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Unit Values, Unit Labor Costs and Trade Performance in Four Central European Countries

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Abstract

Our paper, relying on product and industry level data, analyses factors behind divergences in aggregate export price changes in four Central European countries, Poland, Hungary, Czech Republic and Slovakia. We focus on exports to Germany, their largest trading partner and observe the period 2000-2010. As our hypothesis is that divergence in changes may be explained by convergence in levels, we construct relative level indices of export unit values (UVs, as proxies of export prices) and unit labor costs (ULCs), based on the COMEXT and EU KLEMS databases, respectively. By merging the relative level indices with trade performance indicators (export volumes, market shares, extensive and intensive margins), we investigate the relation between UVs and ULCs, their changes, as well as their respective impact on trade performance. Our results suggest that (i) there is convergence in the four countries' export UV levels, (ii) changes in UVs were positively correlated with changes in ULCs, (iii) a higher UV increase was associated with lower growth in export volume, (iv) the level of ULC and that of labor productivity does not show convergence, but the level of labor costs and wage shares do. The results indicate that our approach helps understanding factors contributing to changes in UVs, as well as trade performance of countries. However, to reach more general results, the approach should be extended to more countries and markets.

Keywords: export price indices and unit values; unit labor costs; price level convergence; export performance

JEL classification: F14, F16

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A külkereskedelmi egységértékek, a fajlagos bérköltségek és az exportteljesítmény alakulása a visegrádi országokban

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Összefoglaló

Tanulmányunk termékszintű, illetve ágazati adatok alapján vizsgálja Csehország, Magyarország, Lengyelország és Szlovákia jelentősen eltérő mértékű exportár-változásainak lehetséges okait. Az elemzés a Németországba irányuló kivitelre koncentrál, és a 2000-es évtizedet fedi le. Mivel hipotézisünk szerint az árindexek divergenciáját szintbeli konvergencia is magyarázhatja, a COMEXT, illetve az EU KLEMS adatbázisok felhasználásával szint-mutatókat képeztünk az export egységértékekre (az árszint-eltérések kifejezésére), illetve – ágazati vásárlóerő-paritások felhasználásával – a fajlagos bérköltségekre. A relatív szint-mutatók és az exportteljesítményre vonatkozó egyes indikátorok (export-volumen, piaci résesedés, extenzív és intenzív határ) összekapcsolásával vizsgáljuk egyrészt az egységértékek, illetve fajlagos bérköltségek szintje és változása közötti összefüggést, másrészt az utóbbiak kapcsolatát az exportteljesítménnyel. Eredményeink szerint (1) a négy ország kiviteli egységérték-szintjeit konvergencia jellemzi; (2) a kezdeti szintekre kontrollálva, az egységérték-változások és a fajlagos bérköltség változások között pozitív a kapcsolat; (3) az egységértékek változása és az export-volumen változása közötti kapcsolat negatív; (4) az ágazati fajlagos bérköltség- és termelékenységi szintek nem mutatnak konvergenciát, ellenben a fajlagos bérköltség egyes komponenseit, így az egy dolgozóra jutó bérköltséget és a bérhányadot konvergencia jellemzi.

A tanulmány szemlélete és módszere – a külkereskedelmi egységértékekre, a termelékenységre és a fajlagos bérköltségekre vonatkozó dezaggregált szint-mutatók képzése és összekapcsolása – egybevág a Penn World Tables (PWT) „következő generációjának” kidolgozását célzó erőfeszítésekével. Eredményeink igazolják e megközelítés alkalmasságát, ám általánosabb következtetések levonásához az általunk vizsgáltnál több országra és piacra, valamint az import-egységértékekre is kiterjedő elemzés szükséges, amelyre az új szemléletű PWT nyújt lehetőséget.

Tárgyszavak: külkereskedelmi árindexek és egységértékek, fajlagos bérköltségek, árszint-konvergencia, exportteljesítmény

JEL kódok: F14, F16

Contents

1. INTRODUCTION

Several studies have addressed issues related to income and *domestic* price level convergence of the new EU member states – both to older members of the EU and to each other. Our study deals with a neglected aspect of economic convergence, namely, that in foreign trade prices and export performance.

Comparative analyses of international trade performance generally focus on *changes* in relative prices and/or costs, and avoid issues related to relative price/cost *levels* in explaining changes in market shares or differences in export-growth. This is understandable, as price and cost-based real exchange rate indices are readily available from several statistical sources, while indicators of relative levels need to be constructed by the analyst. Ignoring levels may be reasonable when treating short-term developments, but it might turn out to be grossly misleading if medium-term changes, i.e., questions related to convergence, are addressed. In the latter case, it is difficult to interpret developments over time without *some* sense of the "initial" level of the variables. A case in point is the medium-term trade performance of four Central and Eastern European countries (CEE4) – the Czech Republic, Hungary, Poland and Slovakia – before and after their accession into the European Union. Quantifying the initial level of their respective indicators is important both in discussing their convergence to each other and to old member states, as well as in interpreting changes in their performance.

The CEE4 display several peculiarities regarding comparative changes in trade prices and unit values, as well as in alternative indices of volume-changes. These call for an explicit treatment of cross-country relative price (unit value) *levels*. While foreign trade price indices sharply diverge between the four countries, volume indices, surprisingly, move almost identically during the 2000s. Foreign trade unit value indices, in turn, show milder divergence, but the implied volume indices significantly deviate from each other. Given these index numbers, published by national statistical offices and the Eurostat, the analyst is keen to get some idea of the price (unit value) levels involved. In particular, one wishes to know (i) in what *direction* and (ii) to what *extent* do the levels deviate. Lacking this information, it is impossible to assess whether comparative levels (i) converge or diverge and (ii) the changes are, or are not, significant relative to the gaps in levels. Similar questions and dilemmas hold for the comparison of unit labor costs, to which we return.

Ideally, one would wish to compare both foreign trade price (P) and unit value (UV) levels between countries, as the content of the two may considerably differ. Actual price indices are meant to express "pure" price changes over time, while UV indices show the combined effect of changes in price, quality and composition. Since we have no access to the primary information necessary for constructing comparative foreign trade price level indices (from national statistical offices), we calculate only comparative UV level indices, relying on the value and quantity data of the Eurostat's COMEXT database.

Building on export UV level indices of the CEE4 in their trade with Germany (the major trading partner of the four countries), we explore three issues. First, we quantify export UV levels for the four countries (and Austria as a benchmark), try to clarify what explains differences in levels and their change over time and analyze whether there is convergence in UV levels. Second, we decompose market shares of the CEE4 countries within German EU-imports into a "price" (UV) and two "volume" components, the latter consisting of the extensive margin on the one hand, and the quantity margin on the other (weighted number of products, and actual volume, respectively). Third, beside *changes* in UV-s, we also use UV levels for explaining the growth in exports of the CEE4 to Germany. These goals are ambitious, but they also indicate that the scope of our study is limited, as the empirical findings are related to an important, but single trading partner, Germany. While this methodological choice provides a straightforward comparison and mitigates a number of methodological problems related to the selection of export markets, it clearly does not provide a full picture of these countries' exporting activities.

Our study supports the hypothesis that there is convergence in UV levels, however, drawing on these results, further work on intra- and *extra-EU* trade of the CEE4 is essential for understanding divergences in aggregate UV/price indices and trade performance of the four countries.

Beside UV levels, we also address issues related to unit labor cost (ULC) levels. More specifically, we calculate and decompose ULC level indicators for tradable sectors relative to Germany for the CEE4 countries, covering the period 1997-2007. In constructing these level indices, we combined two databases of the Groningen Growth and Development Centre: the productivity level database assembled by Inklaar and Timmer (2008) for the year 1997 and the EU KLEMS database (including annual nominal data and volume indices). We consider the construction of the ULC level database for the CEE4 (relying on two concepts of production-side purchasing power parities, PPPs) as a result in itself; the data is available for further research at the webpage of the present project. Apart from decomposing comparative ULC levels into (i) relative wage and productivity levels and (ii) wage shares and relative price levels, we also make an attempt to combine our data regarding UVs from foreign trade statistics with ULC-data from the production side (i.e., industry-level statistics). We find some evidence of a positive relationship between ULCs and UVs, but the results are far from being conclusive.

Our research is in line with the endeavor to create the “next generation” of the Penn World Tables (PWT), as the most important prospective innovations to the PWT consist of the inclusion of comparative price levels for exports and imports, as well as including international volume comparisons from the industry side.

The paper is organized as follows. Section 2 presents stylized facts – using aggregate level variables – motivating our study, and provides a selective review of the literature. Section 3 introduces data used in the paper and describes the creation of UV level indices. In Section 4, we quantify UV levels, explain what factors may shape these levels and discuss how their changes affect export performance. In section 5, we decompose export market shares in German imports and identify UV levels. Section 6 discusses the creation, content, decomposition, possible applications and limitations of alternative ULC level indices; here we touch upon the role of relative UV and ULC changes in export-growth. Section 7 concludes and indicates lines of further research based on UV and ULC levels.

2. BACKGROUND, STYLIZED FACTS, MOTIVATIONS AND A REVIEW OF PREVIOUS WORK ON THE TOPIC

In this section, we address developments revealed by aggregate indicators of volume and price changes in foreign trade, as well as changes in unit labor costs. We argue that these changes are difficult to interpret without considering the comparative level of these indicators. The section also presents a selective review of the literature on our topic.

2.1. CHANGES IN FOREIGN TRADE PRICES AND UNIT VALUES

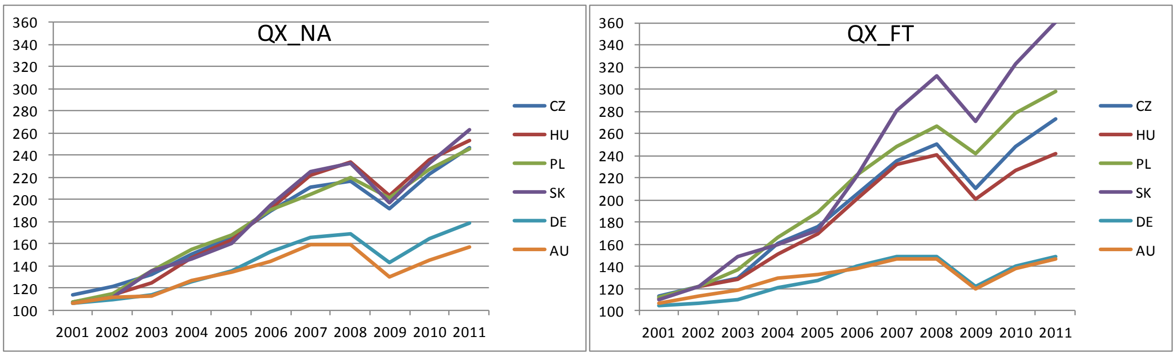
We depart from some conflicting observations regarding changes in foreign trade *volumes* in four Central-East European countries (the Czech Republic, Hungary, Poland and Slovakia, CEE4). The source of both data is the *Eurostat*, which reports two types of foreign trade volume indices. One is based on price deflators (or price indices) of exports and imports of goods, these indices are parts of the National accounts database. The other type of indicator for changes in quantities is calculated by so-called unit value indices; these are included in the International trade database.[1] As Figure 1 shows, rather different conclusions may be drawn, depending on whether one relies on the first or the second set of

[1] The price deflator is the ratio of a value index to a volume index; the price index is based on price surveys (by national statistical offices) on exported (and imported) goods. The unit value is the value of a product-group divided by a quantity measure (i.e., kilograms). To simplify the exposition, we refer to both price indices and deflators as price changes, to distinguish them from changes in unit values. Munkácsi (2009) provides a review of alternative indices and actual practices of statistical offices in the CEE4.

indicators. Since, beside the CEE4, we shall use trade data for Austria and Germany as well, the latter two countries are also added to the comparisons that follow.

Figure 1.

Volume indices of exports of goods, based on national accounts data (left pane) and international trade data (right pane), 2000=100



Source: Eurostat: databases on national accounts and international trade.

The left vs. right hand sides of the chart tell us two profoundly different stories. While the figure based on national accounts data (left pane) suggests that the export performance of the CEE4, at least in volume terms, was practically identical over the period observed, volume indices from international trade data (right pane) indicate very significant divergence. In particular, Slovakia appears to have outperformed the other three countries' export growth by a wide margin, while Hungary seems to lag behind the others, by displaying "only" 140% growth over the 11 years observed. Though impressive relative to Austria's and Germany's 40% increase, it is dwarfed by the 260% growth characterizing Slovakia – according to volume indices from the foreign trade database.

Choosing volume indices as a starting point signifies that the relation between foreign trade price and UV indices, though relevant in itself, has further important implications. For example, how did the market share of countries change at constant prices? Such "export performance" indicators are regularly published e.g. in the AMECO database[2] of the EU Commission. However, the contrast between the two sides of Figure 1 strongly suggests that a single indicator may not be sufficient for the purpose.

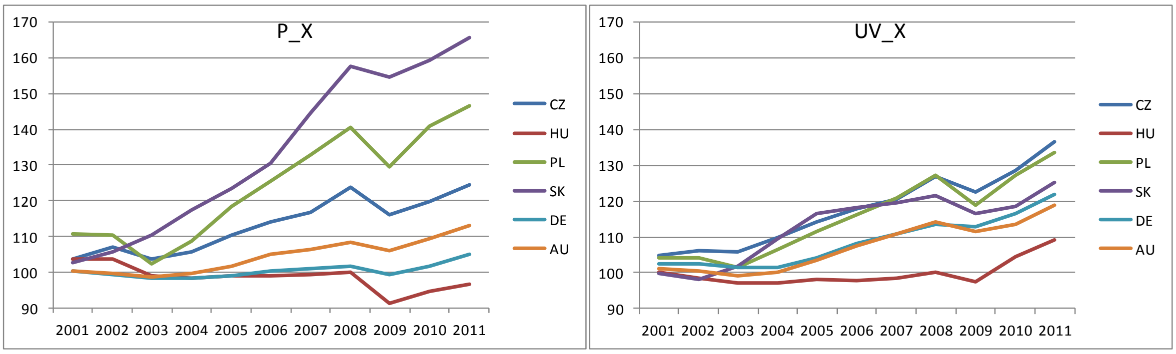
There may be two reasons behind the differences displayed by the two sides of Figure 1: either the value indices or/and the price (unit value) indices differ between the two sources. Though there is an example for considerable differences in the value indices (the Czech

[2] http://ec.europa.eu/economy_finance/ameco/user/serie/SelectSerie.cfm. Export performance indicators in the AMECO database refer to goods and services; volume indices are obtained by using price indices/deflators. (Unit value indices are available only for trade in goods.)

Republic – see Figure 3), the general reason behind the different stories told by national accounts data on the one hand, and foreign trade data on the other, is that price indices and unit value indices are different. Figure 2 shows the deflators applied by the two sources for obtaining volume indices.

Figure 2.

Export price indices (deflators) from national accounts (left pane) and unit value indices from international trade data (right pane) in euros, 2000=100



Source: Eurostat databases on national accounts and international trade.

In a way, Figure 2 is the inverse of Figure 1. Though the differences between the left and the right panes are milder than in the case of volume indices, they are still impressive. Price indices diverge considerably (left pane), while the dispersion of unit value indices is smaller (right pane). It is important to note that, in contrast with volume indices, no regional pattern can be identified in the evolution of price and UV indices (e.g., both indices are lower for Hungary than for Austria and Germany.) [3]

Our attempt to understand developments behind Figure 2, as well as their implications, is one of the basic motivations of our research. However, before formulating specific questions regarding Figure 2, it should be instructive to review developments in export values (expressed in euros) and their decomposition into price/UV and corresponding quantity changes. Figure 3 presents annual rates of change in the first and the second half of the 2000s in order to get a general idea on differences between the pre- and post EU accession period regarding the CEE4. Figure 3.1 exhibits value indices and Figure 3.2 shows their decompositions.

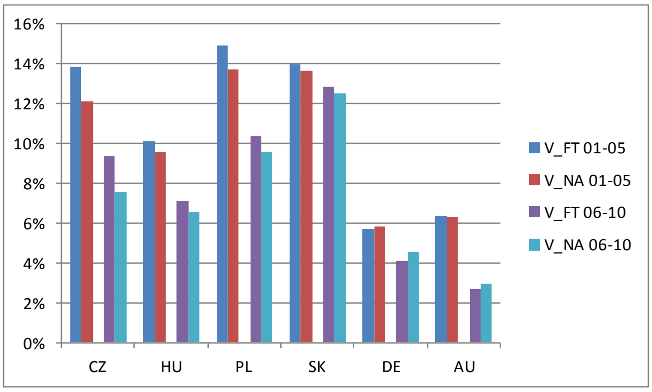
The basic message of Figure 3.1 is that, except for the Czech Republic, differences in value changes between data from national accounts and international trade are not really

[3] We note that the work of Landesmann and Burgstaller (1997) and Havlik et al (2001) indicated that the relative export UV level of Hungary was high compared to other CEE countries in 1999, and its increase from 1995 was outstanding. Our findings, discussed in section 4, also support that Hungarian UVs were relatively high.

important. Therefore, it makes sense to compare price/UV changes, as well as volume changes from the two sources, as done in Figure 3.2.

