1713	1728
R^2	0.15	0.14	0.08	0.07	0.14

Source: Eurostat data, data from the Centre D'Etudes Prospectives et D'Informations Internationales webpage and from the World Bank's World Development Indicators database, and author's calculations.

The results are not very satisfactory, with R-squared only 0,14 for aggregate manufacturing. However, I still assume the estimates to be quite good and use them for further analysis.

In the second model, I regress only the ten CEE-10 countries, in total 110 observations. Table 14 reports the results.

[19] I calculated both regressions using the statistical software Stata 9. I employed linear regression for longitudinal data with GLS random effects. For both regressions, I verified assumptions with some unsuccessful results. I neglect this, otherwise important fact, as it is common in the similar international trade research literature, compare with Schott (2008).

Table 4. Regression of unit values on country characteristics, CEE-10, 1995 – 2005, manufacturing industries

Industry (SITC)	Chemicals (5)	Manufactured Materials	Machinery (7)	Miscellaneous manufacturin	Aggregate (A)
	$Log(u_{5ct})$	$Log(u_{6ct})$	$Log(u_{7ct})$	$Log(u_{8ct})$	$Log(u_{Act})$
Log ($PCGNI_{ct}$)	0.7185769	1.286859	0.9552367	-0.2985549	1.393306
	0.080123	0.0828637	0.0866089	0.0688679	0.0975854
Log ($Distance_c$)	-0.552498	0.7076688	0.6776293	-0.0327087	0.5645859
	0.4824958	0.2454851	0.3502147	0.367402	0.5100082
Constant	0.9573294	-12.65528	-7.256408	9.269637	-11.87423
	3.631734	2.124635	2.796288	2.804146	3.902972
Observations	110	110	110	110	110
R^2	0.5	0.67	0.45	0.08	0.49

Source: Eurostat data, data from the Centre D'Etudes Prospectives et D'Informations Internationales webpage and from the World Bank's World Development Indicators database, and author's calculations.

With R-squared for aggregate manufacturing 0,49 and for manufactured materials as high as 0,67, the model explanatory variables seem to be well chosen.

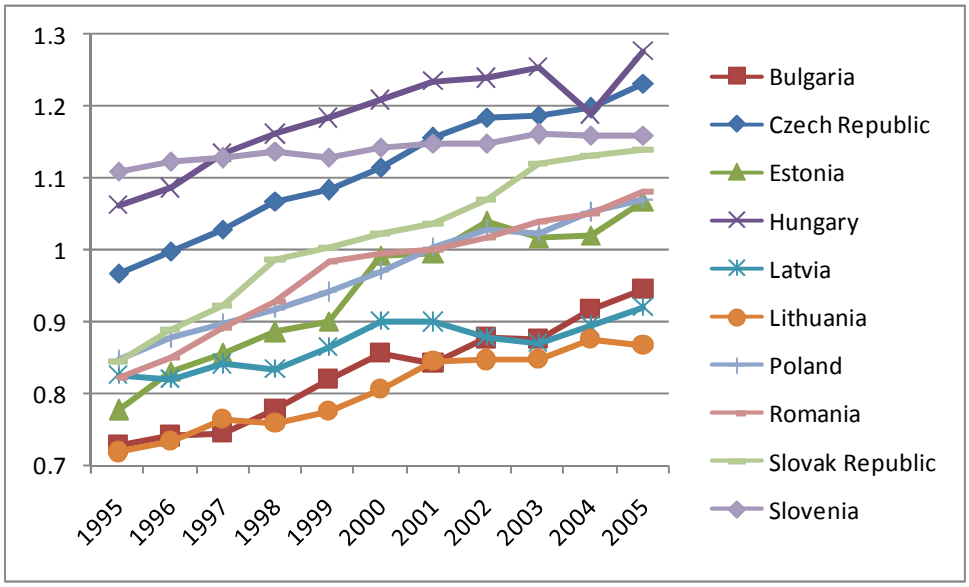
In the next section, I make use of both regressions to predict the values of $log(u_{Act})$ for the CEE-10 countries according to the respective regression model. I then construct regression log unit value ratios (RUVR),

$$\mathrm{RUVR_{ti}} = \log\left(u_{ti}^{reality}\right) / \log\left(u_{ti}^{prediction}\right), \quad (3)$$

where $u_{ti}^{reality}$ and $u_{ti}^{prediction}$ are the unit values of industry *i* in year *t* in reality and according to model prediction, respectively, and log is natural logarithm. This enables me to carry out useful comparison for CEE-10 with similarly developed or distanced countries and within the CEE-10 countries themselves. In this analysis I focus only on the aggregate manufacturing although similar analysis could be carried out for individual industries or even more disaggregate groups of products.

Figure 1 shows the results of RUVRs based on the first regression that was based on all world countries.

Figure 1. Regression log unit value ratios for the CEE-10 countries, aggregate manufacturing, world regression

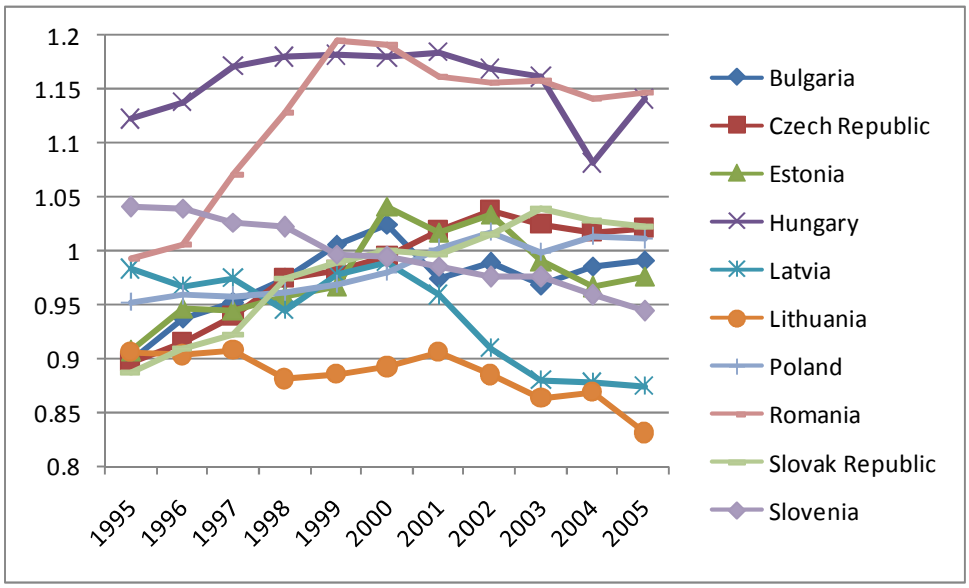


Source: Eurostat data and author's calculations.

According to the graph and the model, 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. Generally, all CEE-10 countries experienced substantial upgrading of their prices in comparison to what the model would predict, based on per capita income and distance from Brussels. We should bear in mind from which model we derived the RUVRs – R-squared only 0,14 – and therefore strictly limit the interpretation of this model.

Figure 2 reports the Regression log unit value ratios (RUVRs) for the CEE-10 countries, similarly to the previous Figure 1, but this time it is based on a regression that consisted only of 110 observations.

Figure 2. Regression log unit value ratios for the CEE-10 countries, aggregate manufacturing, CEE-10 regression



Source: Eurostat data and author's calculations.

According to Figure 2, it is possible to easily differentiate between three groups of countries as far as the development of their RUVRs is concerned. The underlying model achieved R-squared of 0,49 and it is therefore possible to draw some reliable conclusions using the level and time development of RUVR. Five countries experienced a rise of RUVR to the level of 1, two countries have their RUVRs fluctuated around the level of 1,15 and three countries experienced a nearly permanent decrease of their RUVRs over the time.

First, there is a group of five countries with quite similar development of RUVR during the sample period: after an increase of their real unit values in comparison to the model predictions, they approximately stabilised around the predicted value. The Czech Republic, Estonia, Poland, Bulgaria and Slovakia all started around the RUVR of 0,9 in 1995 and increased the ratio to around 1,0 during the late 1990s and maintained the similar level till 2005.

Second, two of the CEE-10 countries have considerably higher unit values than would be predicted by their distance and per capita income in the model. Hungary and Romania achieved the highest levels of RUVR for most of the period. Third, the real export prices in relation to the predictions of the model decreased significantly for the three of the ten

CEE-10 countries. Slovenia's, Latvia's and Lithuania's RUVR declined throughout the sample period.

4.3.2. Within-product sophistication relative to the OECD

In this part I use a straightforward measure to estimate the relative quality of exports of CEE-10, inspired by Schott (2008). I compare the CEE-10 and the OECD-11 export unit values according to log unit value ratio,

$$\log(UVR_{ti}) = \log\left(u_{ti}^{CEE-10}/u_{ti}^{OECD-11}\right), \quad (4)$$

where u_{ti}^{CEE-10} and $u_{ti}^{OECD-11}$ are the unit values of industry *i* in year *t* for CEE-10 and OECD-11, respectively, and log is natural logarithm. Similarly, I 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 to 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 5 reports the results by industry and country for 1995 and 2005.

Table 5. 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

Source: Eurostat data and author's calculations.