Figure 3.1.

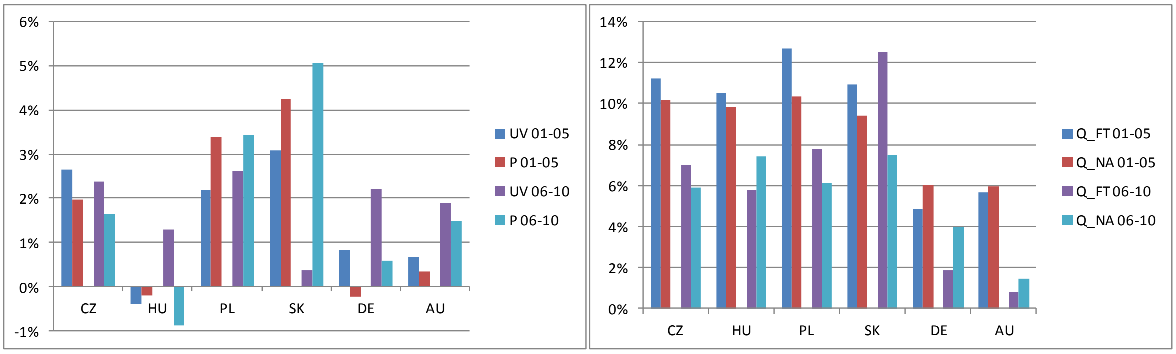
Annual rate of change in export values (in euros) in the CEE4, Austria and Germany according to national accounts and foreign trade data between 2001-2005 and 2006-2010 (in percent)



Notations: V_FT: value change according to International trade data;
V_NA: value change according to national accounts data

Figure 3.2.

Annual rate of change in export UVs vs. prices (left pane) and in volumes corresponding to UV and price changes (right pane), in the CEE4, Austria and Germany between 2001-2005 and 2006-2010 (in percent)



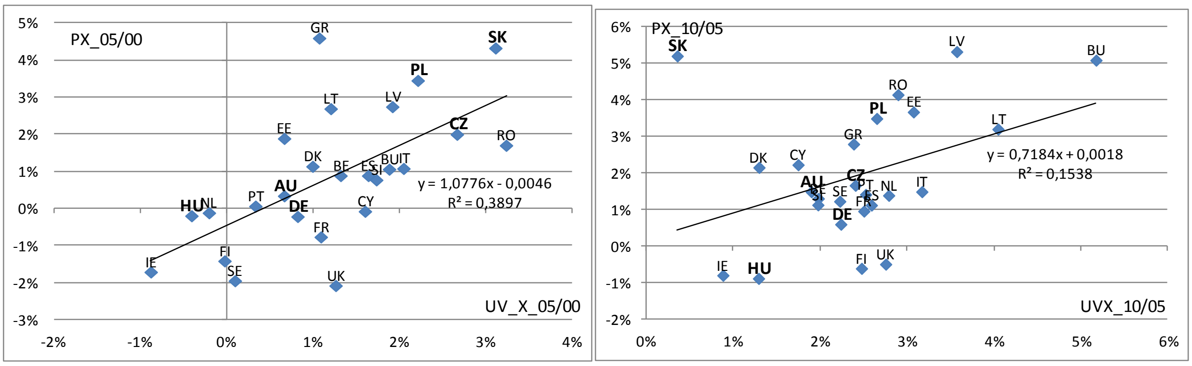
Notations: UV: unit value, P: price; Q_FT: volume change based on UV; Q_NA: volume change based on P.
Source: calculations based on Eurostat

Our focus is on the left pane of Figure 3.2, which reveals substantial diversity across countries and periods in the relationship between changes in export UVs and prices. The difference is the largest in Slovakia during the period 2006-2010, but significant divergences characterize Hungary and Germany as well. It is notable that in some countries (e.g. the Czech Republic and Poland) the pattern is similar in the two sub-periods, while in others (e.g. Hungary and Austria), the relation between the two indicators change amid the two periods observed. The right pane of figure 3.2 reveals the importance of the choice between UVs and price indices. Slovakia offers an extreme example: the volume change based on UV index indicates an increase, while the one based on price index shows a decline in volume growth in the second period as compared to the first one.

The next three figures place developments regarding export UVs and prices in the six countries in a broader international context, i.e., that of the EU.[4] Figure 4 shows the relation between export UVs and prices in the first and second half of the 2000s.

Figure 4.

The relation between the change in export unit values and prices in EU member states. Annual rates of change over 2001-2005 (left pane) and 2006-2010 (right pane)



Notations: PX and UV_X: price and UV index of exports, repectively; 05/00 and 10/05: change between 2000 - 2005 and 2005-2010, respectively.
Source: own calculations based on Eurostat

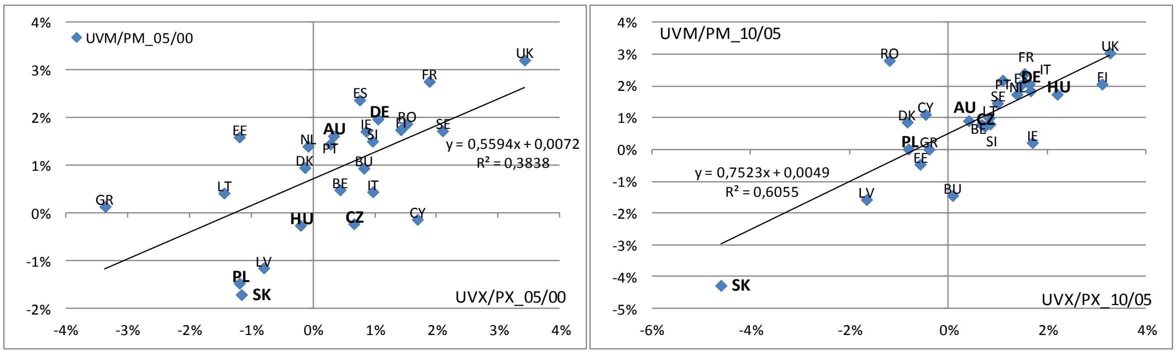
The right pane shows that in the second period the relationship between UV and price changes became much looser than in the first one. In addition, by the second period Slovakia (and to some extent, Hungary, in the opposite direction) became an outlier, while the other four fit better into the general pattern.

Though our study focuses on exports, it is useful to get an idea of the relation between changes in export UVs (prices) and those in imports. These relationships are shown from two perspectives by Figure 5 and Figure 6. Figure 5 displays the relationship regarding UV and price changes *within* exports and imports, respectively. Figure 6, in turn, shows the relationship across export/import UV and price changes, respectively, i.e. changes in the terms of trade, as measured by UVs and price indices.

[4] Due to the extreme observations belonging to Luxemburg and Malta, data for these two countries are omitted.

Figure 5.

The difference between the annual rate of change in foreign trade unit values and prices regarding exports (horizontal axis) and imports (vertical axis) in the EU in 2001-2005 (left pane) and 2006-2010 (right pane)



Source: own calculations based on Eurostat

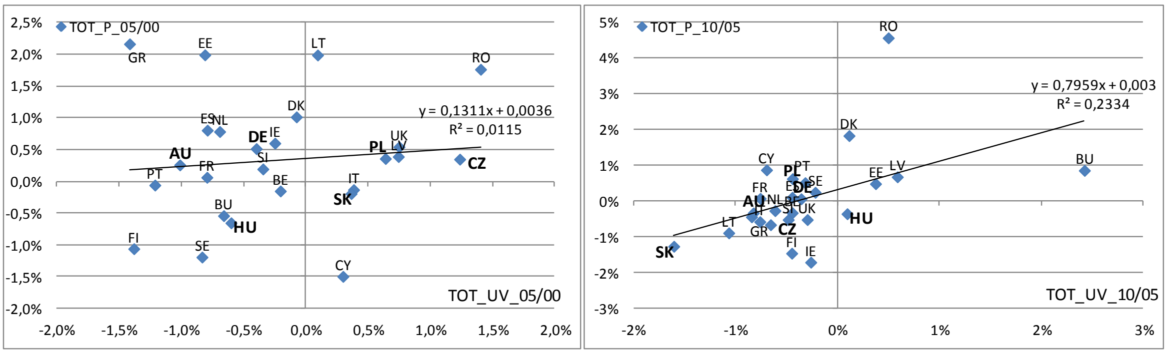
By the second period, the relation between the ratio of UV to price changes in exports and imports became closer, and all of the six countries fit in this general pattern. This suggests that the common factors affecting UV changes in exports and imports on the one hand, and price changes in exports and imports, on the other hand, have become relatively more important, than those affecting UV and price changes in exports and imports, separately. This is expressed in an alternative way by *Figure 6*, which shows the annual rate of change in the terms of trade (TOT) during the two periods.

Explaining these developments is beyond the scope of our study; their relevance for the following analysis is that if we observe similar changes in the case of our six countries, they represent general patterns rather than specificities of our sample.

Returning to the countries in our focus, Figure 7 shows UV and price changes in five countries' exports relative to those of Germany's imports. This comparison is useful as a background information, but it is only indirectly relevant for our purposes (we shall compare common bundles).

Figure 6.

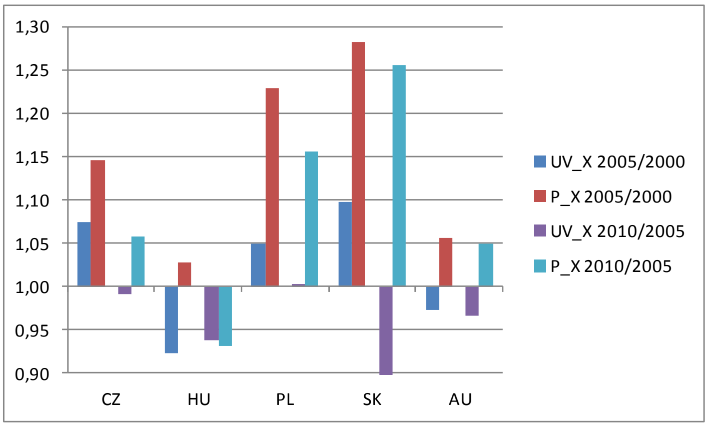
Annual average changes in the terms of trade as measured by UV and price indices in the EU between 2001-2005 (left pane) and 2006-2010 (right pane)



Source: own calculations based on Eurostat

Figure 7.

Changes in unit values and prices in five countries' exports relative to those in Germany's imports, in the first and second half of the 2000s



Source: own calculations based on Eurostat

Figure 7 corresponds to the left pane of Figure 3.2. above, and indicates that UV vs. price changes in the five countries' exports relative to those of Germany's imports are strongly affected by the denominator. For some of the five countries, the relative UV indices, while for others, the relative price indices resemble more the changes in the relative UV *level-indices,* to be calculated and analysed in the next sections.

This leads us back to the *basic motivation of our research*: we would like to understand what actually is behind the developments shown by Figure 2, 3.2 andFigure 7. These figures indicate considerable differences in UV indices and huge variations in price indices among the CEE4 countries. However, the different *movements* in UVs (prices) beg the question: how did the *comparative level* of UVs (prices) evolve over the period observed? Did different changes over time involve a divergence or convergence in *levels*? Without some idea regarding comparative levels ("initial" gaps), it is extremely difficult to interpret the size and importance of changes over time. Take the two extreme cases regarding export price indices within the CEE4, Slovakia (with the largest increase) and Hungary (with a decrease; see Figure 2 above). One would certainly like to have a sense of the initial comparative levels before addressing any implications of comparative changes in prices (UVs). The possible implications include relative trade performance, as measured by e.g., comparative increases in export volumes or changes in market shares.

Given the large discrepancies between UV and price indices, it would be important to calculate level indices for both UVs and prices, and compare the two. However, the detailed information necessary for constructing level indices is only available for UVs. Elementary data from price surveys regarding foreign trade, conducted by national statistical offices, are not accessible for international comparisons. Therefore, we are left to level comparisons of UVs, in which we shall rely on the COMEXT database of the Eurostat.

Since constructing UV level indices for total exports would have been an overly ambitious attempt in an experimental study as ours, we focus at relative UV levels of the CEE4 in exports to Germany, the main trading partner of the four countries. As a point for comparison, we shall calculate similar UV levels for Austria as well.

Thus, we define three goals related to export UVs (with Germany as a reference country): 1. estimating comparative UV level indices; 2. explaining differences in UV levels and their changes; 3. estimating the effect of changes in UVs on trade volumes, controlling for initial UV levels and other variables.

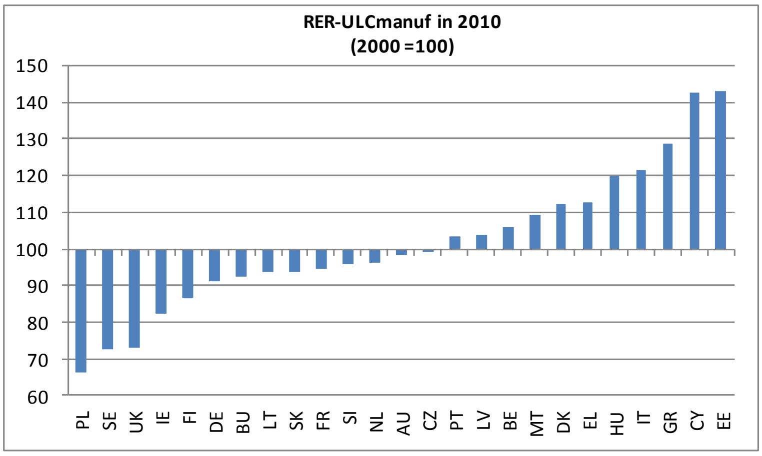
As explained in detail in section 5, we also estimate an alternative measure of comparative UV levels, using information on *Germany's imports* from the CEE4 and Austria. The results from the two approaches differ, a point to which we shall return.

2.2. UNIT LABOR COSTS

Besides estimating UV level indices for exports, we calculate comparative unit labor cost level indices (ULCLIs) for broad industrial categories within the tradable/manufacturing sector, covering the CEE4, with Germany as the reference country. Our calculations refer to the period 1997-2007, and combine the productivity level estimates of Inklaar and Timmer (2008) for the year 1997 with time series for value added and labor costs per labor input of the EU KLEMS database. The motivation for quantifying ULCLIs is similar to the one behind the estimation of comparative UV levels. Real exchange rate (RER) indices reflecting changes in manufacturing ULC display significant variation across countries. Figure 8 shows ULC-based RER changes in the member states of the EU between 2000 and 2010 relative to the average of the Euro Area (EA). The changes vary between 30 percent decline and 40 percent increase over the 10 years observed. However, here again, one would like to have some hint regarding the comparative level of ULCs (at least in one of the 10 years), before drawing conclusions on, e.g., the cost-competitiveness of the countries compared.[5]

Figure 8.

Changes in real exchange rates based on manufacturing ULCs in the EU-countries relative to the Euro Area average between 2000 and 2010



Source: own calculations based on the real exchange rate index database of DG ECFIN of the European Commission [6]

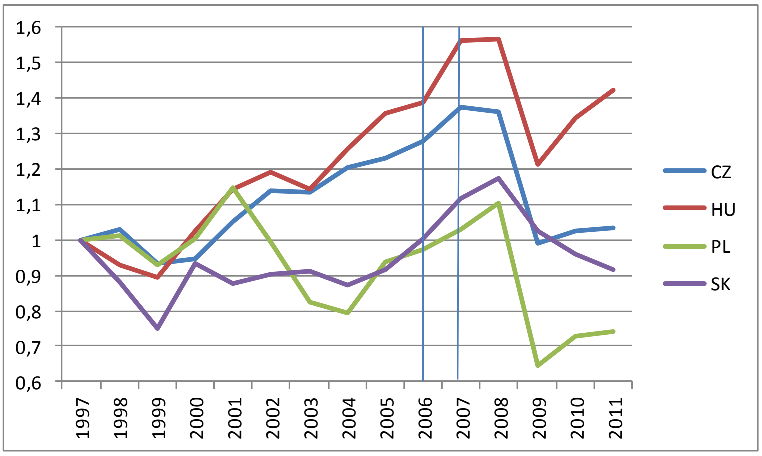
Among the CEE4, large differences can be observed in ULC changes, but here Poland is the outlier (with the largest decline in relative ULC), while Hungary posts a significant increase. To motivate the relevance of comparative ULC level indices, Figure 9.1 shows *changes* relative to Germany, followed by Figure 9.2, exhibiting *levels* (also compared to Germany). Figure 9.1 uses the same data as Figure 8 above, while the two sides of Figure 9.2 are based on our calculations.

[5] The study by Lewney et al (2011) on Europe's cost competitiveness is a remarkable example of ignoring level-issues. The study discusses Europe's cost competitiveness over 140 pages, without even mentioning that beside changes in ULCs, their level may also be relevant.

[6] http://ec.europa.eu/economy_finance/db_indicators/competitiveness/data_section_en.htm

Figure 9.1.

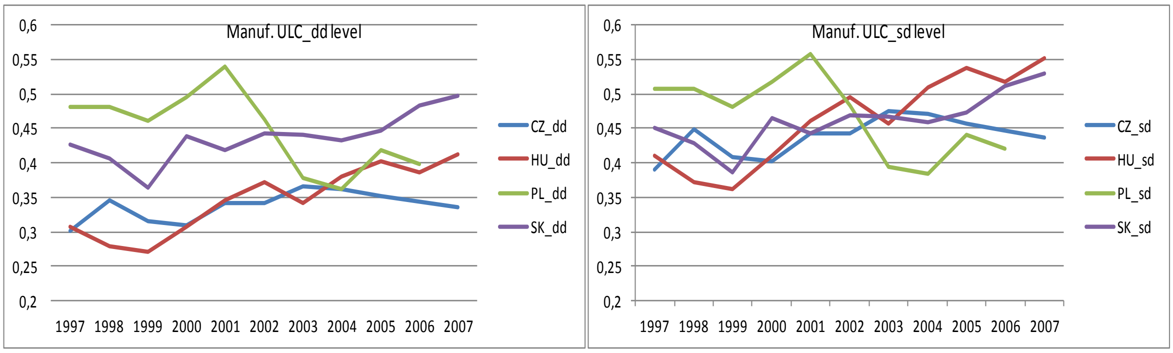
RER changes based on manufacturing ULCs in the CEE4 relative to Germany (1997=1)



Source: see Figure 8.

Figure 9.2.

ULC level indices in manufacturing relative to Germany, based on double deflation (dd) and single deflation (sd) of value added



Source: own calculations

The vertical lines, corresponding to years 2006 and 2007, indicate the last year of our estimates regarding level indices (for Poland the EU KLEMS data terminate in 2006). Figure 9.2 presents alternative estimates of comparative *level* indices for ULCs.

Double deflation (dd), means that the calculation of the level of value added is based on separate comparison of inputs and outputs; while single deflation (sd) indicates that levels are compared by applying uniform purchasing power parities (PPPs) for inputs and outputs. (See section 6 for details.) The point we wish to make here is that although the two approaches to estimating levels (shown by the two panes of Figure 9.2) offer different results, the divergence in comparative levels is definitely milder than suggested by the indices in Figure 9.1, with 1997 as a base. Most notably, the initial level in Poland was much higher than in the other countries (by both measures) and the relative level of Hungary in

2007 did not deviate from the other three countries to the extent implied by Figure 9.1. While having two empirical indicators for a single concept may seem confusing, we believe that estimating two empirical magnitudes (indicating a band, within which the "actual" indicator is likely to be positioned), is superior to having no indicator whatsoever for an important concept, i.e. the level of ULC.[7]

The last observation leads to a more general proposition, which also concerns the estimation of UV levels. Namely, the quest for finding "the" single, appropriate indicator of relative price/cost levels is doomed to failure. Just as there is no single answer to the question, how trade volumes have changed (because UV and price indices, respectively, involve different changes in volumes), there is no single answer to the question how much higher/lower the level of foreign trade UV is across countries and their respective product groups (industries). The ambiguity is partly related to choice regarding the bundles compared and to the weighting scheme; we shall have more to say on this in section 4. However, and even more importantly, the answer also depends on the choice whether export UVs *to* a particular country, or imports UVs of the same country are compared. The two often differ (see section 3.), which may have to do, e.g., with the threshold size for recording transactions in the exporting and the importing country.

Before presenting a selective review of the literature on our topic, we recall that our research, and in particular, our attempt to construct both foreign trade price (UV) and ULC *level* indices is in line with the effort at constructing the "next generation" of the Penn World Tables (PWT), as described by Feenstra et al. (2012). The new concept of PWT involves a major change and an important extension, as compared to the International Comparison Project (ICP) in general, and to previous versions of the PWT in particular. The major change is in recognizing the importance of international differences in export and import price levels. The extension is in adding production-side (industry-level) cross-country volume comparisons to the existing demand-side ones. The attempt to quantify differences in international trade prices is important, as the PWT formerly used the price level of domestic absorption as a proxy for the price level of exports and imports. The common Eurostat-OECD-UN-World Bank ICP project, in turn, used the exchange rate as a substitute of the price level of both exports and imports, and offered the following explanation for this practice:

> "Export PPPs could be calculated by comparing the prices of goods and services for export in the participating countries. The same thing could be used for imports. *In most cases, the PPPs so obtained would be very close to the exchange rate and would diverge mainly because of differences in freight costs* (our italics). For ICP 2005 (as in all

[7] Having alternative indicators at the industry level involves the temptation of „manual" selection from different sources, based on our judgment regarding plausibility. As discussed in section 6, we resisted this temptation.

previous rounds), exchange rates were used as reference PPPs." (World Bank, 2008, p.145)

Our work, pointing to significant differences in international UV levels, suggests that using the exchange rate as a proxy for foreign trade PPPs is an unsound practice. Therefore, the attempt at calculating specific PPPs for exports and imports represents a major advance in international comparisons. Our main contributions to previous work on price/UV level comparisons, reviewed below, include the following:

- UV level comparisons of exports, based on a detailed (HS-8) trade classification;
- Applying two approaches to calculating UV level indices,
- Analyzing both levels of, and changes in, ULCs and their components, namely
    - labor cost levels and labor productivity
    - wage shares and comparative price levels
- Merging information on UV and ULC level indices and their changes to explain
    - UV levels and
    - relative export performance

However, as mentioned above, the scope of our approach is limited: we focus on a small sample of countries (the CEE4 + Austira) and address issues related to their exports to a single (though major) market, Germany.

2.3. A SELECTIVE REVIEW OF THE LITERATURE

While this review focuses on studies on level-comparisons, we first refer to an important work on UV/price *changes*. *Silver (2007)* presents a summary of the differences between foreign trade prices and unit value indices. He finds that unit value indices usually involve a bias and misrepresent price changes. There are discrepancies related not only to the signs of the differences, but also to the magnitudes. These criticisms are even more relevant for calculations of the terms of trade. Silver highlights many reasons of the bias, e.g., compositional changes, quality changes, seasonal goods, customs unions, increasing share of trade in services, e-trade. He also provides empirical evidence based on German and Japanese data and suggests some improvements.

As for *levels,* an early paper on UV level comparisons is *Aiginger (1997)* who points out that a unit value measures both price (cost) and quality (productivity, technological) competitiveness. In case products are homogeneous, the production technology is available for all producers, there is price competition, so prices reflect costs. However, if quality and innovation are important, unit values also incorporate the ability to set prices, so they are not only related to costs. The author distinguishes markets and product groups, where unit values reflect costs, and where they reflect quality differences.

Prices and unit values are useful when evaluating quality ranking of countries. One example is Hallak-Schott (2011) who decompose export prices into quality and quality adjusted components using trade balances; holding export prices constant a trade surplus indicates higher quality. They conclude that unit value ratios poorly approximate relative quality differences. Among CEE countries, they consider Hungary, Poland and Romania and they find that the relative quality of Hungarian export increased between 1989 and 2003. This relatively high growth in quality is accompanied by a considerable growth in GDP, which suggests quality upgrading. At the same time, Poland experienced one of the largest decrease in its quality ranking.

Feenstra-Romalis (2012) develop a model where firms simultaneously choose prices and quality. Based on the United Nations' Comtrade database they estimate the implied gravity equation which has new terms related to quality; and identify quality and quality-adjusted prices. They report price levels (with US price in 2005 normalized to 1) for exports and imports for 1987, 1997 and 2007. These price levels are estimated for all CEE4 countries as well. Although all CEE4 countries' export quality improved significantly, in all of the years reported, Hungary had the best quality ranking (e.g., 19th out of 52 in 2007

As mentioned earlier, the explicit consideration of UV levels is an important aspect of improving the Penn World Tables. *Feenstra et al (2009)* were the originators of the new concept of the PWT. The PWT actually provides expenditure-side real GDP; but the authors propose to modify it by the difference in the terms of trade to reflect the production side. This means that nominal national income must be deflated by PPP for outputs (PPP^o) rather than for expenditure (PPP^e). PPP^o is based on export and import prices and is broken down into PPP-s of final expenditures, exports and imports. Export and import "prices" are based on unit values of the United Nations database and are reported in relation to the US. They provide these and also the terms of trade for the whole Visegrad Group in 1996. Hungary has the highest export UV and the second highest import UV level (in the latter case following the Czech Republic).

There are some papers where trade performance is analysed by taking the initial unit value levels into account, although the number of these papers is rather limited. One example in the literature is *Fabrizio et al (2007)* identify the determinants of rapid export growth of CEE in the 2000s. They find that product quality had a considerable role in export performance. In the regressions the controls are not only the change in the real exchange rate and unit values, but also the initial unit value and some controls for technology intensity are included (as unit values might not only reflect quality but also changes in composition). They also describe the methodology of constructing unit values. They calculate the unit value for broad product groups by dividing the trade value by the quantity and normalize it by the relevant world unit value. Finally they aggregate the product unit values by using the weights of each product in the country's export (so the weights change when the composition changes). Only those products are considered, which have been exported at a continuous basis. The authors find that Hungary had the highest export unit value in CEE4 and although the unit values increased rapidly in all countries; the Czech Republic overtook Hungary in 2004. The Hungarian export unit value increased mainly between 1998 and 2000, while in the Czech Republic the most rapid growth occurred after 2000. Naturally, there are significant differences by product categories.

The paper by *Hallak-Schott (2011)* also addresses the relation between unit values and qualities and gives a detailed description of calculating unit value levels. Unit values are computed for each good of each source by country by dividing free-on-board import value by import quantity. Among CEE, they consider Hungary, Poland and Romania. Both in 1989 and 2003 Hungary's export UV level was the highest out of these three countries (although smaller than the sample average).

Other examples of studies based on using unit values include e.g., *Fontagné et al (2006)* who distinguish three trade types (inter-industry, intra-industry in horizontally and in vertically differentiated products) where the distinction between the two latter is based on unit value similarity/dissimilarity. *Khandelwal (2010)* estimates the quality of US imports based (partly) on unit values, and concludes that quality specialization has important implications for the US labor market.

3. DATA AND VARIABLES

This section describes the data sources of, and the variables applied in, our analysis.

3.1. COMEXT

Our empirical analysis relies on statistics of international trade published by the Statistical Office of the European Communities (Eurostat). COMEXT database provides access to information on trade value and quantity of EU member states.

Some features of the COMEXT data

Statistics on trade between the Member States of the European Union are based on information provided by trading firms.
Each member state has a threshold system (agreed annually) which guarantees that at least 97% of the total trade value is covered by the statistics. Small businesses and enterprises who never achieved a given threshold in arrivals or dispatches do not have to provide data, or are allowed to provide only limited data.
Extra-EU trade statistics are based on customs data and cover transactions whose value reaches 1000 euros or whose net mass is at least one ton.
Raw data contains the following variables: declaring member state, reference period, flow, product (as defined in the Common Nomenclature), trading partner, statistical value, net mass (in tons), quantity in any supplementary units and the statistical procedure (only for Extra-EU trade).
Raw data we use is broken down by sub-headings of the Combined Nomenclature (CN) which is based on the eight-digit Harmonized System (HS8) including ca. 10 000 product categories.
The Combined Nomenclature is revised once a year (new product categories are introduced and coverage of existing ones change). Countries always declare their trade activity according to the current revision of the Combined Nomenclature which complicates the comparison between years.
There are also alphanumeric product codes indicating confidential or adjusted data, and cases for which trade values cannot be broken down at the most detailed level. Raw data also include subtotals. These observations are dropped from the data.

Statistics on trade are based on information provided by firms. Member states have different minimum reporting thresholds which reduces the comparability across countries. When analyzing products traded by all five countries we use a 10 000 euro threshold on trade values at a HS8 level (observations under this threshold are not considered) that might reduce the bias caused by different statistical practices. Table 1 shows the frequency and relative aggregate value of observations under 10 000 euro.

Table 1.

Proportion of observations under 10 000 euro in terms of number and export value

		HU	SK	PL	CZ
2005	**number of observations**	24.11%	33.37%	21.97%	19.80%
	export value	0.02%	0.03%	0.02%	0.02%
2010	**number of observations**	27.74%	28.13%	20.18%	17.85%
	export value	0.02%	0.03%	0.01%	0.01%

In a non-negligible part of observations quantity measures of trade flows are missing (takes zero value). According to the documentation of Eurostat, since January 2006 firms are not required to report the net mass for all commodities that have a supplementary unit. However, states applying the simplification shall, since 1 January 2010, estimate the missing net mass data. As a consequence of the new regulations, data on net mass became incomplete. Table 3 show the percentage number and export value of observations with zero supplementary quantity and net mass.

To avoid biases caused by non-reported quantities, in our regression analysis, we use supplementary quantity to compute unit values if it is available for at least one month of a year for a given HS8 category. If supplementary quantity is missing, then net mass is used. Monthly HS8 level observations for which value is available but the reported quantity – used in the given year and hs8 category – is zero, are dropped before constructing yearly aggregates.

Table 2.

Percentage number of observations with zero supplementary quantity and net mass (monthly data, HS8 level)

	Reporter				
year	***AT***	***CZ***	***HU***	***PL***	***SK***
2004	17.70%	15.68%	15.02%	14.24%	23.62%
2005	17.42%	15.41%	14.59%	13.86%	25.44%
2006	17.07%	16.37%	14.97%	13.71%	24.30%
2007	17.14%	13.35%	14.96%	13.70%	26.02%
2008	17.07%	16.03%	14.91%	12.15%	26.86%
2009	18.46%	14.33%	16.45%	13.26%	29.74%
2010	14.85%	14.32%	16.76%	12.46%	24.77%

Table 3.

Percentage export value of observations with zero supplementary quantity and net mass (monthly data, HS8 level)

	Reporter				
year	***AT***	***CZ***	***HU***	***PL***	***SK***
2004	0.40%	0.36%	0.15%	0.12%	0.72%
2005	0.31%	0.29%	0.12%	0.13%	1.33%
2006	0.28%	0.25%	0.13%	0.10%	1.12%
2007	0.29%	0.16%	0.08%	0.10%	1.59%
2008	0.25%	0.24%	0.09%	0.12%	1.50%
2009	0.29%	0.14%	0.12%	0.09%	2.46%
2010	0.13%	0.15%	0.13%	0.07%	0.33%

Extra-EU data is also broken down by statistical regime. Normal imports and exports are distinguished from imports after/export for outward processing, imports for/exports after inward processing, suspension system and imports for/exports after inward processing, drawbacks or repayment system. We use total imports/exports (sum of the above categories, denoted by code 4) both for intra- and extra-EU trade.

Since all member states report both export and import values, for transactions between two member states, there are two possible sources of export/import data. However, there are significant differences between reported values by the exporter and the importer even at the most disaggregated level because of two reasons. Firstly, the statistical value of trade is an FOB value (free on board), for exports and dispatches, and CIF (cost, insurance, freight) for imports and arrivals. Secondly, various reporting thresholds in member countries might cause substantial differences.

Table 4 shows the differences in average log unit values computed from export and import statistics. It can be seen that not only log levels but percentage unit value changes are significantly different. Discrepancies are especially large in case of Hungary and Slovakia. Value weighted averages follow similar patterns. Interestingly, differences between parallel export and import statistics seem to decline if we do not drop HS8 categories reported only in import or export statistics for a given country pair and year, but still remain substantial.

Table 4.

Average level of unit values and their changes

	Average log level of unit value							Change in average log unit value between 2005 and 2010
	2004	2005	2006	2007	2008	2009	2010	
	export statistics							
CZ	6.39	6.41	6.22	6.24	6.40	6.51	6.58	17.4%
HU	6.62	6.56	6.64	6.70	6.80	6.74	6.74	18.2%
PL	6.11	6.14	6.24	6.22	6.26	6.23	6.27	13.4%
SK	6.31	6.40	6.43	6.60	6.65	6.61	6.83	43.0%
	import statistics							
CZ	6.40	6.42	6.47	6.50	6.55	6.56	6.57	15.6%
HU	6.61	6.73	6.80	6.82	6.90	6.81	6.82	8.2%
PL	6.06	6.13	6.15	6.19	6.27	6.25	6.28	14.2%
SK	6.27	6.37	6.39	6.52	6.59	6.51	6.54	16.7%

Notes: HS8 level, simple average. HS8 categories reported only in import or export statistics for a given country pair and year are dropped.

Values are expressed in euros in the COMEXT database, while member countries not belonging to the eurozone report in national currency and the conversion is based on monthly average exchange rates. In our analysis, we always use the yearly aggregates of monthly figures provided by Eurostat.[8]

3.2. EU KLEMS

A further source of our data is the EU KLEMS database[9], merged with the sectoral productivity level data of Inklaar and Timmer (2008). The sources, as well as the primary and derived indicators are discussed in detail in section 6.1, where we address the methodology of calculating ULC level indices. Here we only give a brief description of the indicators used in sections 4 and 5. All of the level indices are calculated so that their respective levels in Germany are equal to 1 (this is why the indicators are termed as "comparative").