Appendix and its Figure 9 contain detailed results on each country and industry.

Overall trend in all CEE-10 countries across all industries is clear – the unit value ratios in relation to the OECD-11 are increasing between 1995 and 2005. There are two important exceptions to the overall trend, one in terms of countries, and the other in terms of industries. Slovenia's UVRs more or less stagnated for the most of the period and began to rise significantly in the second half of the period. Chemicals have the lowest UVR level among all industries, for the vast majority of countries and years, and their UVRs rise only slightly, fluctuate or even decline over the time period of 1995 to 2005.

5. Across-product sophistication

In this section, I look for 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. I compare the range of manufacturing product categories CEE-10 exports to 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, similarly to Schott (2008). As noted earlier, I assume, in the line with Schott (2008), 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.

5.1. Market share

I compare performance of CEE-10 in the EU-15 market in terms of market share and product penetration to that of other regions, similarly to Schott (2008). To compute the market shares of region I employ the market share index (MSI).

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

$$MSI_{tri} = 100 \times \sum_{c \in r} V_{tci} \,/\, \sum_{c} V_{tci}, \tag{5}$$

where *c* indexes countries, $c \in r$ captures the set of countries in region *r* and V is import value. Note that market shares across the columns of Table 3 do not sum to 100% because all EU-15 trading partners are not represented. Table 3 reports the EU-15 market share of OECD-10, Asia, China and CEE-10 in terms of import value, by industry, for the first and last years of the sample.

Table 6. 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

Source: Eurostat data and author's calculations.

The market shares included in Table 3 convey several messages. Firstly, they show 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, similarly to findings on the US market by Schott (2008). While the OECD-10 accounted for 53% of manufacturing imports in 1995, this share falls to 38% by 2005. Secondly, the data in Table 3 show that, after China, CEE-10 was the region with the second highest increase in manufacturing imports to the EU-15 over the period. CEE-10's share of manufacturing imports to the EU-15 increases steadily from 9% in 1995 to 15% in 2005, driven especially by relatively large gain in Machinery (which also includes cars and car parts).

Since Hallak (2006) confirms theoretical prediction that rich countries tend to import relatively more from countries that produce high quality goods, the increases in market share can be linked with the increases in export product quality.

Table 4 reports the countries with the top ten absolute changes in manufacturing market share between 1995 and 2005. A half of the CEE-10 comprises also the half of the top ten countries with the highest absolute change, including the Czech Republic, Hungary, Poland, Slovakia and Romania.

Table 7. Largest gains in market share, 1995 to 2005

Country	1995	2005	Change	% change
China	6,25	16,74	10,48	268
Czech Republic	1,94	3,75	1,81	193
Hungary	1,57	3,17	1,59	201
Turkey	1,86	3,20	1,34	172
Poland	2,47	3,73	1,26	151
South Korea	2,76	3,52	0,76	127
United Arab Emirates	0,17	0,91	0,74	548
Slovakia	0,72	1,40	0,68	194
Romania	0,80	1,43	0,63	178
South Africa	0,63	1,05	0,42	166
Average	1,92	3,89	1,97	220

Source: Eurostat data and author's calculations.

5.2. Product penetration

There are generally two ways how to increase market share. Either through increasing exports of incumbent products and an increase in the number of products exported. In the next two parts I focus on the latter. In this section I am going to look at so called product penetration, in other words, 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 I 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 5 reports manufacturing product penetration by region, year and industry in 1995 and in 2005. Similarly to Schott (2008), each cell in the table reports the percentage of products in each industry exported by the CEE-10 region countries or other regions and countries. Region has a penetration of 100% if every product in the industry is exported by at least one country in the region and 0% if no country in the region exports any of the industry's products to the EU-15. The total average number of products in each industry according to CN in both 1995 and 2005 is included in the Table 1.[20] Since the market shares of following regions are roughly comparable, I assume it is makes sense to compare their product penetration.

Table 8. 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

Source: Eurostat data and author's calculations.

Table 5 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 to three other regions. The product penetration in

[20] For the transformation of product categories between Combined Nomenclature (CN) and Standard International Trade Classification (SITC) I used the Eurostat's Conversion table for the period between 1988 and 2005.

Asia was similar to the one in the CEE-10 with similar increase between 1995 and 2005. The highest increase in product penetration over the period was made by China, overall manufacturing penetration increased by 17% from 43% in 1995 to 59% in 2005. Therefore, China's average manufacturing product penetration in 2005 was just behind the one of the CEE-10.

The highest increase of the CEE-10's product penetration was in Miscellaneous Manufacturing (SITC 8), from 65% in 1995 to 74% in 2005. In Miscellaneous Manufacturing, the CEE-10's product penetration was therefore almost equal to the product penetration of China, Asia and even OECD-11 that reached the level of 75%, 76% and 77%, respectively.

Despite the 4% increase for the CEE-10 in product penetration in Chemicals (SITC 5), from 51% to 55% in 2005, the penetration was still significantly below the OECD-11's with 70% as well as the Asia's one with 60%. Aggregated data for the CEE-10 region in Table 5 also shows 2% increase for the in Machinery (SITC 7) with 62% in 2005 and stagnation for Manufactured Materials (SITC 8) with 63% at the beginning as well as the end of the period. For both of these industries the penetration for the CEE-10 was the same as for Asia and a few percentage points below the level of the OECD-11 and a few percentage points above the level of China.

Table 6 reports detailed information on product penetration for all ten countries of the CEE-10 region that convey a more specific and also interesting message about the penetrations for the region. The Czech Republic, followed closely by Poland, has the highest product penetration in both 1995 and 2005. It can be probably attributed to both its historically rooted focus on industry as well as the average highest proximity to the EU-15 among the CEE-10 countries.

Table 6 also shows that Lithuania and Latvia have the lowest product penetration which is in the line with the fact that they are the least developed economies among the CEE-10 countries.

Table 9. Product penetration by country and year

	Bulgaria		Czech Rep		Estonia		Hungary		Lithuania	
SITC1 industry	1995	2005	1995	2005	1995	2005	1995	2005	1995	2005
5 Chemicals	15	15	33	37	9	18	31	32	5	12
6 Manufactured Materials	25	34	51	54	26	33	43	46	17	26
7 Machinery	28	35	51	52	28	31	44	47	13	25
8 Misc Manufacturing	34	54	58	67	39	45	55	62	22	40
Overall Manufacturing	24	31	47	50	24	29	41	44	13	23
	Latvia		**Poland**		**Romania**		**Slovenia**		**Slovakia**	
SITC1 industry	1995	2005	1995	2005	1995	2005	1995	2005	1995	2005
5 Chemicals	5	10	29	38	12	19	18	23	17	23
6 Manufactured Materials	13	20	48	53	30	44	38	42	32	39
7 Machinery	12	22	48	51	27	45	39	43	33	39
8 Misc Manufacturing	16	35	58	61	33	56	46	58	39	51
Overall Manufacturing	11	19	44	49	25	39	34	39	29	36

Source: Eurostat data and author's calculations.

Table 7 shows that, not surprisingly, the CEE-10 countries with the lowest manufacturing product penetration in 1995 such as the Baltic countries and eastern European duo, Romania and Bulgaria, have the highest increase in product penetration over the period. Romania has the highest increase of 14 percentage points in product penetration to 39% in 2005 that is above the average of 36%.

Table 10. Gains in product penetration in the CEE-10 countries, 1995 - 2005

	1995	2005	Change	% change
Romania	25	39	14	56
Lithuania	13	23	10	77
Latvia	11	19	8	73
Bulgaria	24	31	7	29
Slovakia	29	36	7	24
Estonia	24	29	5	21
Poland	44	49	5	11
Slovenia	34	39	5	15
Czech Rep	47	50	3	6
Hungary	41	44	3	7
Average	29	36	7	24
CEE-10	59	61	2	3

Source: Eurostat data and author's calculations.

5.3. Decomposition of the export growth

In the this section further analyse in which way the regions' and countries' market shares increased or declined. I 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 me to assess the relative importance of product penetration for the CEE-10 countries and also compare it with other regions.

Table 8 examines the intensive margin according to CN product categories. The larger the intensive margin, the larger share of the export growth or decline happened between 1995 and 2005 due to larger quantities of each good in contrast to wider set of products.

Table 11. Decomposition of the export growth or decline by regions, intensive margin, 1995 to 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

Source: Eurostat data and author's calculations.

Table 9 reports similar information as the Table 8 but with detailed data on the CEE-10 countries.

Table 12. Decomposition of the export growth or decline, intensive margin, the CEE-10 countries, 1995 to 2005

SITC1 industry	Bulgaria	Czech Rep	Estonia	Hungary	Lithuania
5 Chemicals	59	62	19	71	59
6 Manufactured Materials	65	67	55	65	39
7 Machinery	72	68	30	49	48
8 Misc Manufacturing	88	89	63	93	41
Overall Manufacturing	69	68	38	53	46
SITC1 industry	**Latvia**	**Poland**	**Romania**	**Slovenia**	**Slovakia**
5 Chemicals	41	75	67	59	40
6 Manufactured Materials	36	69	50	77	56
7 Machinery	36	71	44	82	62
8 Misc Manufacturing	54	82	83	92	87
Overall Manufacturing	36	71	49	79	61

Source: Eurostat data and author's calculations.