- *Comparative unit labor cost level index* (ULCLI) is the ratio of *nominal* labor cost (converted at the current exchange rate) to the *volume* of value added (converted at sector-specific purchasing-power parities, PPPs). Thus ULCLI = W/VAQ, where W indicates nominal labor costs and VAQ is the volume (quantity) of value added. These indices are calculated for 13 industries of the four countries in our focus.
- *Comparative labor productivity level index* (LP) is the volume of value added per hour worked (VAQ/H), where H stands for hours worked.
  We have two measures of sectoral ULCLIs and LPs, one based on double deflation (sectoral inputs and outputs are deflated by different PPPs) denoted as ULCLI1 and LP1, and one on single deflation (inputs and outputs are both calculated by PPPs for output) denoted as ULCLI2 and LP2.
- *Comparative (nominal) labor cost level index* is labor cost per hour worked (W/H).
- *Comparative wage share* is the fraction of nominal labor costs in *nominal* value added (W/VAN), where VAN refers to nominal value added.

4. COMPARING UNIT VALUES: LEVELS AND CHANGES ACROSS COUNTRIES

This section aims at quantifying and explaining differences in export UV levels and changes in the CEE4 countries. After reviewing the characteristics of our data, we present UV level indices, inquire whether there is convergence in levels and discuss potential explanations of UV levels. The analysis is based on exports to Germany at HS8 digit level.

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[8] For more information on the trade statistics of Eurostat: http://epp.eurostat.ec.europa.eu/NavTree_prod/everybody/BulkDownloadListing?sort=1&file=comext%2F201302%2Ftext%2FUSER+GUIDE+2006+KS-BM-06-001-EN.pdf or http://epp.eurostat.ec.europa.eu/NavTree_prod/everybody/BulkDownloadListing?sort=1&file=comext%2Freadme.txt

[9] http://www.euklems.net/

4.1. UNIT VALUES BY COUNTY

In the following we turn to the analysis of our main dataset. First, we can look at the 2005 levels (log UV at HS8). In Table 5, the first panel presents the full dataset, the second panel presents continuously exported products, i.e. those that are present both in the 2005 and the 2010 samples. In both cases, a simple average is followed by weighted average (weighted by 2005 log values).

This plain data shows that in 2005 average unit values seem highest in Hungary, followed by the Czech Republic and Slovakia, and are the lowest in Poland. The ranking is the same when using weights. Moreover, this ranking is kept, when focusing on the smaller sample of products sold both years.

Table 5.

Unit values in 2005

Nominal values						
	Full sample			**Surviving products**		
country	observations	log UV (2005)	log UV (2005), weighted	observations	log UV (2005)	log UV (2005), weighted
Hungary	2854	5.259	5.387	1717	5.194	5.304
Czech Republic	5121	5.191	5.291	3419	5.088	5.164
Slovakia	2112	5.097	5.218	1203	5.077	5.141
Poland	5043	4.982	5.088	3424	4.825	4.923
Difference to Hungary						
	Full sample			**Surviving products**		
country	observations	log UV (2005)	log UV (2005), weighted	observations	log UV (2005)	log UV (2005), weighted
Czech Republic	5121	-0.068	-0.095	3721	-0.106	-0.140
Slovakia	2112	-0.162	-0.169	1282	-0.116	-0.163
Poland	5043	-0.276	-0.299	4014	-0.368	-0.381

Notes: HS8 data export data

Table 6 compares the change in UVs across countries. Panel I shows that in the full sample on average Hungarian prices (unit values) rose the least, closely followed by Poland and the Czech Republic. The main outlier is Slovakia where prices increased by 47.7%, treble the speed of other country average. (This result is very close to price indices, see section 2.)

There may be several reasons behind the differences. For instance, as this is not weighted by volume, it is possible that a large number of small value and volatile items bias the figures. Dropping all goods below a 50.000 euro threshold (in line with suggestions of Schott 2004), we find little change, except for Slovakia, where price change is reduced by

10pp. This smaller sample includes 69% of product-country observations. Yet, the overall trend is unchanged and the Slovakian price change is still twice as strong as that of the Czech Republic.

Importantly, comparing unit values at face value may be problematic, as it is possible that firms in Poland and Hungary produce completely different products and a plain comparison is hence, meaningless. To tackle this issue, we apply several methods. First, only commonly traded goods will be considered. Second, we deflate unit values in the four countries, by the unit values of similar goods in Austria. This allows a better comparison across levels. Third, we consider a greater set of goods and look at differences across time, thus, controlling for individual characteristics.

As a start, note that it is possible that the composition of the traded bundle is different country by country. For instance, Slovakia may be specialized in a set of products that experienced unit value change maybe because of high demand or a technological innovation reducing price. To filter out composition effects, we reduced the scope of the dataset to commonly traded goods. It may be argued this is a much smaller sample (19% of the total), but offers a closer comparison. Yet, panel II shows a fairly similar picture, with similar changes in the Czech Republic, Hungary and Poland, but again, much greater rise in Slovak UVs. In this case, the difference due to goods traded at small volume is rather negligible, as unification of the sample also leads to dropping most products below the volume threshold.

Table 6.

Average changes in Unit values

	I. Full sample			II. Restricted sample		
	All goods		**Min €50.000**	**All goods**		**Min €50.000**
country	**Observations**	**Change**	**change**	**observations**	**change**	**Change**
Hungary	1717	13.5%	14.1%	453	15.2%	15.5%
Czech Republic	3419	18.2%	17.5%	453	18.3%	19.0%
Slovakia	1203	47.7%	38.3%	453	47.1%	48.0%
Poland	3424	16.0%	14.1%	453	17.9%	16.6%

Notes: HS8 data, change is between 2005 and 2010. Restricted sample is for products exported by CEE4 countries and Austria

4.2. UNIT VALUES RELATIVE TO AUSTRIA

Next, we calculate relative unit values at the HS8 digit level and compare them to Austria. Our aim here is not discussing absolute differences in levels, but just changes. Having a country as a benchmark helps to filter out across HS8 product differences and allows for a better level comparison. Comparing to Austria may be useful, as Germany is the major export market both for the CEE4 and Austria.

One focus of our analysis is on products exported by both the CEE4 countries and Austria both in 2005 and 2010. There are 453 HS8 categories exported by all countries both in 2005 and 2010 and these categories account for approximately 50 % of total export value on average both in 2005 and 2010. Let us define G^*as the set of common products at HS8 classification.

This cross section exercise allows us to compare the unit value level of these goods weighted by individual country weights. The basis is Austria. Let us define $P_{H,2005}$ and $P_{H,2010}$ as the Hungarian relative UV index for 2005 and 2010, the weighted average of unit values of all common products, with Hungarian export weights X.

$$P_{H,2005} = \sum_{hs \in G^*} \frac{UV_{H,2005}(hs)}{UV_{A,2010}(hs)} * X_{H,2005}(hs)$$
$$P_{H,2010} = \sum_{hs \in G^*} \frac{UV_{H,2010}(hs)}{UV_{A,2010}(hs)} * X_{H,2010}(hs)$$

Obviously, these figures may be calculated for all four countries.

Also, we can look at the difference in changing values, and use X_{2005} rather than X_{2010} to explain change and dissect the pure impact of UV change and the impact of changing weights.

Table 7.

Relative unit value levels, compared to Austria

	P2005, w2005	**P2010, w2005**	**P2010, w2010**	***total***	***within***	***volume***
Czech Republic	0.87	1.00	0.96	***1.11***	***1.16***	***0.96***
Hungary	1.46	1.24	1.28	***0.87***	***0.85***	***1.03***
Poland	0.67	0.78	0.72	***1.07***	***1.16***	***0.93***
Slovakia	1.22	1.50	1.27	***1.04***	***1.22***	***0.85***

Notes: HS8 level, full sample

Table 7 focuses on the common bundle for five countries with all CEE prices taken in relative terms to Austria. Thus, a 0.87 value means 87% of average Austrian unit value. The first column presents the 2005 average level of unit values, the second keeps 2005 weights but uses 2010 prices, while the third has both weights and prices at the 2010 level.

The average unit value rose by most in Czech Republic (11%), followed by Poland (7%) and Slovakia (4%) and declined (13%) in Hungary. Using 2005 weights helps to dissect the total change into a within (i.e., unchanged weights) and volume (i.e., change in volumes of goods sold) component. The dissection offers a more pronounced picture. The Czech Republic, Poland and in particular, Slovakia were able to raise UVs (prices) by 16-22%, but experienced a rebalancing towards lower unit value products as suggested by below 1 values in the "volume" column. Hungarian UVs fell markedly, with a slight move towards larger sales in higher UV goods.

4.3. IS THERE CONVERGENCE IN UNIT VALUES?

This subsection deals with the question of regional price (unit value) convergence over time. It can be argued, that the difference in price changes is related to price levels, and increased market integration brought about convergence. Figures in Table 8 offer preliminary support for a convergence hypothesis, those with lower 2005 unit values (Czech Republic, Poland) experienced a stronger UV increase, while high UV is associated with a decline (Hungary). Slovakia had relatively high UV level and also managed to get higher unit values – with a hit on volume of higher UV goods.

In this subsection, we rely on two samples when analyzing differences, albeit using products available in both 2005 and 2010 has reduced the sample size (see Table 8). We will try to understand the factors behind both levels and changes in unit values. To do this, we will use EU KLEMS data on industry performance and costs in addition to the trade dataset.

We will report results both with the full sample of trade goods, and similarly to section 4.1, also on the restricted sample of commonly exported goods on the breakdown of observations.

Table 8.

Number of observations for UVs

	2005 levels		Differences 2010-2005	
	Full sample	Joint sample	Full sample	Joint sample
Hungary	2841	452	1710	450
Czech Republic	5057	452	3385	450
Slovakia	2101	452	1195	450
Poland	4979	452	3384	450
Total	14978	1808	9674	1800

We have seen in both previous sub-sections that there seems to be some evidence of price convergence. Using HS8 product level data, we now seek further evidence on convergence across countries as well as across products within a country. We estimate the change in log unit value (dUV) as a function of the 2005 level of UV, country (c=HU, SK, CZ, PL) and industrial sector dummies (s=1…13). We both estimate on the full sample and separately for each country.

$$d(UV)_{ic} = \alpha + \beta UV_{2005} + \theta_c + \epsilon_s + \varepsilon \qquad (1)$$

Results presented in Table 9 indicate that an initially 10% higher unit value corresponds to almost 1% (0.96) lower change in UV. However, this relationship varies by country. It is the lowest in Hungary in Poland and the Czech Republic, some convergence is present, but it is particularly strong in Slovakia.

Table 9.

Estimated UV convergence values

	I. Simple OLS			**II. Value weighted OLS**		
	Est. Coeff.	s.e.	R^2	Est. Coeff.	s.e.	R^2
Full sample	-0.0961***	0.0110	0.0671	-0.0695***	0.0065	0.1143
Hungary	-0.0466**	0.0188	0.0304	-0.0764***	0.0162	0.1741
Czech Rep	-0.0729***	0.0169	0.0924	-0.0285**	0.0113	0.0570
Slovakia	-0.1613***	0.0301	0.0716	-0.1513***	0.0207	0.2498
Poland	-0.0850***	0.0177	0.0704	-0.0480***	0.0090	0.1254

Notes: HS8 level data considering only the restricted sample of commonly exported goods. All regressions include industrial sector dummies (based on NACE classification), the full sample regression also have country dummies. Panel II includes regressions with weights of 2005 export values in euro. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

The second panel presents result from the same simple set of regressions, but observations are weighted by the 2005 value of exports. This is closer to a price index. First, note the smaller role of volatile items, as the explanatory power is increased over the board. Importantly, it is still true that convergence of Slovakian values is 2-3 times of the change in other countries. However, the relationship between the Czech Republic and Hungary is reversed: the weighted convergence in Hungary is stronger, while it is just significantly different from zero in the Czech Republic.

4.4 EXPLAINING UNIT VALUES

Next, we try to understand the factors behind both levels and changes in unit values. To do this, we will use EU KLEMS data on industry performance and ULC levels in addition to the trade dataset.

We will report results both with the full sample of traded goods, and similarly to section 4.3, also on the restricted sample of commonly exported goods. First, we looked at how the level of unit values is related to supply and demand side variables.

Still using HS8 product level export data, we regress the level in log unit value (UV_{ic}) for a given product i, and country c on a function of the 2005 level of quantity sold (Q_{ic}) and total German imports of the good (Di) along with country (c=HU, SK, CZ, PL) and industrial sector dummies (s=1…13). All data come from the Comext trade database. Unit values and quantities, as well as German import demand are all measured in logs.

$$UV_{ic,2005} = \alpha + \beta_1 Q_{ic,2005} + \beta_2 D_{i,2005} + \beta_3 S_{sc,2005} + \theta_c + \epsilon_s + \varepsilon \qquad (2)$$

Specifications differ in the third explanatory variable. First, we add the market share of country c in the product group within Central Europe (sh_{ic}). For other specifications, we merge this data with data from the EU-KLEMS database (see section 3.2 for the content of the indicators). In particular, we consider the industry and country specific unit labor cost levels (ULCLIs) and wage shares. As indicated above, both ratios are normalized so that Germany's level =1.

First, we look at levels, comparing unit values in 2005. Results, including market share, wage share and the unit labor cost, are presented in columns 1 to 3 of Table 10. In columns 4-6, we repeated the same exercise for only overlapping products.

Results – for both samples – suggest that there is a negative relationship between quantity and unit value. This may partly come from measurement issues (both are devised for the value variable –unit value is value/volume). Importantly, we find strong evidence that a larger market size allows for higher UVs.[10]

Performance of firms in a given product category is measured in three ways. First, regional market shares are strongly and positively associated with higher unit values. This suggests that important suppliers are able to get a larger market share.

Then we used wage share. Here we find negative correlation in the overlapping product sample, suggesting that a lower wage share (in value added) is associated with higher unit values. This result may seem to be surprising[11]. However, a lower wage share might also be associated with higher innovative content or better quality; the result obviously calls for further analysis. Unit labor costs are not significant when using the *level* of ULC1 (double deflated). However, the level of ULC2 (single deflated) is significant: a lower level of ULC2 is associated with higher unit values. At this stage it seems that this relationship is not robust to the ULC definition or model specification - for details, see Table A1 in the Appendix.

Finally, note that we have been using industry and country dummies. As the last two variables are defined at the industry-country level, identification comes from within sectoral differences across countries. Indeed, without industry dummies, results are different – as

[10] In line with Manova-Zhang (2012). However, this may be a statistical phenomenon, as higher unit values may also inflate market size.

[11] Taken at face value, it indicates that higher unit values are correlated with relatively higher profit shares in domestic industries. This implies the inverse of the received wisdom regarding transfer pricing (i.e., that companies transfer their profits abroad by charging lower export prices.)

shown in Tables A2 and A3 in the Appendix. In all regressions, when using variables from the EU-KLEMS data, we cluster standard errors at the industry level.

Table 10.

UV Regressions – levels

VARIABLES	I. Full sample			II. Restricted sample		
	Dependent variable: log unit value in 2005					
log quantity in 2005	-0.493***	-0.424***	-0.423***	-0.683***	-0.554***	-0.553***
	(0.0434)	(0.0395)	(0.0393)	(0.0777)	(0.0741)	(0.0736)
log value of total	0.442***	0.320***	0.320***	0.576***	0.454***	0.452***
imports of Germany	(0.0587)	(0.0482)	(0.0484)	(0.111)	(0.115)	(0.114)
market share out of	1.978***			3.416***		
CEE4 countries in 2005	(0.229)			(0.425)		
wage share		-0.357			-0.926***	
		(0.223)			(0.154)	
ULC1 level in 2005			-0.0411			-0.133
			(0.206)			(0.236)
CZ dummy	-0.0288	0.341***	0.365***	0.135**	0.525***	0.599***
	(0.0393)	(0.0873)	(0.0923)	(0.0596)	(0.0973)	(0.0800)
SK dummy	-0.210***	-0.362***	-0.284***	-0.148*	-0.379***	-0.153
	(0.0672)	(0.0778)	(0.0754)	(0.0781)	(0.0526)	(0.0958)
PL dummy	-0.123***	0.108*	0.164***	0.00973	0.220**	0.385***
	(0.0384)	(0.0498)	(0.0474)	(0.0289)	(0.0849)	(0.113)
Constant	-1.158	1.435**	1.262**	-0.632	2.089	1.366
	(0.767)	(0.482)	(0.470)	(1.599)	(1.669)	(1.614)
Observations	14,978	14,978	14,978	1,808	1,808	1,808
R-squared	0.543	0.483	0.482	0.767	0.667	0.666

Notes: HS8 level. Restricted sample means sample of commonly exported goods. All regressions include industrial sector dummies (based on NACE classification). Standard errors, clustered at industry level, in parentheses. *** p < 0,01, ** p < 0,05, * p < 0,1

Second, we consider changes using a difference in difference estimation method. This allows us filtering out product specific concerns. Let Δ denote change between 2010 and 2005. We estimate

$$\Delta UV_{ic} = \alpha + \beta_1 \Delta Q_{ic} + \beta_2 \Delta D_i + \beta_3 \Delta S_{sc} + \theta_c + \epsilon_s + \varepsilon \quad (3)$$

The advantage of using cross section data of 2005 is the availability of the EU-KLEMS data. However, this is not the case for 2010 as the EU-KLEMS data runs until 2007 only. Hence, for unit labor costs and wage shares we used change between 2004 and 2007 as proxy. Thus, these results should be handled with caution.

Results of the difference in difference estimation are presented in Table 11. The first three specifications show results for including the change in market share, wage shares and ULC, respectively. The second three specifications repeat this for the sample with overlapping products only. Results show that there is a negative relationship between unit value change and quantity change, much like it was shown earlier for the cross section. Similarly, total German import demand remains positively correlated with unit value and there is also a positive relationship between the change in the market share and unit values. Other cost variables have limited statistical significance - may be a result of imprecise measurement. In particular, the change in wage share and unit labor costs are both (weakly) associated with an increase in unit values.

Country dummies are included in all regressions and are reported separately. Coefficient estimates of country effects show that compared to the baseline, i.e., Hungary, Czech and Polish unit values have risen a slightly (3-12%) faster. The main difference comes from Slovakia, where unit values rose by about 25% more than in Hungary, even after controlling for changes in demand and sales.

To investigate the potential heterogeneity across countries, Table 12 presents result for countries separately. It suggests that the Slovakian reaction to changes in quantity and demand is the largest, partially explaining the cross country differences.

Table 11.

UV Regressions –changes

	I. Full sample			II. Restricted sample		
VARIABLES	**Dependent variable: change in unit value levels between 2005 and 2010**					
change in quantity	-0.249***	-0.185***	-0.197***	-0.415***	-0.302***	-0.321***
	(0.0248)	(0.0179)	(0.0162)	(0.0180)	(0.0160)	(0.0188)
change in the value of	0.115***	0.0830***	0.0921***	0.237***	0.168***	0.202***
total import of Germany	(0.0179)	(0.0134)	(0.0201)	(0.0512)	(0.0433)	(0.0265)
change in market share	1.062***			2.025***		
out of CEE4 countries	(0.142)			(0.107)		
change in wage share		0.240			0.649**	
		(0.257)			(0.209)	
change in ULC level			-0.109			0.806*
			(0.389)			(0.444)
CZ dummy	0.0710*	0.0409	0.0338	0.0115	-0.00655	0.0494
	(0.0382)	(0.0341)	(0.0525)	(0.0369)	(0.0603)	(0.0516)
SK dummy	0.271***	0.291***	0.288***	0.162***	0.224***	0.216***
	(0.0455)	(0.0526)	(0.0472)	(0.0426)	(0.0321)	(0.0401)
PL dummy	0.0828*	0.122***		0.00660	0.147***	
	(0.0393)	(0.0384)		(0.0485)	(0.0410)	
Constant	0.139***	0.0803	-1.134***	-0.0994**	-0.156***	-0.316***
	(0.0255)	(0.0672)	(0.0820)	(0.0332)	(0.0346)	(0.0362)
Observations	9,674	9,674	6,290	1,800	1,800	1,350
R-squared	0.227	0.163	0.165	0.462	0.331	0.351

Notes: HS8 level. Restricted sample means sample of commonly exported goods. All regressions include industrial sector dummies (based on NACE classification). Standard errors, clustered at industry level, in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 12.

UV Regressions – changes by country

VARIABLES	HU	CZ	SK	PL
	Dependent variable: change in unit value levels between 2005 and 2010			
change in quantity	-0.188***	-0.285***	-0.326***	-0.210***
	(0.0245)	(0.0322)	(0.0217)	(0.0388)
change in market share out of CEE4 countries	1.135***	1.189***	1.945***	0.740***
	(0.179)	(0.166)	(0.274)	(0.181)
Constant	0.351***	0.135***	0.340***	0.391***
	(0.00990)	(0.00478)	(0.0328)	(0.00400)
Observations	1,717	3,419	1,203	3,424
R-squared	0.169	0.264	0.266	0.206

Notes: HS8 level. All regressions include industrial sector dummies (based on NACE classification). Standard errors, clustered at industry level, in parentheses. *** p < 0,01, ** p < 0,05, * p < 0,1

5. DECOMPOSING EXPORTS BY THE HUMMELS-KLENOW METHODOLOGY

In this section, we decompose the exports of the four CEE countries and Austria into three margins: the extensive margin (the weighted number of products exported), the unit value margin and the quantity margin (the quantity exported from each product). This decomposition has two main uses. First, it allows us to compare the levels of each of these margins across countries in each year, which complements the unit value level calculations in the previous sections. Second, by following the evolution of each margin across years, we can get a more detailed picture on the evolution of competitive advantages of each country.

5.1. METHODOLOGY

When performing this decomposition, we rely on the methodology of Hummels and Klenow (2005). This method builds on the CES aggregator of Feenstra (1994), which handles simultaneously the differences in weights of exported products, as well as the differences in the set of products exported by each country. We implement this methodology using German import data at the 8-digit Harmonized System level from the five countries analyzed previously[12] and we use total German imports from the rest of the EU-27 countries

[12] We use additional cleaning. We drop all observations when the quantity (in terms of complementary units) is less than 10, and when the difference between country *j*'s and the EU-27 unit value is larger than 100 (ln) percentage points. The results on the cleaned and the raw data are similar.

as a comparison.[13] As a consequence, the calculated margin levels have a meaningful unit of measurement, i.e. they will be interpreted as percentages of the respective EU-27 margins.

When implementing the decomposition we compare the exports (to Germany, DE) of country j to that of the EU27. In particular, we decompose the share of country j in total EU27 exports to Germany (s_j^{DE}) into three margins: the extensive margin (EM_j^{DE}), the unit value margin (P_j^{DE}) and the quantity margin (X_j^{DE}):

$$s_j^{DE} = EM_j^{DE} P_j^{DE} X_j^{DE}$$

where

$$s_j^{DE} = \frac{\sum_{i=1}^{I} p_{j,i}^{DE} x_{j,i}^{DE}}{\sum_{i=1}^{I} p_{EU,i}^{DE} x_{EU,i}^{DE}}$$

where i indices indicate 8-digit products, $p_{EU,i}^{DE}$ and $x_{EU,i}^{DE}$ represents the unit value and the quantity exported from product i to Germany by the rest of the EU, respectively.

The extensive margin represents the (weighted) number of products exported by country j relative to the set of products exported by the rest of EU27:

$$EM_j^{DE} = \frac{\sum_{i \in I_j^{DE}} p_{EU,i}^{DE} x_{EU,i}^{DE}}{\sum_{i \in I_{EU}^{DE}} p_{EU,i}^{DE} x_{EU,i}^{DE}}$$

where I_j^{DE} represents the set of products exported by country j to Germany, while I_{EU}^{DE} is the set of products exported by the rest of the EU to Germany.

The extensive margin can be interpreted as a weighted count of products exported by country j. The weights come from the EU exports, hence a product may not appear important simply because the country in question exports a lot from it. Note, that implicitly we assume that all products exported by these countries are exported by at least one more EU country to Germany. While this is a good approximation, there are a few products, which are only exported by one CEE country. We drop these products (138 8-digit categories).

The second margin, the unit value component, is the weighted average of country j's unit values, normalized by the average unit value of EU27 exports. The weights come from the Feenstra (1994) exact price index.

$$P_j^{DE} = \prod_{i \in I_j^{DE}} \left(\frac{p_{j,i}^{DE}}{p_{EU,i}^{DE}} \right)^{w_{j,i}^{DE}}$$

[13] As a result, the unit values analyzed here are CIF rather then FOB unit values. Also, following Hummels and Klenow (2005), in each case the comparison group is the remaining 26 EU-27 countries rather than the group outside CEE.

where $w_{j,i}^{DE}$ is the logarithmic mean of the share of product i in the German imports from country j ($s_{j,i}^{DE}$) and from the rest of the EU-27 ($s_{EU,i}^{DE}$) (we calculate the share of the product from the product set exported by country j):

$$s_{j,i}^{DE} = \frac{p_{j,i}^{DE} x_{j,i}^{DE}}{\sum_{i \in I_j^{DE}} p_{j,i}^{DE} x_{j,i}^{DE}}$$

$$s_{EU,i}^{DE} = \frac{p_{EU,i}^{DE} x_{EU,i}^{DE}}{\sum_{i \in I_j^{DE}} p_{EU,i}^{DE} x_{EU,i}^{DE}}$$

$$w_{j,i}^{DE} = \frac{\dfrac{s_{j,i}^{DE} - s_{EU,i}^{DE}}{\ln s_{j,i}^{DE} - \ln s_{EU,i}^{DE}}}{\sum_{i \in I_j^{DE}} \dfrac{s_{j,i}^{DE} - s_{EU,i}^{DE}}{\ln s_{j,i}^{DE} - \ln s_{EU,i}^{DE}}}$$

Finally, we calculate the quantity margin by dividing country j's share with the product of extensive and unit value margins:

$$X_j^{DE} = \frac{s_j^{DE}}{EM_j^{DE} P_j^{DE}}$$

5.2. RESULTS BY COUNTRY

Figure 10 shows the evolution of the shares of each country from all EU-27 export into Germany. This suggests that in general export shares are strongly related to the size and development of each country: for example, Slovakia's market share is the smallest in each year. The picture reflects strong export growth in the Czech Republic and Poland, slower increase in Slovakia and relative stagnation in Hungary's exports. The decomposition should shed some light on the source of these differences.

Figure 10

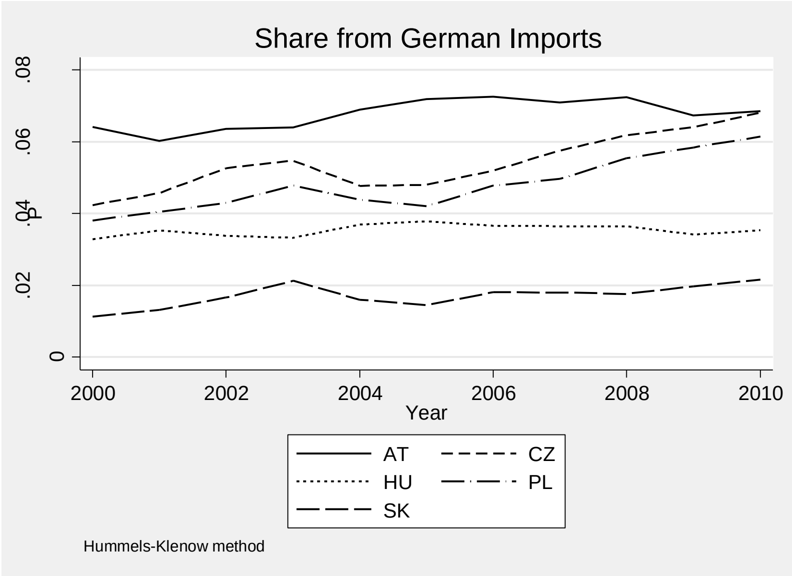


Figure 11 shows the extensive margin for each country. The interpretation of the numbers is the following: in 2000 Austria exported about 78 % of the products exported by the EU-27 (weighted by the importance of products in Germany's imports). The same number is about 65 percent for the Czech Republic and Poland, 60 % for Hungary and 49 percent for Slovakia.

In terms of dynamics, the figure shows that increasing the number of products sold, was an important channel of the Czech and Polish export growth. In contrast, the extensive margin stagnated for Hungary and Poland (more precisely, it did not grow faster than the extensive margin of EU-27 exports to Germany).

Figure 11

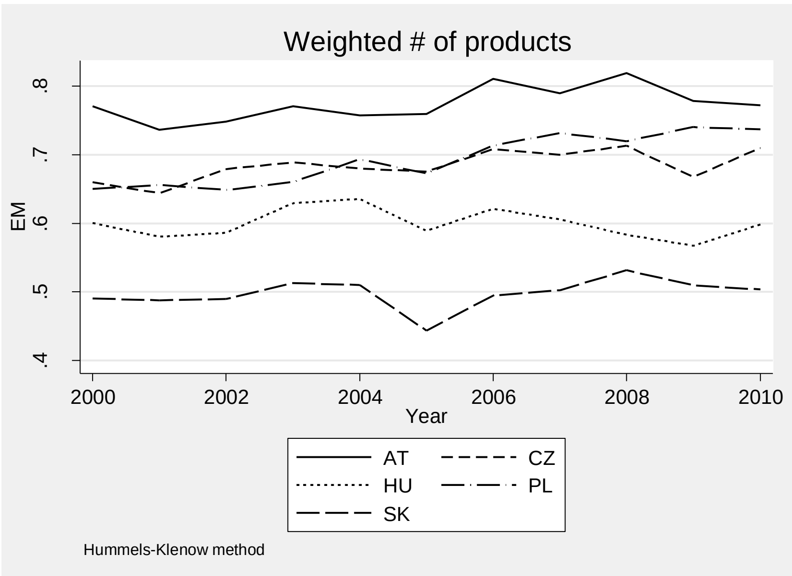
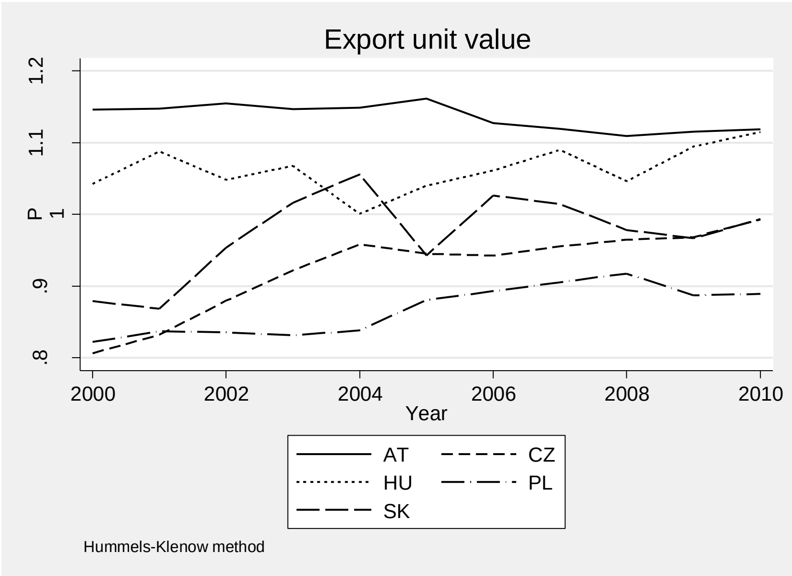


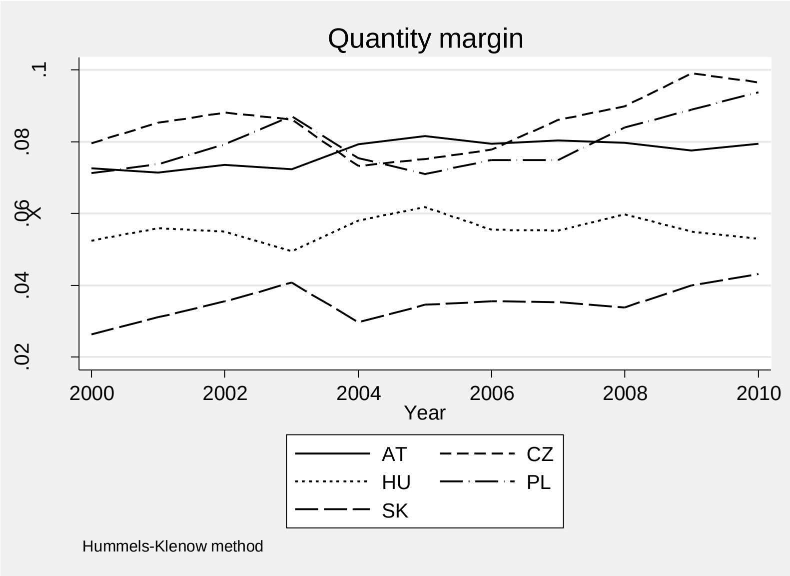
Figure 12 shows the relative unit values for each country. The figure shows large initial differences in 2000: while Hungarian unit values were larger than the average of the rest of EU-27, the UV level of the three other CEE countries were between 80 and 90 percent of the rest of EU-27 average. The figure also suggests convergence in CEE export unit values to the EU-27 average: it has increased quickly for all CEE countries, reaching 110 percent for Hungary and nearly 100 percent for Slovakia and the Czech Republic in 2010. While also increasing, Polish export unit values remained somewhat lower, around 90 percent of EU-27 average in 2010.

Figure 12



Finally, Figure 13 depicts the quantity margin. While this is somewhat erratic, there is a strong increase in the second half of the 2000s for the Czech Republic, Slovakia and Poland. Hungary's quantity margin stagnated in this period.

Figure 13



We may conclude that the Czech and Polish exports increased significantly during the 2000s. This is decomposed to a strong growth in all margins: Czech quantities and prices have grown in parallel, suggesting strong quality upgrading. A similar pattern can be observed in the Polish case, with the difference that export unit values were still relatively low in 2010. The quality (and/or the price) of Polish exports may have increased, but it still seems to be lower than that of the other countries. In contrast, Hungarian share on the German market stagnated during the second half of the 2000s. The decomposition suggests relatively high and increasing Hungarian export unit values together with relative stagnation of quantities.