It is clear from Table 8 and Table 9 that the relative contribution of the intensive margin to the change in exports varies across regions, 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 to Asia and China and therefore less opportunity for gains through extensive margin.

In combination with the observations on market shares and product penetration, it is possible to draw interesting comparisons on countries' industries. For example, Czech Machinery (SITC 7) industry has been much more advanced and broad in products in 1995 than Lithuania's or Latvia's or Romania's. In comparison to the Baltic states, Romania's machinery industry developed much more successfully during the period to 2005.

5.4. Export similarity with the OECD

This part of the paper estimates the export similarity of the CEE-10 region and its countries with the OECD-11. To assess the similarity I employ the export similarity index (ESI), developed by Finger and Kreinin (1979) and used recently for instance by Schott (2008)[21].

[21] Schott (2008) used ESI to estimate the relative sophistication of China's manufacturing exports and I employ ESI very similarly.

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,

$$ESI_t^{cd} = \sum_p \min\left(s_{tp}^c, s_{tp}^d\right), \quad (6)$$

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, I computed ESI of Asia, China and CEE-10 for export similarity with the OECD-11.

Table 13. 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

Source: Eurostat data and author's calculations.

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 demonstrated thus its relative export maturity.

To gain more specific knowledge of the CEE-10 countries' exports, I computed ESI of the CEE-10 countries for export similarity with the OECD-11.

Table 14. The CEE-10 countries' export similarity with the OECD-11

	Bulgaria		Czech Rep		Estonia		Hungary		Lithuania	
SITC1 industry	1995	2005	1995	2005	1995	2005	1995	2005	1995	2005
5 Chemicals	0,11	0,12	0,22	0,19	0,04	0,14	0,23	0,31	0,05	0,06
6 Manufactured Materials	0,19	0,19	0,30	0,36	0,17	0,18	0,32	0,29	0,15	0,17
7 Machinery	0,21	0,21	0,31	0,37	0,17	0,22	0,26	0,33	0,07	0,16
8 Misc Manufacturing	0,21	0,22	0,31	0,33	0,25	0,18	0,34	0,28	0,28	0,25
Overall Manufacturing	0,18	0,20	0,30	0,35	0,19	0,20	0,29	0,32	0,16	0,19
	Latvia		**Poland**		**Romania**		**Slovenia**		**Slovakia**	
SITC1 industry	1995	2005	1995	2005	1995	2005	1995	2005	1995	2005
5 Chemicals	0,06	0,10	0,17	0,19	0,09	0,09	0,16	0,26	0,13	0,12
6 Manufactured Materials	0,15	0,11	0,27	0,35	0,23	0,31	0,33	0,34	0,24	0,26
7 Machinery	0,11	0,25	0,25	0,29	0,18	0,27	0,23	0,28	0,21	0,24
8 Misc Manufacturing	0,18	0,16	0,30	0,28	0,19	0,30	0,26	0,30	0,19	0,20
Overall Manufacturing	0,15	0,15	0,27	0,30	0,19	0,29	0,27	0,30	0,21	0,24

Source: Eurostat data and author's calculations.

Differences across countries and industries are substantial. While the Czech Republic reaches ESI of 0,37 in Manufactured Materials (SITC 6) in 2005, Lithuania has ESI of only 0,05 in chemicals in the same year. On average, the highest ESI value among the CEE-10 countries in both years has the Czech Republic with 0,30 and 0,35 in 1995 and 2005, respectively. The lowest values had the Baltic trio and Bulgaria with overall manufacturing ESI below or at 0,20 for both years.

The largest increased in ESI was in Romania where it rose from the under average value of 0,19 in 1995 to the above average value of 0,29 in 2005. To complete the analysis, Table 12 reports ESI of three regions with the CEE-10 region.

Table 15. Regions' export similarity with the CEE-10

	Asia		China		OECD-11	
SITC1 industry	1995	2005	1995	2005	1995	2005
5 Chemicals	0,35	0,30	0,16	0,21	0,27	0,29
6 Manufactured Materials	0,35	0,36	0,22	0,34	0,40	0,43
7 Machinery	0,21	0,30	0,20	0,30	0,36	0,44
8 Misc Manufacturing	0,43	0,39	0,39	0,37	0,38	0,37
Overall Manufacturing	0,30	0,32	0,25	0,31	0,37	0,42

Source: Eurostat data and author's calculations.

6. 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 and therefore deliver new, interesting findings. This research also led to a methodological innovation by developing a brand-new method to assess export quality. Predominantly, this paper investigates the link between rising unit values and rising product quality of central and eastern European exports. Export quality is of a major importance to an economic development and, evidently, played a key role also in the post transition period of the former Communist countries.

This research observes rising unit values of manufacturing exports from ten central and eastern European countries to the original fifteen 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 research employs various methods to assess whether it is so. Similarly to 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, some of them 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 method uses the ratio between unit values of the central and eastern European countries and of the most developed 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.

Though the results in this paper provide crucial insight into how the export quality of central and eastern European countries is rising, it raises a few questions requiring further research. Namely, nowadays there is no theoretically correct method available that could be empirically implemented to estimate the export quality. Promisingly, there are methods being developed that should succeed in theoretically proved estimates of export quality:

especially Hallak and Schott (2008) or, alternatively, Khandelwal (2007), both soon to be published. As discussed, unit value approach has theoretical limitations and this paper attempts to make the best possible from the approach by developing a new method and implementing other innovate ones. To conclude, all of them provide evidence that quality of the central and eastern European manufacturing exports is rising.

7. References

Abed-el-Rahman, Kamal, 1991. Firms' competitive and national comparative advantages as joint determinants of trade composition. Review of World Economics, 127(1): 83-97.

Aiginger, Karl, 1995A. Creating a Dynamically Competitive Economy: Defining the competitiveness of a nation and a case study. In Devine, P., Katsoulacos, Y., Sugden, R. (eds.), Competitiveness, subsidiarity and objectives, Ruthledge.

Aiginger, Karl, 1995B. The Unit Value as a Complementary Indicator for the Assessment of the Competitive Position of USA, EU and Japan. In conference On the Future of Industry in Advanced Societies at MIT.

Aiginger, Karl, 1995C. A Framework for Developing the Dynamic Competitiveness of Nations. Discussion paper, EUNIP.

Aiginger, Karl, 1997. The Use of Unit Values to Discriminate Between Price and Quality Competition. Cambridge Journal of Economics, 21(5): 571-592.

Aiginger, Karl, 1998A. Unit Values to Signal the Quality Position of CEECs. In The Competitiveness of Transition Economies. OECD Proceedings, 1998(10): 93-121.

Aiginger, Karl, 1998B. A Framework for Evaluating the Dynamic Competitiveness of Countries. Structural Change and Economic Dynamics, 1998: 159-188.

Aiginger, Karl, 2001. Europe's Position in Quality Competition. Enterprise Papers of European Comission, 2001(4).

Aiginger, Karl and Michael Landesmann, 2002. Competitive Economic Performance: The European View. In conference on Transatlantic Perspectives on US-EU Economic Relations: Convergence, Conflict & Cooperation at Harvard University.

Aturupane, Chonira, Simeon Djankov and Bernard Hoekman, 1999. Horizontal and vertical intra-industry trade between Eastern Europe and the European union. Review of World Economics, 135(1): 32-81.

Aw, Bee Yan and Mark J. Roberts, 1986. Measuring quality change in quota-constrained import markets: The Case of U.S. Footwear. Journal of International Economics, 21(1): 45-60.

Benáček, Vladimír, 2006. Determining Factors of Exports and Imports: A Synthesis of Explanatory Paradigms. Prague Social Science Studies, Charles University.

Benáček, Vladimír, Jiří Podpiera and Ladislav Prokop, 2005. Determining Factors of Czech Foreign Trade: A Cross-Section Time Series Perspective. Czech National Bank, Working Paper No. 2005/03.

Benáček Vladimír, Ladislav Prokop and Jan Ámos Víšek, 2003. Determining Factors of the Czech Foreign Trade Balance; Structural Issues in Trade Creation. Czech National Bank, Working paper No. 2003/03.

Bils, Mark, 2004. Measuring the Growth from Better and Better Goods. National Bureau of Economic Research, Working Paper No. 10606.

Boorstein, randi and Robert C. Feenstra, 1987. Quality Upgrading and its Welfare Cost in U.S. Steel Imports, 1969-74. National Bureau of Economic Research, Working Paper No. 2452.

Broda, Christian and David E. Weinstein, 2004. Globalization and Gains from Variety. National Bureau of Economic Research, Working Paper No. 10314.

Brooks, Eileen, 2006. Why Don't Firms Export More? Product Quality and Colombian Plants. Journal of Development Economics, 80(1): 160-178.

Brunner, Hans-Peter, 2001. East German International Trade during Transition As a Reflection of the Dynamics of Competitiveness. 27(3): 287-308.

Chiarlone, Stefano, 2001. Evidence of Product Differentiation and Relative Quality in Italian Trade. CESPRI, University Bocconi, Working paper, 2000(114): 147-168.

Copeland, B. R. And A. Kotwal, 1996. Product Quality and the Theory of Comparative Advantage. European Economic Review, 40(9): 1745-1760.

Czechinvest, government agency, the Czech Republic, 2008. Retrieved from the official website of Czechinvest www.czechinvest.org in March 2008, on the economic policies towards higher export quality.

Czech Statistical Office, 2007. Statistics of Foreign trade. Retrieved from www.czso.cz in November 2007.

Diewert W.E., 1976. Exact and Superlative Index Numbers. Journal of Econometrics 4(2): 115–145.

Dulleck, Uwe and Neil Foster, 2004. Why Transition Countries May Specialize in Low-Quality Production. Transition Studies Review, 11(3): 114-124.

Dulleck, Uwe, Neil Foster, Roberst Stehrer and Julia Woerz, 2005. Dimensions of Quality Upgrading, Economics of Transition, 13(1): 51-76.

Fabrizio, Stefania, Deniz Igan and Ashoka Mody, 2007. The Dynamics of Product Quality and International Competitiveness. IMF Working Paper.

European Commission, 2007. Pro Inno Europe, Inno Metrics, Europan Innovation Scoreboard 2006, Comparative Analysis of Innovation Performance. A report prepared by the Maastricht Economic Research Institute on Innovation and Technology (MERIT) and the Joint Research Centre (Institute for the Protection and Security of the Citizen) of the European Commission.

Eurostat, 2008. External Trade Data Comext. Retrieved from epp.eurostat.ec.europa.eu in February 2008.

Fontagné, L. and M. Freudenberg, 1997. Intra-Industry Trade Methodological Issues Reconsidered. Centre d'Etudes Prospectives et d'Informations Internationales, Working Paper 97.01.

Fontagne, Lionel, Guillaume Gaulier and Soledad Zignago, 2007. Specialisation Across Varieties Within Products and North-South Competition. Centre d'Etudes Prospectives et d'Informations Internationales, Working Paper 07.006.

Feenstra, Robert C., 1988. Quality Change Under Trade Restraints in Japanese Autos. Quarterly Journal of Economics, 103:131-146.

Feenstra, Robert C., 1994. New Product Varieties and the Measurement of International Prices. American Economic Review, 84(1): 157-177.

Flam, H. and E. Helpman, 1987. Vertical Product Differentiation and North-South Trade. American Economic Review, 77, 810- -822.

Fertö, Imre, (2007). The Dynamics of Trade in Central and Eastern European Countries. Managing Global Transitions 5(1): 5–23.

Green, William H., 2003. Econometric Analysis. International and fifth edition, Pearson Education International.

Greenaway, David, Robert Hine and Chris Milner, 1995. Vertical and horizontal intra-industry trade: A cross industry analysis for the United Kingdom. Economic Journal, 105(433): 1505-1518.

Grossman, Gene and Elhanan Helpman, 1991. Quality Ladders and Product Cycles. Quarterly Journal of Economics, 106(2): 557-586.

Hallak, Juan C., 2006. Product Quality and the Direction of Trade. Journal of International Economics, 68(1): 238-256.

Hallak, Juan C. and Peter K. Schott, 2008. Estimating Cross-Country Differences in Product Quality. National Bureau of Economic Research, Working Paper No. 13807.

Havlik, Peter, Michael Landesmann and Robert Steher, 2001. Competitiveness of CEE Industries: Evidence From Foreign Trade Specialization and Quality Indicators. WIIW Research Reports, No. 278.

Horáková, Tereza, 2005. Quality of Czech Exports and Imports: Quantitative Analysis of the Evolution of Unit Prices. Prague Social Science Studies, Charles University.

Hotopp, Ulrike, Slavo Radosevic and Kate Bishop, 2005. Trade and Industrial Upgrading in Countries of Central and Eastern Europe: Patterns of Scale- and Scope-Based Learning. Emerging Markets Finance and Trade, 41(4): 20-37.

Hummels, David and Peter Klenow, 2005. The Variety and Quality of a Nation's Exports. American Economic Review, 95: 704-723.

Feenstra, Robert C., 2004. Advanced International Trade. Princeton University Press.

Finger, J.M. and M.E. Kreinin, 1979. A Measure of "Export Similarity" and Its Possible Uses. Economic Journal, 89, 905–912.

Ianchovichina, Elena, Sethaput Suthiwart-Narueput and Min Zhao, 2003. Regional Impact of China's WTO Accession. In Krumm, Kathie and Homi Kharas (eds), East Asia Integrates: A Trade Policy Agenda for Shared Growth, The International Bank for Reconstruction and Development.

Junz, Helen B. and Rudolf R. Rhomberg, 1973. Price Competitiveness in Export Trade Among Industrial Countries. The American Economic Review, Papers and Proceedings of the Eighty-fifth Annual Meeting of the American Economic Association, 63(2): 412-418

Kandogan, Yener, 2005. How Much Restructuring did the Transition Countries Experience? Evidence from Quality of their Exports. Comparative Economic Studies, 47: 543-560.

Kandogan, Yener, 2006. The Reorientation of Transition Countries' Exports: Changes in Quantity, Quality and Variety. Intereconomics, 41(4): 216-229.

Khandelwal, Amit, 2007. The Long and Short (of) Quality Ladders. Columbia Business School, working paper.

Krugman, Paul, 1980. Scale Economies, Product Differentiation, and the Pattern of Trade. The American Economic Review, 70(5): 950-959.

Kugler, Maurice and Eric A. Verhoogen, 2008. Product quality at the plant level: Plant size, exports, output prices and input prices in Colombia. Columbia University, Economics Department Discussion Papers.

Landesmann, Michael A., 2003. Structural Features of Economic Integration in an Enlarged Europe: Patterns of Catching-Up and Industrial Specialization. Euopean Commission, Directorate-General for Economic and Financial Affairs, Economic Papers, No. 181.

Lipsey, Robert E., 1994. Quality Change and Other Influences on Measures of Export Prices of Manufactured Goods and the Terms of Trade Between Primary Products and Manufactures. National Bureau of Economic Research, Working Paper No. 4671.

Lommatzsch Kirsten and Silke Tober, 2004. Productivity Growth and the Real Appreciation of the Accession Countries' Currencies. University of Michigan, The University of Michigan Business School, William Davidson Institute Working Paper No. 675.

Maizels, A., 1957. Unit Value and Volume Index Numbers of Inter-Area Trade. Journal of the Royal Statistical Society. Series A - General, 120(2): 215-219.

Martínez-Zarzoso, Inmaculada and Celestino Suárez Burguet, 2000. Measurement of export prices and changes in product quality. International Advances in Economic Research. 6(2): 619-632.

Mandelson, Peter, 2005. Open markets, open trade: Europe's global challenge. Speech at the Market Access Symposium, European Parliament, Brussels, 19 September 2005.

Ministry of Education, Youth and Sports, the Czech Republic. National Research and Development Policy of the Czech Republic for 2004-2008.

Ministry of Industry and Trade, the Czech Republic, 2008. Information from the official website of the Ministry, retrieved from www.mpo.cz in March 2008, on the economic policies towards higher export quality.

Ministry of Industry and Trade, the Czech Republic. National Innovation Policy of the Czech Republic for 2005 – 2010.

Murphy, K. and A. Schleifer, 1997. Quality and Trade. Journal of Development Economics, 53: 1-15.

Nešvera, Václav, 2002. Ceny v zahraničním obchodě. Politická ekonomie, 5/2002.

Nešvera, Václav, 2003. Jednotkové ceny v zahraničním obchodě, The University of Economics, Prague, Working Paper.

Nešvera, Václav, 2005. Ceny v obchode zemí EU s Ceskou republikou, The University of Economics, Prague, Working Paper, Statistika No. 2/2005.

Nielsen, J.U.-M., 2000. Price-quality competition in the exports of the central and eastern European countries. Intereconomics, 35(2): 94-101.

Patria Finance, 2007. A report on the influence of investment incentives on the Czech economy for the Association for Foreign Investments.

Pugel, Thomas, 2006. International Economics. Thirteenth edition, McGraw-Hill and Irwin.

Redding, Stephen, 1996. The Low-Skill, Low-Quality Trap: Strategic Complementarities between Human Capital and R&D. The Economic Journal, 106(March): 458-470.

Redding, Stephen and Peter K. Schott, 2003. Distance, Skill Deepening and Development: Will Peripheral Countries Ever Get Rich? National Bureau of Economic Research, Working Paper No. 9447.

Rosati, Dariusz, 1998. Emerging Trade Patterns of Transition Countries: Some Observations from the Analysis of Unit Values. In MOCT-MOST, 1998(8): 51-67.

Schott, Peter K., 2004. Across-Product versus Within-Product Specialization in International Trade. Quarterly Journal of Economics, 119(2): 647-678.

Schott, Peter K., 2008. The Relative Sophistication of Chinese Exports. Economic Policy, 53: 5-49.

Shaked, A. and J. Sutton, 1987. Product Differentiation and Industrial Structure. The Journal of Industrial Economics, 36(2): 131-146.

Shapiro, C., 1983. Premiums for High Quality Products as Returns to Reputations. Quarterly Journal of Economics, 98(4): 659-680.