5.3. UV LEVELS BY INDUSTRY

Figure 14, Figure 15 and Figure 16 show the evolution of UVs by industry and country. In general, the pattern is similar across industries: there is evidence for convergence and for relatively high Hungarian and low Polish unit values, with the Czech Republic and Slovakia in the middle.

Figure 14.

Unit values by industry (I)

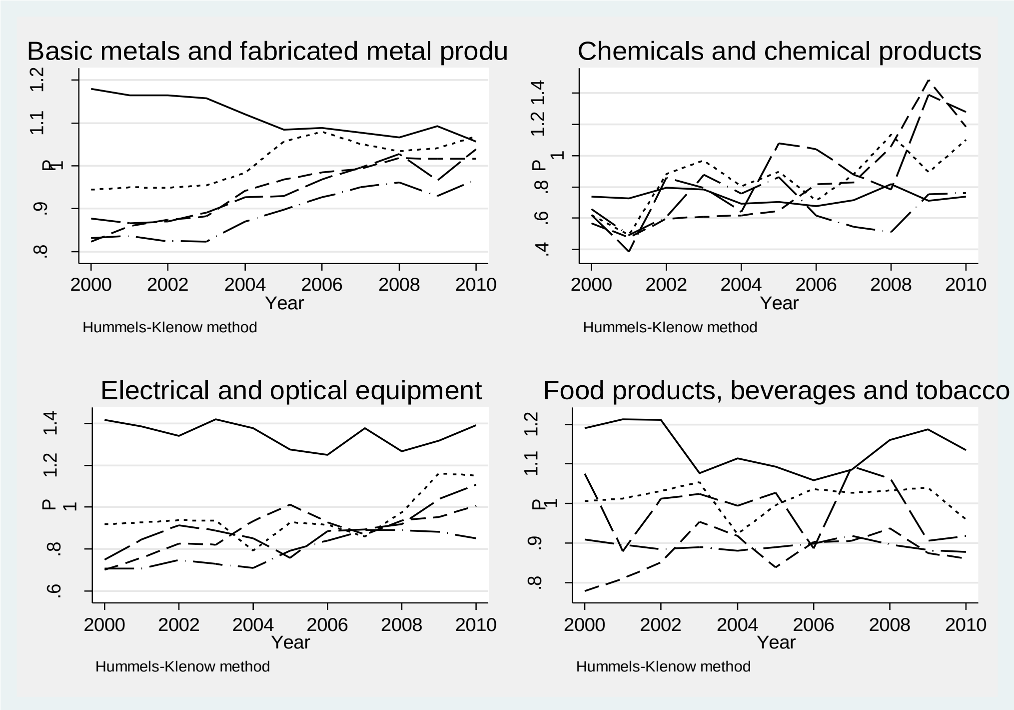


Figure 15.

Unit values by industry (II)

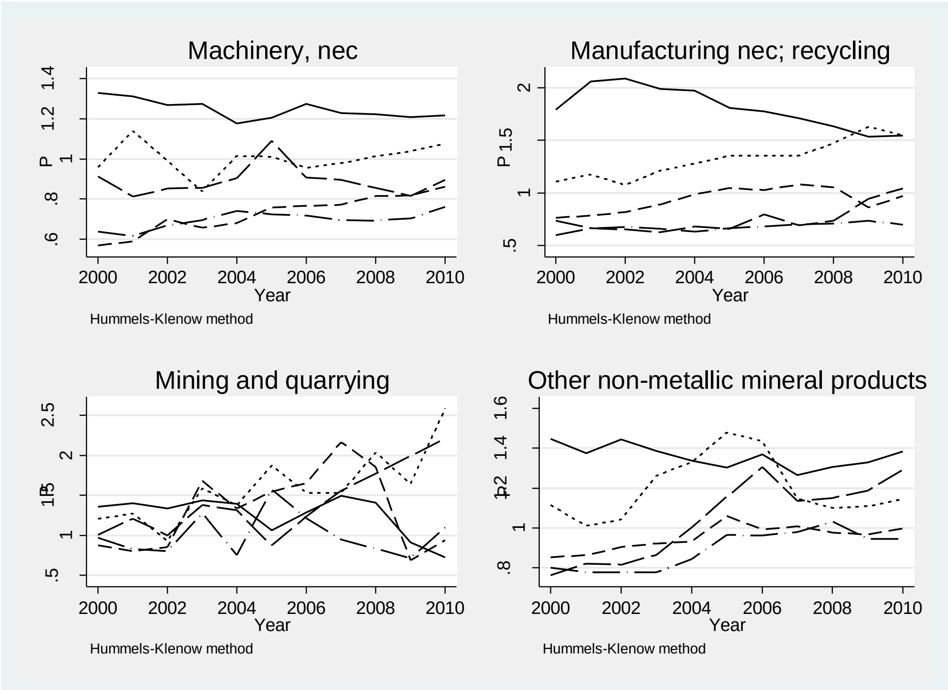
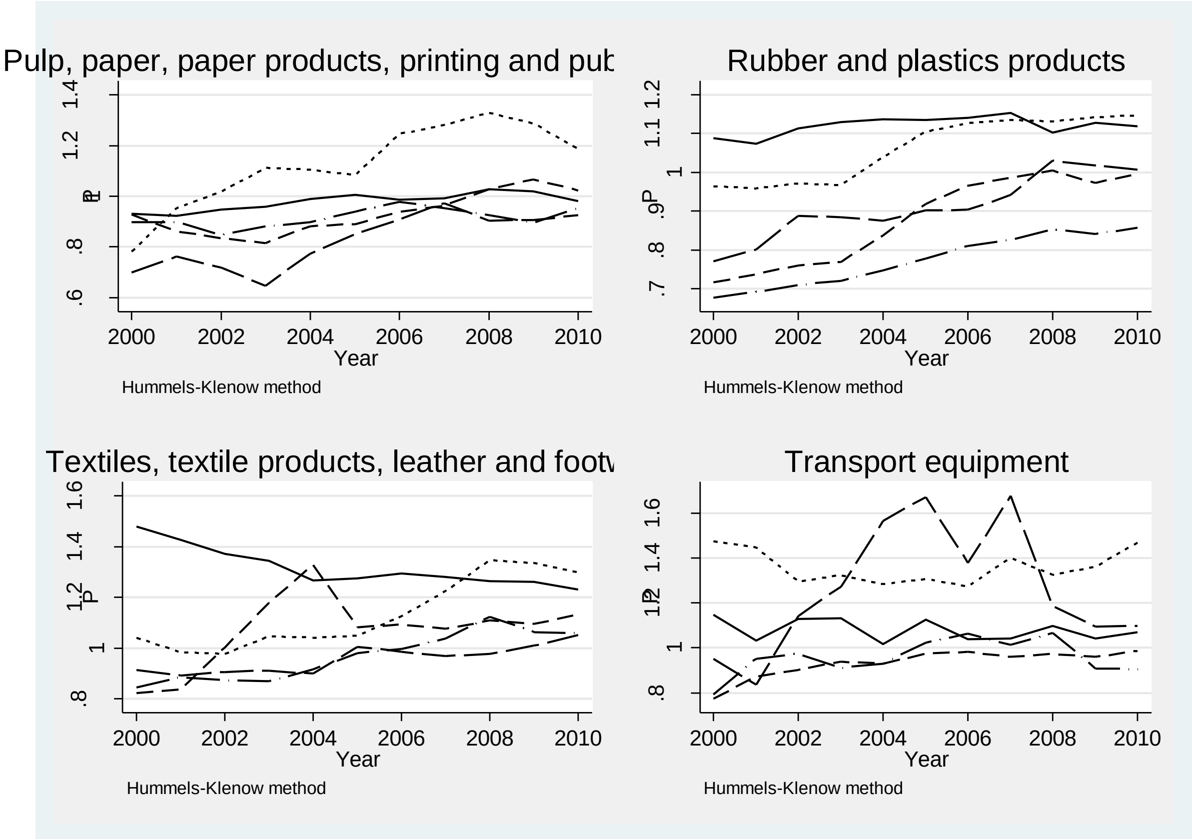


Figure 16.

Unit values by industry (II)



5.4. THE RELATION BETWEEN UVS AND MARKETS SHARES BY INDUSTRY

In this subsection we focus on the relationship between export unit values and quantities. For this, we use industry level data from the Hummels-Klenow decomposition introduced in the previous subsection. First, we analyze the relationship between the levels of unit values and quantities in cross sections, followed by modeling the changes in quantities with lagged price levels. In each regression we include all five countries.

Hence, our first set of regressions show the correlation between unit values and market shares as well as the quantity margin.

$$s_{jk}^{DE} = \beta P_{jk}^{DE} + \mu_j + \eta_k + \varepsilon_{jk} \qquad (4)$$

$$X_{jk}^{DE} = \beta P_{jk}^{DE} + \mu_j + \eta_k + \varepsilon_{jk} \qquad (5)$$

where j indexes countries, as before, k denotes 2-digit NACE industries, μ_j and η_k are country and industry dummies, respectively. We run the two regressions for each year separately and report the results in Table 13, which shows the coefficient of the unit value index as well as the country dummies. Note that Austria is the excluded category; hence the country dummies show each country's performance relative to Austria. 2-digit industry dummies are also included, but not reported in the table for the sake of brevity.[14]

Table 13

Dependent variable: market share and quantity margin

	Dependent variable: market share							
VARIABLES	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Unit value	-0.037	-0.027	-0.032	-0.032	-0.024	-0.019	-0.060*	-0.027
	(0.028)	(0.027)	(0.027)	(0.030)	(0.027)	(0.025)	(0.030)	(0.025)
CZ dummy	-0.041**	-0.031*	-0.030*	-0.021	-0.034**	-0.038**	-0.041***	-0.027*
	(0.018)	(0.018)	(0.017)	(0.018)	(0.016)	(0.015)	(0.014)	(0.014)
HU dummy	-0.054***	-0.050***	-0.051***	-0.049***	-0.053***	-0.054***	-0.054***	-0.053***
	(0.013)	(0.014)	(0.014)	(0.015)	(0.015)	(0.014)	(0.013)	(0.013)
PL dummy	-0.032*	-0.021	-0.023	-0.012	-0.022	-0.022	-0.029*	-0.017
	(0.018)	(0.018)	(0.018)	(0.019)	(0.018)	(0.016)	(0.016)	(0.016)
SK dummy	-0.076***	-0.070***	-0.071***	-0.066***	-0.068***	-0.071***	-0.076***	-0.068***
	(0.016)	(0.017)	(0.015)	(0.017)	(0.016)	(0.015)	(0.014)	(0.014)
Observations	65	65	65	65	65	65	65	65
R-squared	0.631	0.624	0.650	0.573	0.569	0.575	0.637	0.636
	Dependent variable: quantity margin							
Unit values	-0.120***	-0.103***	-0.098**	-0.083*	-0.104***	-0.076**	-0.136***	-0.080**
	(0.041)	(0.036)	(0.038)	(0.045)	(0.038)	(0.035)	(0.042)	(0.032)
CZ dummy	-0.052*	-0.038	-0.027	-0.004	-0.038*	-0.031	-0.036*	-0.017
	(0.026)	(0.024)	(0.023)	(0.026)	(0.022)	(0.021)	(0.020)	(0.018)
HU dummy	-0.062***	-0.056***	-0.052***	-0.042*	-0.050**	-0.040*	-0.043**	-0.043**
	(0.020)	(0.019)	(0.019)	(0.023)	(0.020)	(0.020)	(0.019)	(0.018)
PL dummy	-0.035	-0.015	-0.006	0.008	-0.012	-0.001	-0.014	-0.003
	(0.026)	(0.024)	(0.024)	(0.029)	(0.025)	(0.022)	(0.022)	(0.020)
SK dummy	-0.095***	-0.086***	-0.074***	-0.065**	-0.074***	-0.062***	-0.072***	-0.061***
	(0.023)	(0.023)	(0.021)	(0.026)	(0.022)	(0.021)	(0.020)	(0.018)
Observations	65	65	65	65	65	65	65	65
R-squared	0.544	0.571	0.579	0.468	0.507	0.469	0.558	0.567

Notes: HS8 level. Standard errors in parentheses.*** p<0.01, ** p<0.05, * p<0.1

[14] Omitting the dummies does not substantionally change the results.

The main conclusion one can infer is that unit value levels are strongly negatively correlated with the quantity margin in each year, reflecting an underlying demand function. The country-industry level market shares, on the other hand, are not correlated with the unit value level, which may be explained by the fact that market shares include the product of unit values and quantities, which cancel each other out. The country dummies suggest that the size, distance and development level of each country is also correlated with the two quantity variables, and the relative magnitudes of the estimated coefficients are in line with the expectations, Austria and Poland having the largest market share followed by the Czech Republic, Hungary and Slovakia.

Second, we were interested in how initial values (from 2000) of the different variables affected the change of each margin between 2000 and 2007. The unit of observation, as previously, is the country-industry level.

The results of these regressions are presented in Table 14 and

Table 15. The first column shows how the unit value in 2000 is related to its change between 2000 and 2007; the second column, in turn, shows results when initial market shares are also controlled for.

When considering unit values, we can observe convergence: unit value in 2000 is negatively related to unit value growth between 2000 and 2007. Also, smaller market share was associated with smaller growth in unit values, suggesting that worse initial competitive position did hinder firms in increasing their prices (UVs). Unfortunately, these results are not robust to the inclusion of country dummies.

The next three columns show how initial values are related to the increase in market share. Larger initial share is associated with larger growth in market share. Table 15 shows that an increase in unit value between 2000 and 2007 is associated with an increase in the extensive margin, but a decrease in the quantity margin. These results are robust to the inclusion of country dummies.

Table 14.

Changes in UV-s and market shares

	DEPENDENT VARIABLE (CHANGE)				
	UV	**UV**	**Share**	**Share**	**Share**
initial UV	-0.323***	-0.295***	-0.006	-0.009	-0.012
	(0.104)	(0.103)	(0.008)	(0.008)	(0.009)
initial market share		-1.272**		0.138***	0.125**
		(0.635)		(0.049)	(0.051)
change in UV					-0.010
					(0.010)
Constant	0.438***	0.466***	0.016*	0.013*	0.018*
	(0.100)	(0.099)	(0.008)	(0.008)	(0.009)
No. of observations	65	65	65	65	65
R-squared	0.133	0.185	0.008	0.119	0.134

Notes: HS8 level. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 15.

Changes in the extensive margin (EM) and the quantity margin (X)

DEPENDENT VARIABLE (CHANGE)						
	EM	**EM**	**EM**	**X**	**X**	**X**
initial UV	0.038	0.044	0.079	0.000	-0.000	-0.015
	(0.048)	(0.048)	(0.050)	(0.011)	(0.011)	(0.010)
initial market share		-0.292	-0.143		0.035	-0.027
		(0.297)	(0.299)		(0.068)	(0.063)
change in UV			0.118**			-
			(0.058)			(0.012)
Constant	-0.022	-0.016	-0.070	0.005	0.004	0.027**
	(0.046)	(0.046)	(0.053)	(0.010)	(0.011)	(0.011)
No. of observations	65	65	65	65	65	65
R-squared	0.010	0.025	0.086	0.000	0.004	0.213

Notes: HS8 level. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

6. THE LEVEL OF UNIT LABOR COSTS IN FOUR CENTRAL-EAST-EUROPEAN COUNTRIES: SECTORAL COMPARISONS

As discussed earlier, in order to reach conclusions regarding factors affecting trade performance, not only *changes* in trade prices (unit values, UVs), but also *levels* should be considered. The same holds for unit labor cost (ULCs.) Moreover, comparing UV levels with ULC levels might highlight some driving factors, i.e., whether a higher price level is related to a higher ULC level or not. However, as we shall see, this is easier asked than answered, as unambiguous measures of *sectoral*[15] ULC levels do not exist. To be sure, comparative ULC levels for *the total economy* can be computed easily from the Eurostat, OECD statistics or the Penn World Tables. However, as all of these are built on expenditure side purchasing power parities (PPPs), they are inapt for supply side (industry level) comparisons.

In this section, we present the results of alternative calculations regarding sectoral comparative unit labor cost *level* indices (ULC*LI-s*), based on the combination of productivity level estimations of Inklaar - Timmer (2008) for the year 1997, with the EU KLEMS database for the period 1997-2007. Thus, in contrast with UV level indices, our contribution to the construction of ULC level indices is not in setting up an original database, but in calculating indicators relying on two existing datasets and in merging them to obtain time series for a period covering 10 years. This approach, naturally, has its limitations and drawbacks, which we address when discussing data issues.

We first define the concept of ULCLI, and present two approaches to decomposing ULC levels. This is followed by a discussion of the data (including the limitations of the indicators) and the statistical decomposition of ULCs for selected industries in the CEE4 countries. Finally, we review the results of our econometric analysis regarding ULCLIs, the relation between UV and ULC levels, and their influence on relative trade performance.