Sutton, J., 1986. Vertical Product Differentiation: Some Basic Themes. The American Economic Review, 76(2): 393-398.

United Nations, Department of International Economic and Social Affairs, Statistical Office, 1983. Price and Quality Measurement in External Trade. Statistical Papers, Series M, No. 76.

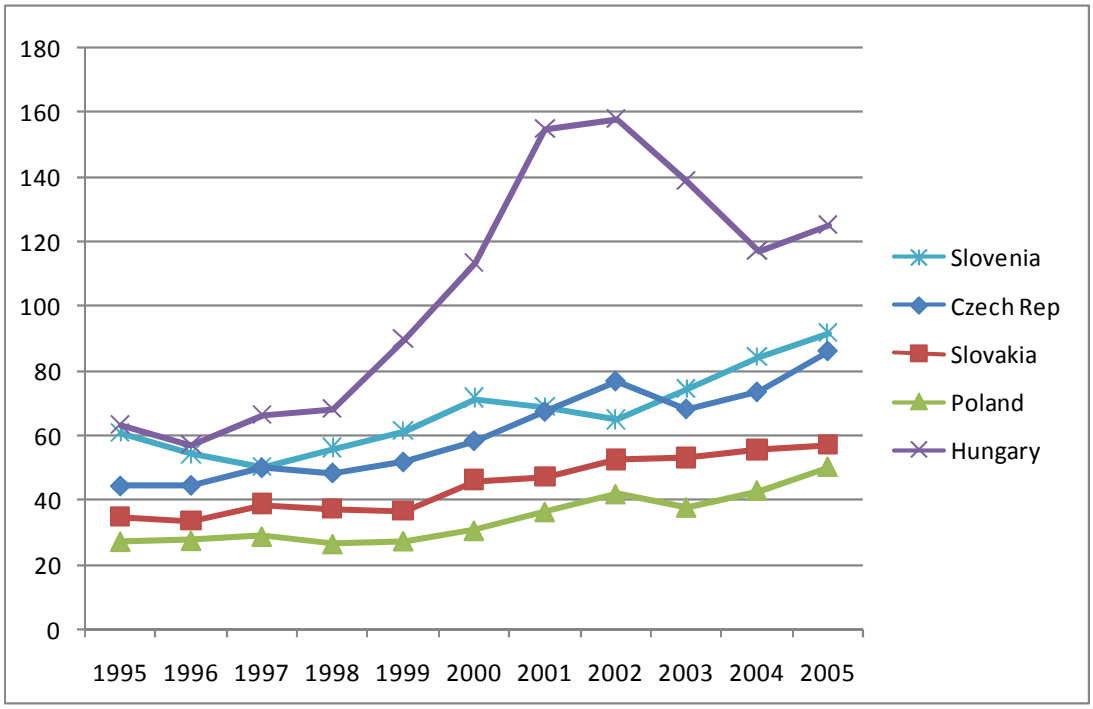
United Nations, Economic Commission for Europe, 2004. The Benefits from Product Differentiation in Modern Economies. In Economic Survey of Europe 2004, No. 1, a United Nations report by Economic Commission for Europe.

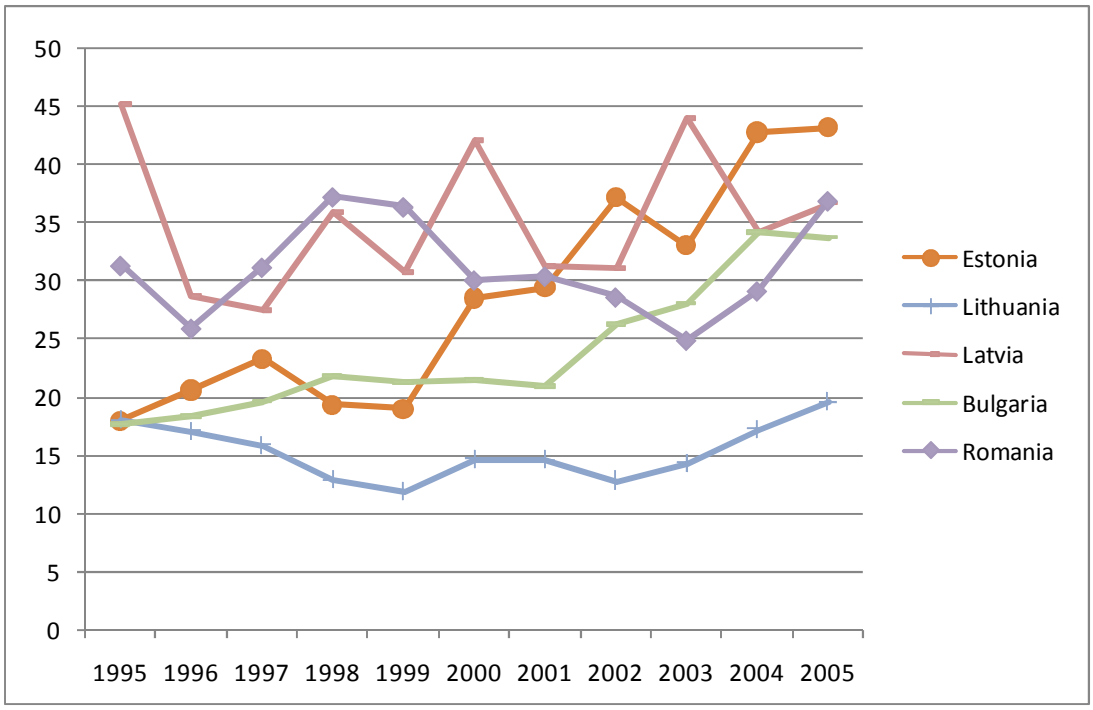
Verhoogen, Eric A., 2007. Trade, Quality Upgrading and Wage Inequality in the Mexican Manufacturing Sector. IZA Discussion Paper No. 2913.

Verma, Samar, 2002. Export Competitiveness of Indian Textile and Garment Industry. Indian Council for Research on International Economic Relations, Working Paper 94.

8. Appendix

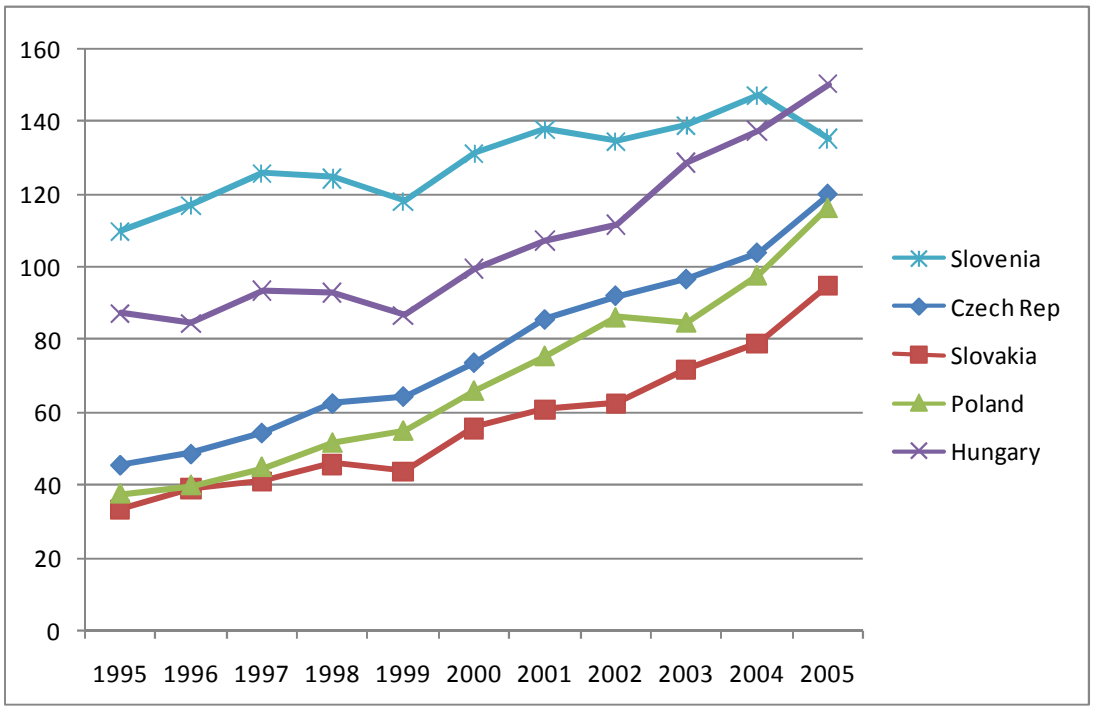
Figure 5. Unit values, imports from the CEE-10 countries to EU-15, Chemicals (SITC 5), euro per 100 kilograms imported, 1995 - 2005

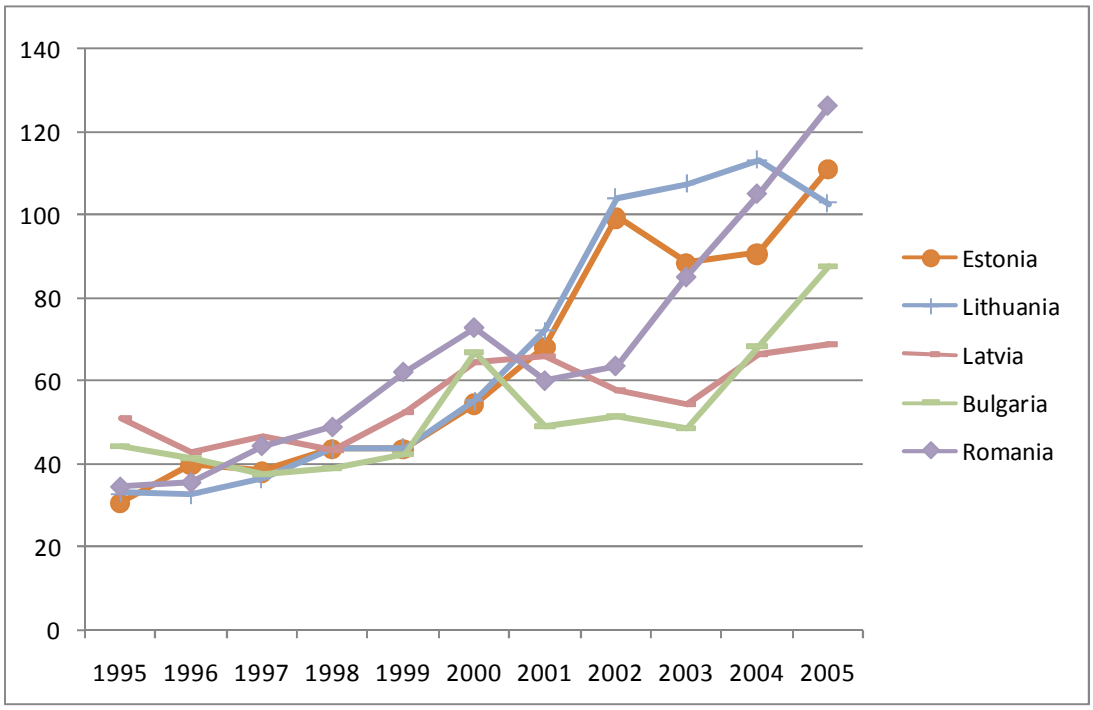




Source: Eurostat data and author's calculations.

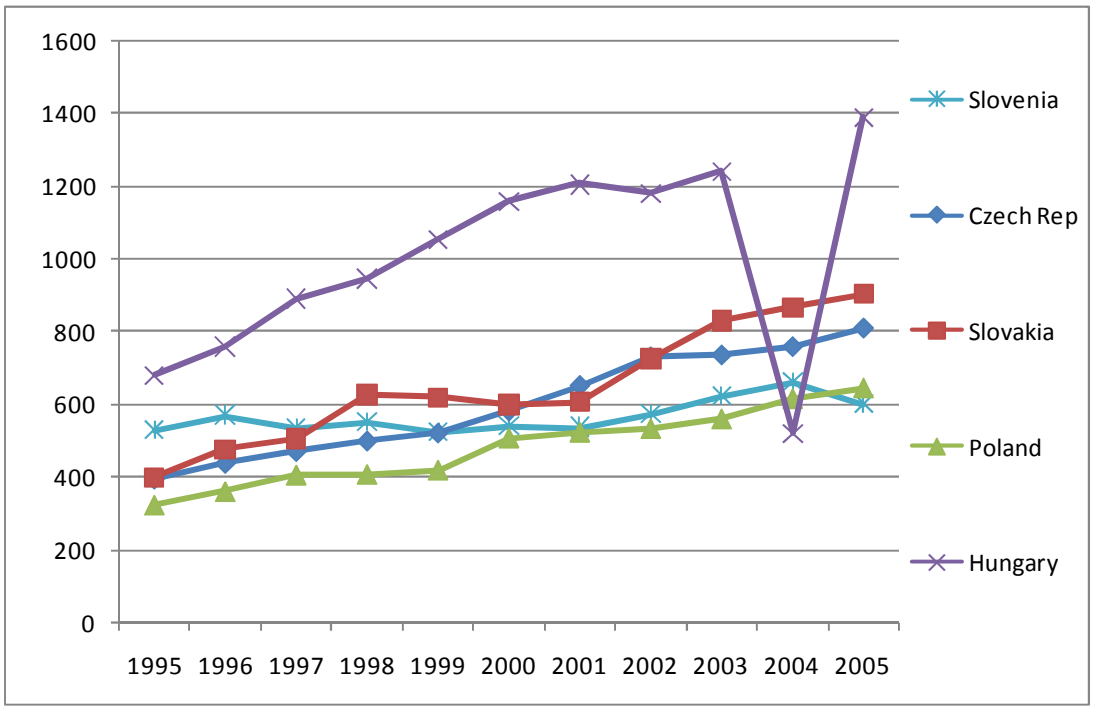
Figure 6. Unit values, imports from the CEE-10 countries to EU-15, Manufactured materials (SITC 6), euro per 100 kilograms imported, 1995 – 2005

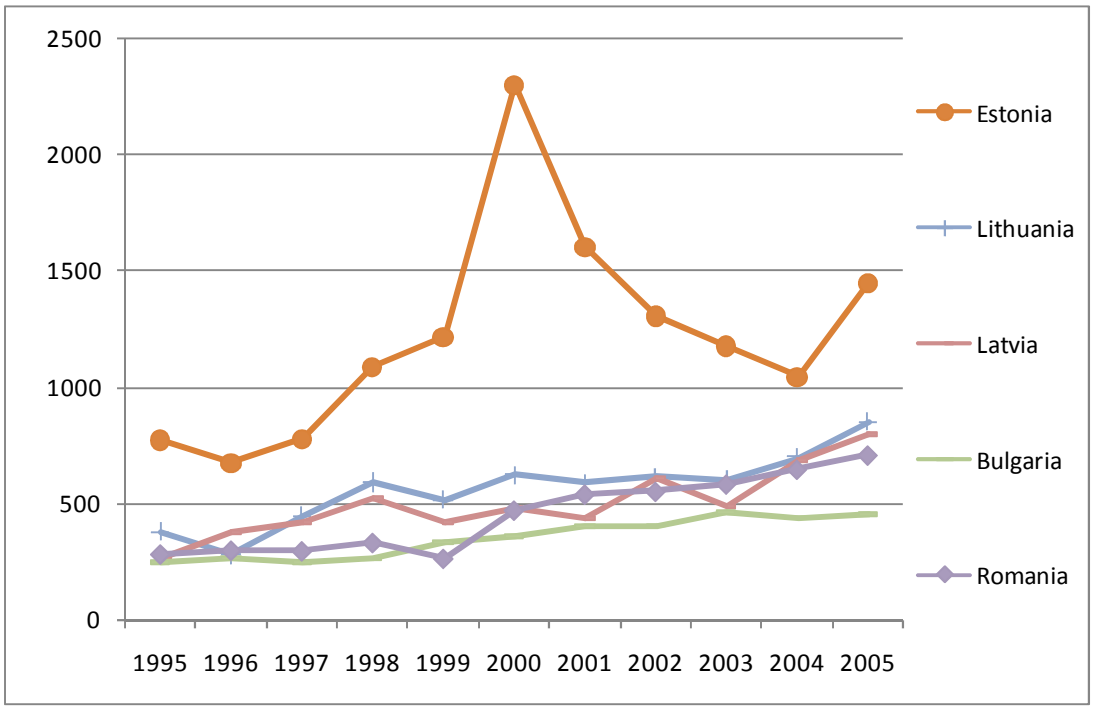




Source: Eurostat data and author's calculations.

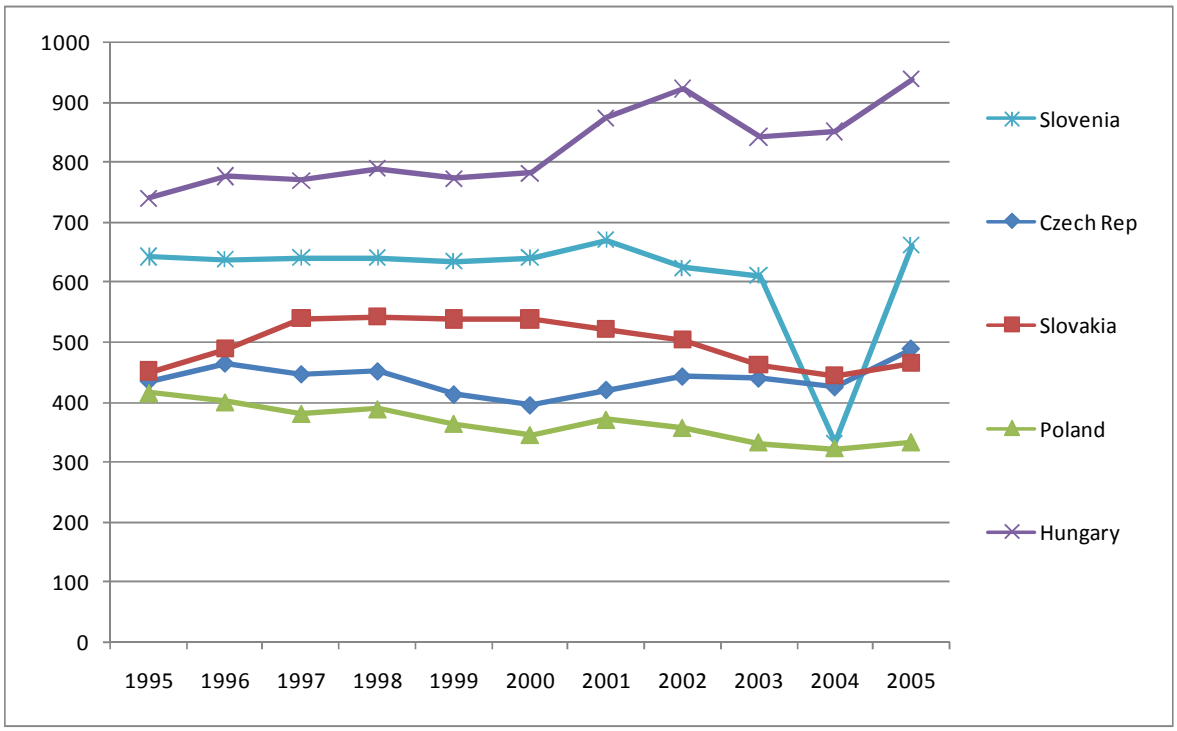
Figure 7. Unit values, imports from the CEE-10 countries to EU-15, Machinery (SITC 7), euro per 100 kilograms imported, 1995 – 2005