6.1. DEFINITIONS AND ALTERNATIVE DECOMPOSITIONS

By the term "ULC *level*" we mean the ratio of labor costs (at current prices) to the ***volume*** ("quantity") of value-added (i.e., W/VAQ, where W and VAQ, respectively, stand for nominal labor costs and the volume of value added).[16]

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[15] By „sectoral" we mean „industry level", but we wish to avid the prhase „industry-level ULC levels".
[16] For an earlier discussion of the concept of ULC levels, see Van Ark, Bart et. al. (2005).

A logical, but confusing terminology: "real" and "nominal" ULC

Several statistical sources (e.g., the Eurostat and the OECD) use the terms "nominal" and "real" ULCs. We shall avoid this terminology, but the reader should be aware of the relation between the terms used by these statistical sources and our terminology. In the Eurostat and OECD publications "nominal ULC" means the ratio of nominal labor cost to the *volume* of value added, while "real ULC" refers to the ratio of nominal labor costs to *value added measured at current price*s. The explanation for this apparently strange terminology is that the terms "nominal" and "real" apply to the numerator (W), and not to the denominator (VA) of the ratio.*/ In the following we refer to the fraction of nominal labor costs in nominal value added as "*wage share*", and use the term "ULC" only for the ratio of nominal labor costs to the volume of value added.

*/ "The division of total labour costs by nominal output is sometimes also referred to as a **real unit labour cost -** as it is equivalent to a deflated unit labour cost where the deflator used is the GDP implicit price deflator for the economic activity (i.e. sector) concerned." (OECD: Main economic indicators, Sources and Definitions)

While the interpretation and measurement of the numerator in the W/VAQ-ratio is more or less straightforward (it generally corresponds to the SNA concept of compensation of employees), the denominator, i.e., the volume of value added, cannot be observed or measured directly.[17] It can be interpreted/measured either as a magnitude expressed at prices of a reference year (in comparisons over time), or at prices of a reference country (in comparisons across countries). Equivalently, and more to the point of the present study, it may be expressed as an index number: either as a change over time at constant prices (as an ordinary volume index), or, in cross-country comparisons, as a volume level index relative to a reference country. In our empirical analysis, we rely on both interpretations: we shall combine the comparative volume level indices for a benchmark year with national volume indices over time.

The comparative unit labor cost level index (ULCLI) in year t, for industry j in country i with respect to a reference country R is defined as follows (t-s, the time indices, are skipped):

$$ULCLI_{ij/Rj} = \frac{W_{ij}/E_{i/R}}{VAQ_{ij}} \Big/ \frac{W_{Rj}}{VAQ_{Rj}} = \frac{W_{ij}/E_{i/R}}{W_{Rj}} \Big/ \frac{VAQ_{ij}}{VAQ_{Rj}}$$

where *W, VAQ and E,* respectively, indicate labor costs, the volume of value added (VA) and the exchange rate between country i and R. The first ratio is the definition of ULCLI, the second shows that it is equivalent to the ratio of relative labor costs to relative volumes of VA. *VAQ*-s for individual industries *in the benchmark year* are obtained by deflating *nominal* VA-s (*VAN*-s) by industry-specific purchasing power parities (PPP-s), i.e.,

[17] This is because VA is the difference between gross output and intermediate consumption. In contrast, the volume of gross output can be interpreted and measured directly, at least at the level of individual products (in kilograms, barrels, pieces etc.).

$$VAQ_{ij} = \frac{VAN_{ij}}{P_{ij}/P_{Rj}}$$

where $P_{ij}/P_{Rj} = PPP_{(i/R),j}$ is the PPP for industry j between country i and R. Note that *VAQ*s (similarly to magnitudes expressed at prices of a reference year) have no meaning in themselves. They serve for obtaining VAQ_{ij}/VAQ_{Rj}-s, i.e., spatial volume indices relative to the reference country R. Therefore, PPP = 1 holds for the reference country; thus $VAQ_R = VAN_R$ for all industries. A further important point relates to an empirical issue: the actual value of VAQ_{ij}/VAQ_{Rj} is ambiguous: there is no single answer to the question "how much higher or lower is the volume of value added in industry j of country i relative to the reference country?" The reason for the ambiguity – as discussed by Inklaar - Timmer (2008) – is that there are two ways of estimating *VAQ*s for the benchmark year 1997. One relies on *double deflation* (DD), whereby outputs and inputs of industries are deflated *by distinct PPPs*. The alternative approach is based on *single deflation* (SD), i.e., *VAQ* is obtained by deflating *VAN* by the *PPP of the industry's output*. Our empirical results and decompositions, based on both approaches, are discussed in section 6.3.

ULCLI can be decomposed in two meaningful ways; these reveal different channels affecting comparative unit labor cost levels. On the one hand, it can be expressed as the product of comparative wage shares and comparative price levels between countries. On the other hand, it may be decomposed as the ratio of comparative labor costs per unit of labor to comparative labor productivities. To simplify the exposition, we use the logarithms of the variables, represented by lower case letters.

$$ulcli_{ij/Rj} = [(w_{ij} - e_{i/R}) - (van_{ij} - ppp_{ij/Rj})] - (w_{Rj} - van_{Rj})$$

$$= [(w_{ij} - van_{ij}) + (ppp_{ij/Rj} - e_{i/R}) - (w_{Rj} - van_{Rj})$$

ULCLI in sector j of country i relative to the reference country is equal to (i) the wage share in country i; multiplied by (ii) the ratio of PPP to the exchange rate, and divided by (iii) the wage share in country R. The second term (PPP/E) is referred to as the *comparative price level index* (CPLI) in international comparisons of prices and quantities (see Eurostat-OECD, 2012). It shows how much higher or lower the price level is in country i relative to the reference country, expressed in a common currency.

For the alternative decomposition, both labor costs and value added need to be expressed per unit of labor input ($l_{.j}$), i.e., hours worked:

$$ulcli_{ij/Rj} = [(w_{ij} - e_{i/R} - l_{ij}) - (w_{Rj} - l_{Rj})] - [(van_{ij} - ppp_{ij/Rj} - l_{ij}) - (van_{Rj} - l_{Rj})]$$

The first term in square brackets is the relative nominal labor cost per labor input expressed in a common currency (the relative labor cost rate); the second term is relative value added at prices of the reference country per unit of labor input (relative labor productivity).

6.2. EXTRAPOLATION OF THE BENCHMARK RESULTS AND OTHER STATISTICAL ISSUES

6.2.1. Extrapolation

The formulae presented in section 6.1. refer to the benchmark year (1997), for which industry-level PPPs are available. To obtain ULCILs for the next 10 years, level-indices for the base year have to be combined with indices over time regarding changes in (i) nominal labor costs (in national currency), (ii) hours worked; (iii) volume of value added and (iv) exchange rates. The first three are available form the EU KLEMS database; annual data on exchange rates are taken from the Eurostat. In our statistical decompositions we use 5 comparative indicators: (i) W/VAN (wage share), (ii) W/L (labor costs per hour), (iii) VAQ/L (labor productivity), (iv) CPLI (=PPP/E) and (v) ULCLI (= W/VAQ). The first can be calculated from national data, and to calculate the second one, the exchange rate has to be applied; these two indicators have a single value. The next three, in turn, have multiple values, depending on whether single (SD) or double deflated (DD) indicators in the benchmark year are extrapolated (relying on indices in the EU KLEMS database).

Our approach to constructing level indices for non-benchmark years (involving volume-comparisons) is similar to that of the OECD in calculating "constant PPP" GDP/capita level indices.[18] Its major drawback is that these level indices compare fixed baskets in consecutive years; therefore, it is not suited for comparing levels in non-benchmark years. However, its merit is related to the same feature: it is most suited for level-comparisons *over time (i.e.*, clarifying whether a particular indicator displays convergence or divergence), as this approach excludes effects related to changes in composition and relative prices.

[18] For a concise explanation of comparisons at constant vs. current PPPs, see Schreyer - Koechlin (2002). See also Appendix II in Inklaar-Timmer (2008) on this matter.

6.2.2. Some additional statistical/data issues

1. *The choice of the reference country*. In the *Inklaar-Timmer (2008)* database, the reference country is the US (in the benchmark year 1997). We rebased the comparative indices so that Germany = 1, because Germany is a more relevant reference for the CEE4 than the US, and these indices yield directly comparable results with the UV levels (where exports to, and imports by, Germany serve as points of reference). The rebasing is permitted by the methodology underlying the construction of sectoral PPPs, as the latter are transitive (e.g., the relation between Germany and the US on the one hand, and the relation between Poland and the US on the other, can be carried over to the relation between Poland and Germany).[19]

2. Time series regarding *nominal magnitudes* (e.g., labor costs) of sectors are certain to be *affected by changes in composition*, while volume indices, in principle, are unaffected by these changes. This may bias ULCLIs for the period 1998-2007 (the more so, the further we get from the base year), but the direction and the magnitude of the bias is unclear.

3. *The existence of both single deflated (SD) and double deflated (DD) comparative VAQ level indices* (and derived indicators, VAQ/L, W/VAQ, CPLI) *raises a dilemma*. While indicators based on DD are conceptually superior to those relying on SD, there are several country-industry pairs, where SD-based empirical indicators are much more plausible than DD-based ones (ULCLI and productivity level indices for electrical equipment and transport equipment in Hungary are just two examples). The dilemma is in whether to leave the two types of datasets as they are, or yield to the temptation of manually assembling an intuitively more reasonable database. For the purposes of econometric analyses, only the first choice is available. This implies that the integrity of the data is maintained, but it goes with a cost: a possible loss in empirical relevance.

4. In our level-comparisons, *we rely on indicators of labor productivity (LP), rather than on total (multi-) factor productivity (TFP)*. Although the latter is more expressive of the comparative efficiency of productive factors, our primary interest relates to the comparative *costs* of production. While the calculation of ULCLIs is relatively straightforward, calculating unit total factor cost level indices involves several complications even for the benchmark year (not to speak about the difficulties of extrapolating the results to further years). Therefore, in this study we do not calculate unit total factor cost level indices.

4. Our empirical *attempt to compare domestic ULCLI and export UV level indices has several limitations*. Most importantly, ULCLIs refer to production, while UVs refer to

[19] See Inklaar-Timmer (2008) section 4.5. (p. 26)

foreign sales. The costs of production designed for foreign and domestic sales may significantly differ, and the difference may vary across industries. In addition, the UVs used in our study refer only to exports to Germany, which, again, may differ from UVs of total exports. Therefore, our results on this point are rather rough and preliminary.

6.3. ULC LEVELS AND CHANGES: AN OVERVIEW

Before analyzing more rigorously the relationship between ULCLIs on the one hand, and UVs and trade performance on the other, we first review some statistical features of our sample. These relate to (i) the level of ULCs in manufacturing, (ii) the share of manufacturing in gross value added (the share of sectors within manufacturing); and (iii) changes in ULCs and changes in the volume of value added in manufacturing (and its subsectors). In addition, we present alternative decompositions of ULCLIs, show that their changes are closely related to changes in exchange rates, and inquire whether there is a convergence in ULC levels. We do not reach a clear answer: depending on the interpretation and the context, we find evidence of both convergence and divergence. It should be remembered that – except for shares in value added and volume growth – all of the indicators reflect levels/changes relative to Germany.

6.3.1. ULCLIs, shares in value added and changes between 1997 and 2007

In what follows, some descriptive statistics are shown for manufacturing and its 10 subsectors. As a starting point, Table 16.1 relating to total manufacturing, displays (1) average shares in total GVA over 1997-2007; average ULCLIs in the same period based on double (2) and single(3) deflation; (4) the annual average change in ULC over the period; and (5) the similarly defined change in the volume of value added. In the rows below the data on individual countries, the (arithmetic) average of the CEE4, the standard deviation (SD), as well as the coefficient of variation (CV) is also shown. As it turns out, there is (i) limited dispersion in average shares; (ii) there is a larger dispersion in ULCLIs measured by double deflation than by single deflation and (iii) changes in ULCs appear to diverge to a larger extent than changes in value added. Moreover, at least at a first sight, no close relationship seems to exist between changes in ULCs and those in the volume of value added. It is to be noted that, for manufacturing as a whole, the gap between double vs. single deflated *average* ULCLIs is noteworthy only in the case of the Czech Republic and Hungary; for the other two countries the difference is negligible. This is not the case, if subsectors are also taken into consideration.

Table 16.1.

Statistics for manufacturing ULCLIs and related data in the CEE4 countries

	1	2	3	4	5
	AV share VA (%)	AV ULCLIdd	AV ULCLIsd	dULC_pa	dVAQ_pa
CZ	0,26	0,34	0,44	1,2%	6,5%
HU	0,22	0,35	0,46	3,0%	7,7%
PL	0,18	0,45	0,47	-2,1%	5,9%
SK	0,24	0,44	0,46	1,6%	8,8%
CEE4	0,23	0,39	0,46	0,9%	7,2%
SD	0,03	0,05	0,01	1,9%	1,1%
CV	0,13	0,13	0,03	2,03	0,16

Notations: AV share VA (%): average share of manufacturing in GVA between 1997 and 2007; AV ULCLIdd and AV ULCLIsd, respectively: double deflated and single deflated levels of ULC, average of 1997-2007 (Germany=1); dULC_pa: annual average change in ULC (relative to Germany) between 1997-2007; dVAQ_pa: annual average change in the volume of value added. CEE4: averages for the four countries; SD: standard deviation; CV: coefficient of variation

The next table shows sectoral details (the 10 sectors cover roughly 75-85 percent of manufacturing in the CEE4). Here the first column refers to the share of sectoral value added in manufacturing; all other indicators have the same meaning as in the table above. The figures indicate significant diversity of the five indicators among manufacturing sectors with respect to both subsectors and countries.

Table 16.2.

ULCs and related data: sectoral statistics

		AV share (%)	AV ULCLIdd	AV ULCLIsd	dULC_pa	dQ_pa
Electrical and optical equipment	CZ	11,3	0,30	0,43	1,0%	13,6%
	HU	18,8	0,20	0,30	-0,3%	17,7%
	PL	8,2	0,96	0,62	-1,4%	9,0%
	SK	9,9	0,69	0,77	6,8%	10,9%
	CEE4	12,1	0,54	0,53	1,5%	12,8%
	SD	4,1	0,31	0,18	3,1%	3,3%
Food products, beverages and tobacco	CZ	13,0	0,28	0,36	-0,7%	2,1%
	HU	13,9	0,44	0,67	5,8%	-3,1%
	PL	18,0	0,50	0,49	-5,7%	7,4%
	SK	11,6	0,20	0,32	-5,4%	11,5%
	CEE4	14,1	0,35	0,46	-1,5%	4,5%
	SD	2,4	0,12	0,13	4,7%	5,5%
Textiles, textile products, leather and footwear	CZ	5,0	0,30	0,45	-1,1%	2,4%
	HU	5,5	0,34	0,58	5,9%	-5,1%
	PL	7,0	0,19	0,37	-0,1%	-0,9%
	SK	6,6	0,73	0,84	5,8%	2,5%
	CEE4	6,0	0,39	0,56	2,6%	-0,3%
	SD	0,8	0,20	0,18	3,3%	3,1%
Wood and products of wood and cork	CZ	3,5	0,27	0,42	0,2%	7,5%
	HU	1,8	0,28	0,43	1,3%	4,4%
	PL	4,2	0,28	0,35	-2,0%	7,3%
	SK	3,9	0,45	0,45	-1,3%	16,3%
	CEE4	3,3	0,32	0,41	-0,5%	8,9%
	SD	0,9	0,08	0,04	1,3%	4,4%
Pulp, paper, paper products, printing and publishing	CZ	5,3	0,95	0,72	5,5%	3,2%
	HU	5,5	0,35	0,53	4,9%	4,8%
	PL	7,9	0,63	0,62	3,7%	4,6%
	SK	7,0	0,31	0,34	2,1%	8,0%
	CEE4	6,4	0,56	0,55	4,1%	5,2%
	SD	1,1	0,26	0,14	1,3%	1,8%
Chemicals and chemical products	CZ	5,8	0,15	0,29	4,8%	3,1%
	HU	9,7	0,65	0,73	9,9%	-1,6%
	PL	7,3	0,40	0,45	0,0%	5,7%
	SK	6,0	0,23	0,29	-0,9%	7,6%
	CEE4	7,2	0,36	0,44	3,4%	3,7%
	SD	1,6	0,19	0,18	4,3%	3,5%
Rubber and plastics products	CZ	5,4	0,19	0,35	-2,8%	16,9%
	HU	4,2	0,33	0,49	3,0%	9,7%
	PL	5,5	0,10	0,25	-2,0%	11,0%
	SK	4,3	0,42	0,42	-0,2%	15,5%
	CEE4	4,8	0,26	0,38	-0,5%	13,3%
	SD	0,6	0,12	0,09	2,3%	3,0%
Other non-metallic mineral products	CZ	7,4	0,19	0,32	1,9%	5,2%
	HU	4,5	0,36	0,46	1,7%	7,4%
	PL	6,5	0,23	0,28	-12,1%	18,9%
	SK	5,8	0,26	0,37	0,5%	9,3%
	CEE4	6,0	0,26	0,36	-2,0%	10,2%
	SD	1,1	0,06	0,07	5,8%	5,2%
Machinery, nec	CZ	6,9	0,08	0,25	-2,9%	10,5%
	HU	6,9	0,08	0,25	-2,9%	10,5%
	PL	7,7	0,66	0,56	-5,7%	8,1%
	SK	8,0	1,00	0,67	-2,4%	9,8%
	CEE4	7,4	0,46	0,43	-3,5%	9,8%
	SD	0,5	0,39	0,19	1,3%	1,0%
Transport equipment	CZ	11,5	0,25	0,35	-2,4%	14,3%
	HU	11,6	0,62	0,39	2,4%	12,7%
	PL	7,4	0,49	0,52	-4,8%	9,5%
	SK	8,8	0,25	0,36	-2,0%	18,0%
	CEE4	9,8	0,40	0,40	-1,7%	13,6%
	SD	1,8	0,16	0,07	2,6%	3,1%

Notations: the same as in the prvious table, except for the first column, where "share" refers to share in manufacturing value added.