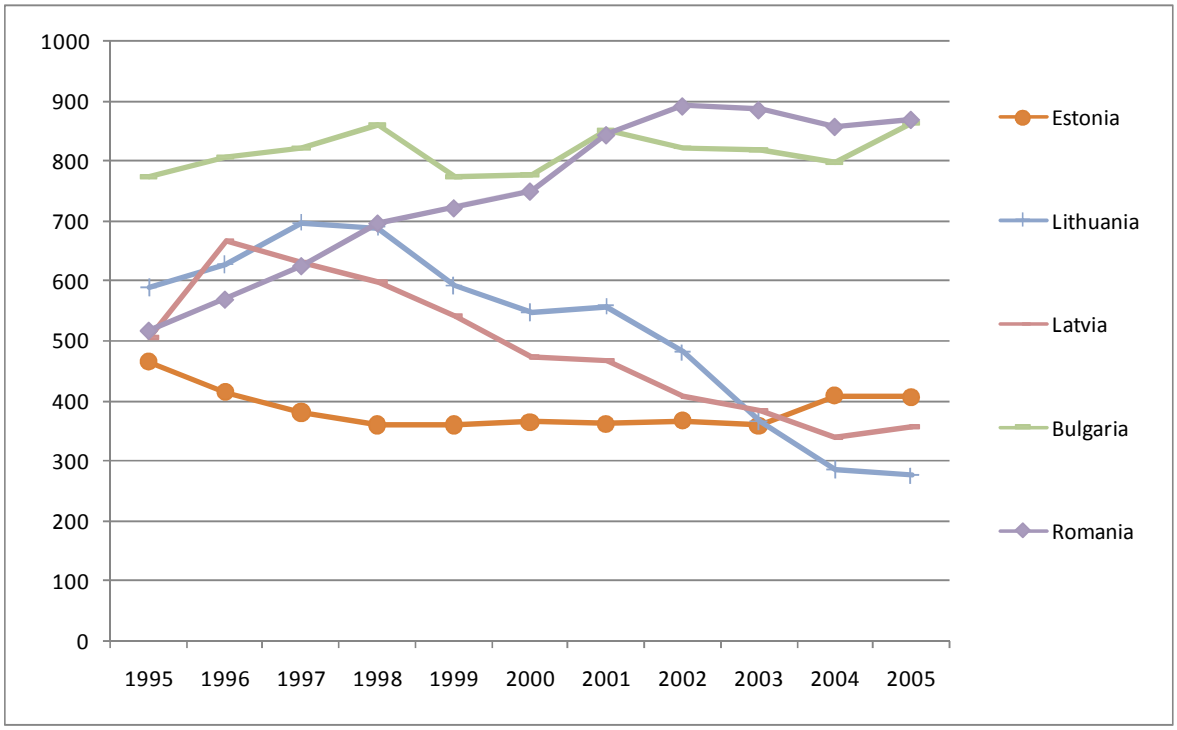




Source: Eurostat data and author's calculations.

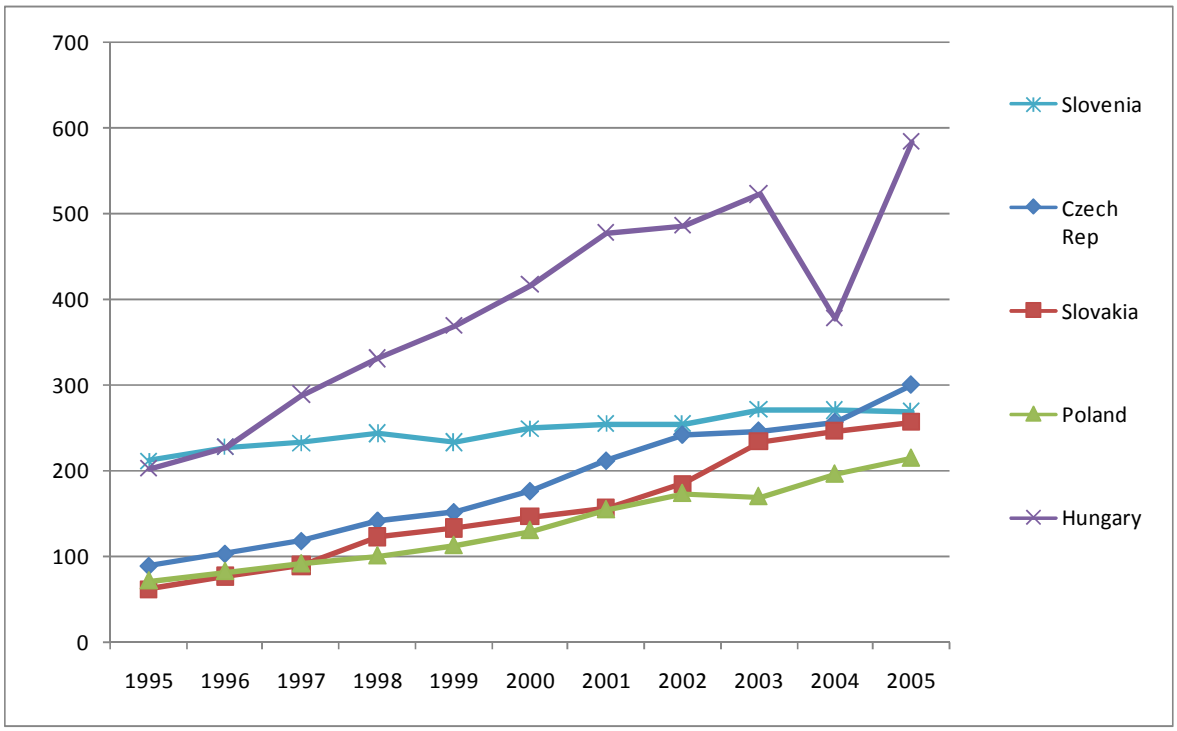
Figure 8. Unit values, imports from the CEE-10 countries to EU-15, Miscellaneous Manufacturing (SITC 8), euro per 100 kilograms imported, 1995 – 2005

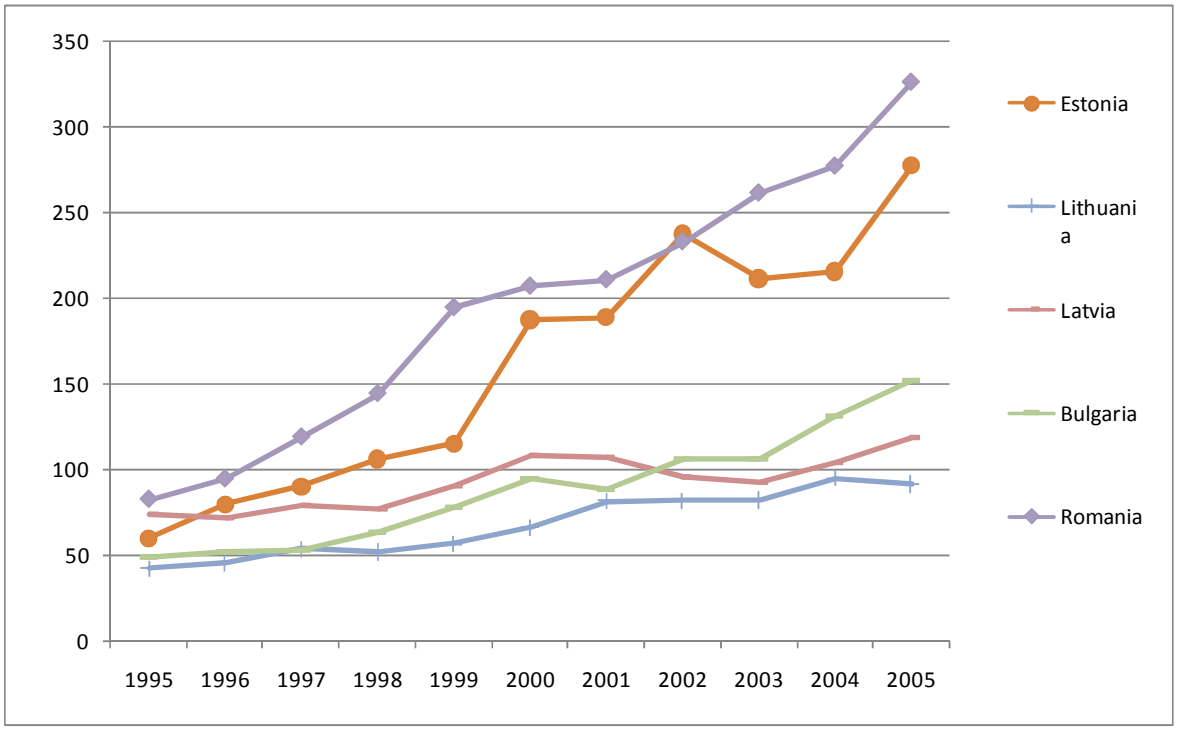




Source: Eurostat data and author's calculations.

Figure 9. Unit values, imports from the CEE-10 countries to EU-15, Overall manufacturing (SITC 5 to 8), euro per 100 kilograms imported, 1995 - 2005

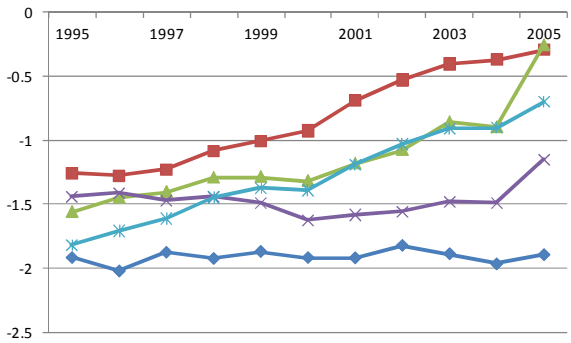




Source: Eurostat data and author's calculations.

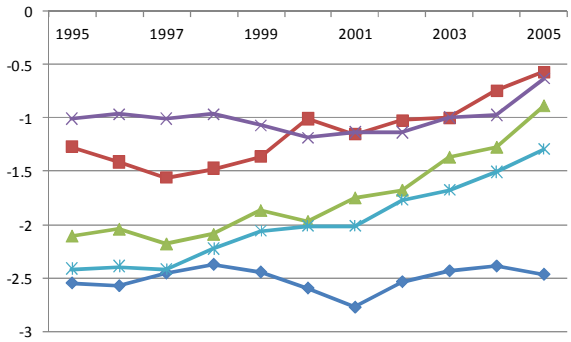
Figure 10. CEE-10/OECD-11 log unit value ratios

CEE-10 aggregate

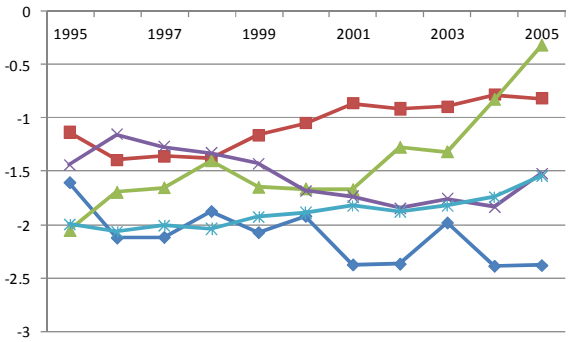


Legend

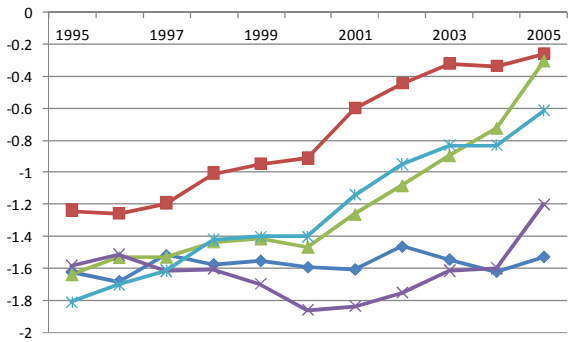
Bulgaria



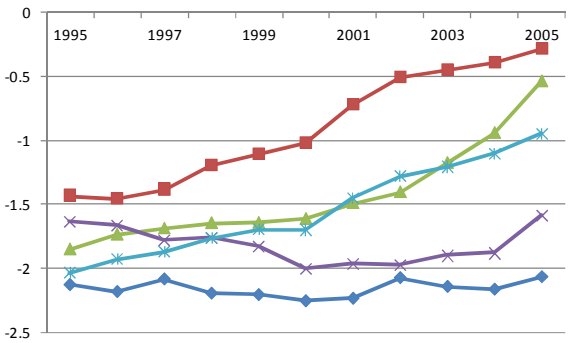
Latvia



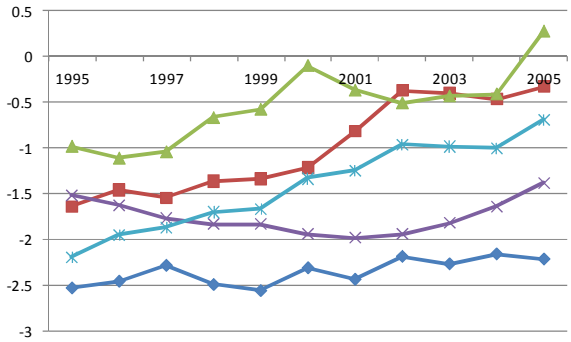
Czech Republic



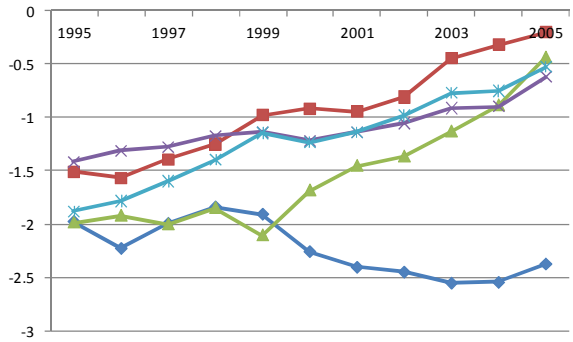
Poland



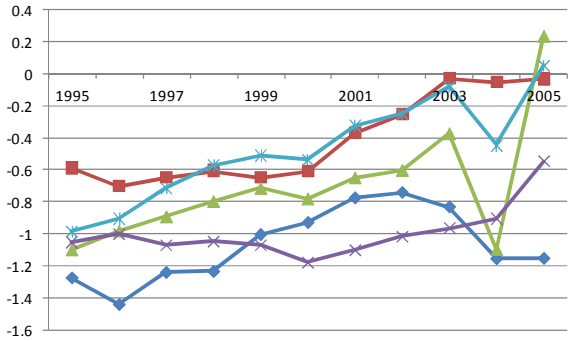
Estonia



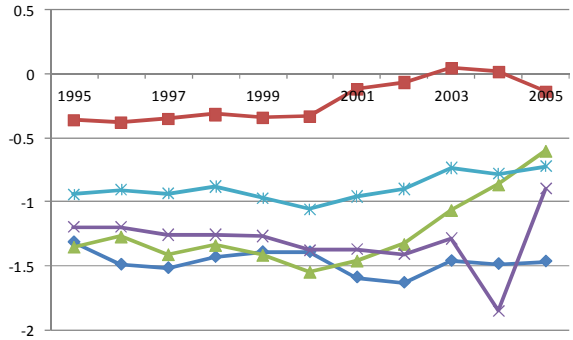
Romania



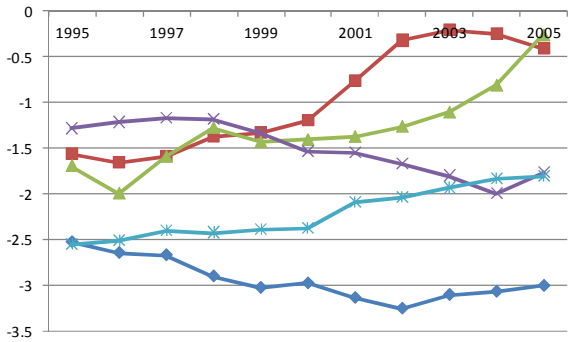
Hungary



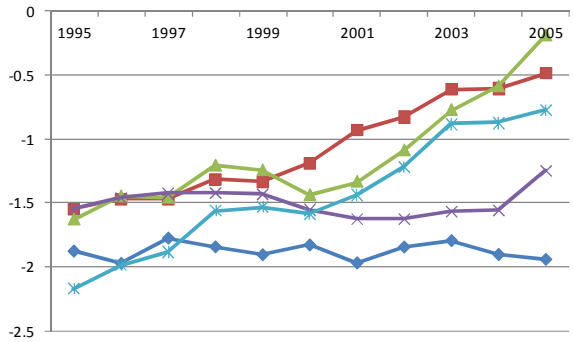
Slovenia



Lithuania



Slovakia



Source: Eurostat data and author's calculations.