Figure 17.a

Average shares in manufacturing value added and average ULCLIs

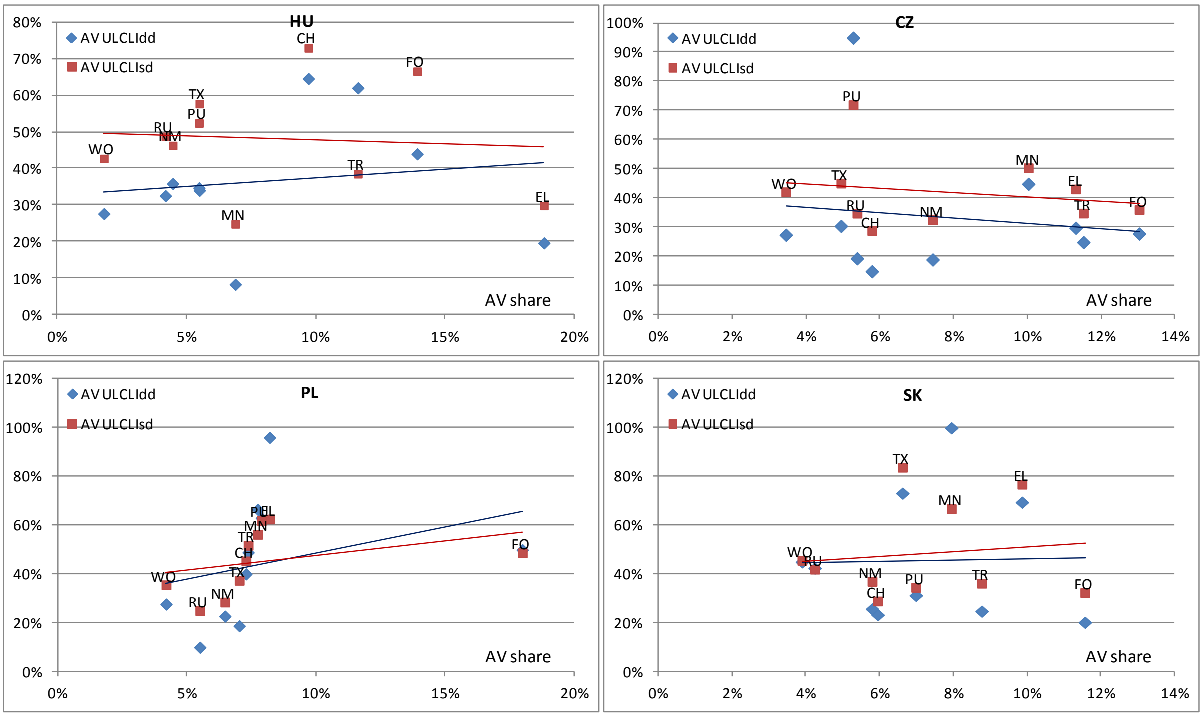
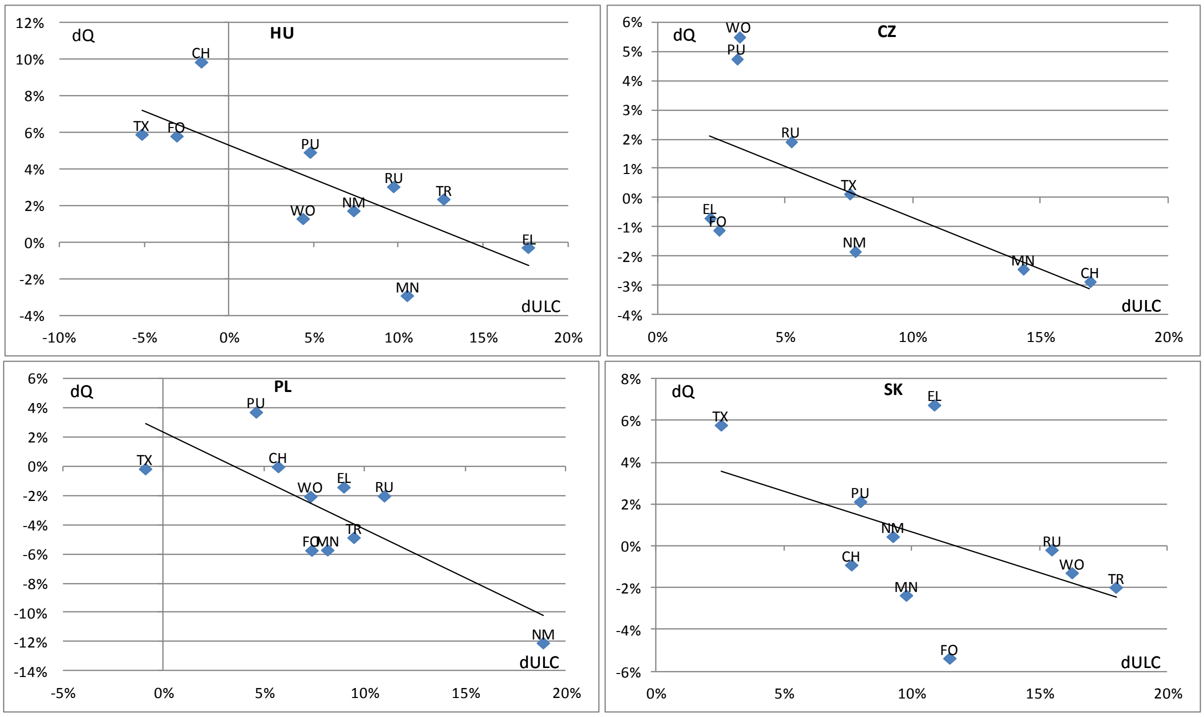


Figure 17.b

Changes in ULCs and in the volume of value added, 1997-2006



Notations: EL: Electrical and optical equipment; FO: Food products, beverages and tobacco; TX: Textiles, textile products, leather and footwear; WO: Wood and products of wood and cork; PU: Pulp, paper, paper products, printing and publishing; CH: Chemicals and chemical products; RU: Rubber and plastics products; NM: Other non-metallic mineral products; MN: Machinery, nec; TR: Transport equipment
Source: our calculations

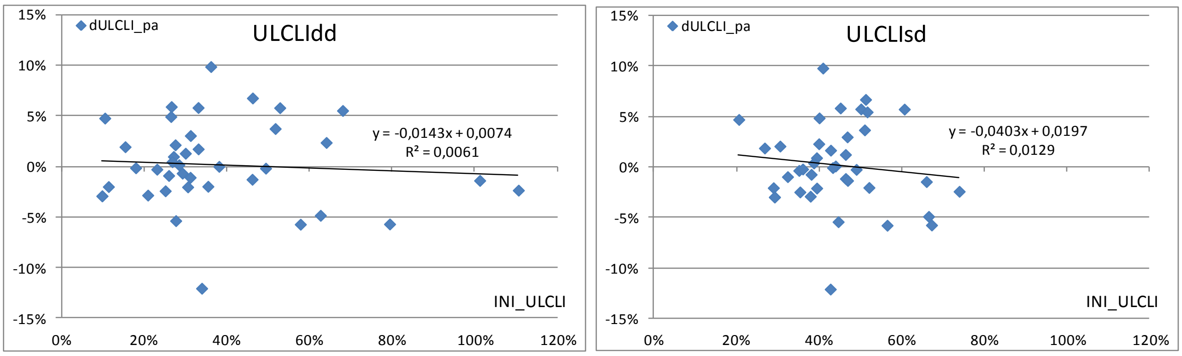
The overall impression is that CEE4 ULCLIs based on double deflation are generally lower relative to Germany than those based on single deflation, but the dispersion is larger in case of the former indicator. While we do not undertake the comparative analysis of individual sectors, we show some figures characterising the four countries and then turn to the overall picture implied by the pooled data of the CEE4.

The message of the charts above is that while no clear connection exists between shares in value added and levels of ULCs, there is a negative relationship between changes in ULCs and changes in the volume of value added in all of the countries: a lager (smaller) increase in ULC involves a smaller (larger) increase in volume. This leads to the next question: do other clear patterns emerge, if we look at the “big picture”, by considering the CEE4 as a single unit of observation? More specifically, does the pooled data indicate convergence or divergence in ULC levels? Beside changes in ULCs, what other factors may be behind changes in the volume of value added?

While double deflated ULCLIs do not indicate convergence (left pane), there seems to be some weak evidence of convergence, if single deflated ULCs are considered (right pane), but the R^2 is low and the coefficient of the initial ULCLI is not significant.

Figure 17.

Changes in ULCs vs. their initial (1997) levels, measured by double deflation (left pane) and single deflation (right pane)

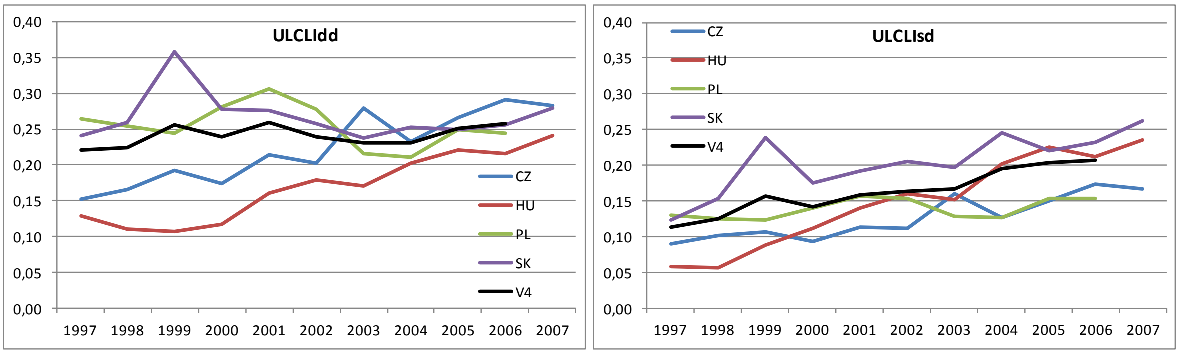


Notations: dULCLI_pa: annual average change in ULC; INI_ULC: ULCLIs in 2007
Source: own calculations

The alternative interpretation of convergence, i.e., decreasing dispersion, suggests both convergence and divergence in ULCLIs (see Figure 18). The figure below, displaying standard deviations (SDs) over time, may be read in different ways. If countries are considered separately, both the Czech Republic and Hungary display increasing divergence (by both measures of ULCLI), while the picture is less clear for Poland and Slovakia. However, if we consider the pooled observations for the four countries (CEE4), SDs for ULCLIdd-s do not show a trend, while those for ULCLIsd-s clearly do. Alternatively, if initial SDs are considered, there is a much wider dispersion across countries in ULCLIdd-s than ULCLIsd-s. Regarding the former, the dispersion decreases; for the latter it does not. Overall, there is no clear evidence of either a general convergence or divergence in ULCLIs in the CEE4.

Figure 18.

The standard deviation of ULCLIs measured by double deflation (left pane) and single deflation (right pane) in the four countries and the pooled CEE4 during 1997- 2007

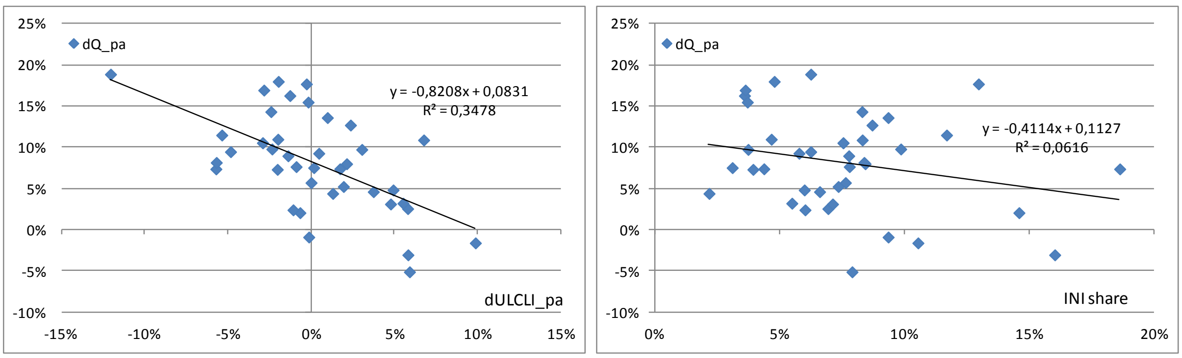


Source: own calculations

Turning to the explanation of (or, more loosely: factors related to) increases in the volume of value added (dQ), two potential factors are shown in the two sides of Figure 19. The left pane displays changes in ULCs in relation to dQs (already considered by countries in Figure 17.b), while the right pane shows the association between initial shares in manufacturing value added and changes in volumes (Q). The effect of the change in ULC, controlled for initial shares is shown in Table .

Figure 19.

The relationship between the change in the volume of value added and (i) the change in ULCLI (left pane) and (ii) the initial share in value added (right pane)



Source: own calculations

Though the sample is small, the regressions on changes in volumes reveal some significant relationships.

Table 17.

Dependent variable: change in the volume of value added (dQ)

variables	1	2	3	4	5
INI_share	-0.412				-0.478**
	(0.253)				(0.192)
AV_ulc1		-0.045			
		(0.039)			
AV_ulc2			-0.170***		
			(0.054)		
d_ULC				-0.845***	-0.871***
				(0.171)	(0.160)
Constant	0.109***	0.095***	0.155**	0.079***	0.116***
	(0.021)	(0.039)	(0.026)	(0.007)	(0.016)
R-squared	0.065	0.033	0.201	0.391	0.478
No of observations	40	40	40	40	40

Notations: INI: initial (1997); AV: average value; d: change

Most importantly, initial shares in manufacturing value added, together with changes in ULCs have a significant explanatory power of changes in the volume of value added. A higher initial share, combined with a higher increase in ULC involves a significantly lower increase in volume growth (column 5). Moreover, while the *level* of ULC1 (double deflated) appears to have no relation with dQ, the level of ULC2 (single deflated) does have: a higher average level of ULC2 involves a significantly lower increase in the volume of value added.

6.3.2. Decompositions of ULC levels and their changes

First, we amend Table 16, by showing the mean values of, and changes in, the components of ULCLIs. As discussed previously, the level (change) of ULC can be decomposed in two ways: (i) as the ratio of the wage rate (W/H) to labor productivity (LP), and (ii) as the product of the wage share (WSh) and the comparative price level index (CPLI). The value of LP and CPLI depends on whether they are calculated by single or double deflated PPPs. W/H and WSh, in turn, have a single value, as the first is converted into a common currency at the nominal exchange rate; while the second is the ratio of nominal labor costs to nominal value added, which does not involve any conversion.

Table 18.

Alternative decompositions of single and double deflated ULCLIs and their changes in manufacturing: labor cost per hour and productivity, vs. wage shares and comparative price levels [average values (AV-s) for the period 1997-2007*/ and annual percentage changes (d) during the period]

	1	2	3	4	5	6	7	8	9	10	11	12	13
	AV ULCLIdd	AV ULCLIsd	dULCpa	AV W/H	d(W/H)pa	AV LPdd	AV LPsd	dLPpa	AV WSh	dWsh pa	AV CPLIdd	AV CPLIsd	dCPLIpa
CZ	0,34	0,44	1,2%	0,13	4,6%	0,38	0,29	3,4%	0,78	1,2%	0,43	0,56	-0,1%
HU	0,35	0,46	3,0%	0,14	6,2%	0,42	0,31	3,1%	0,76	0,6%	0,46	0,61	2,4%
PL	0,45	0,47	-2,1%	0,14	3,4%	0,34	0,31	5,6%	0,82	-2,3%	0,55	0,57	0,3%
SK	0,44	0,46	1,6%	0,13	9,8%	0,30	0,29	8,1%	0,70	0,2%	0,63	0,66	1,4%
CEE4	0,39	0,46	0,9%	0,13	6,0%	0,36	0,30	5,1%	0,76	-0,1%	0,52	0,60	1,0%
SD	0,05	0,01	1,9%	0,01	2,4%	0,04	0,01	2,0%	0,04	1,3%	0,08	0,04	1,0%
CV	0,13	0,03	2,02	0,04	0,40	0,12	0,03	0,40	0,06	-14,28	0,15	0,06	0,98

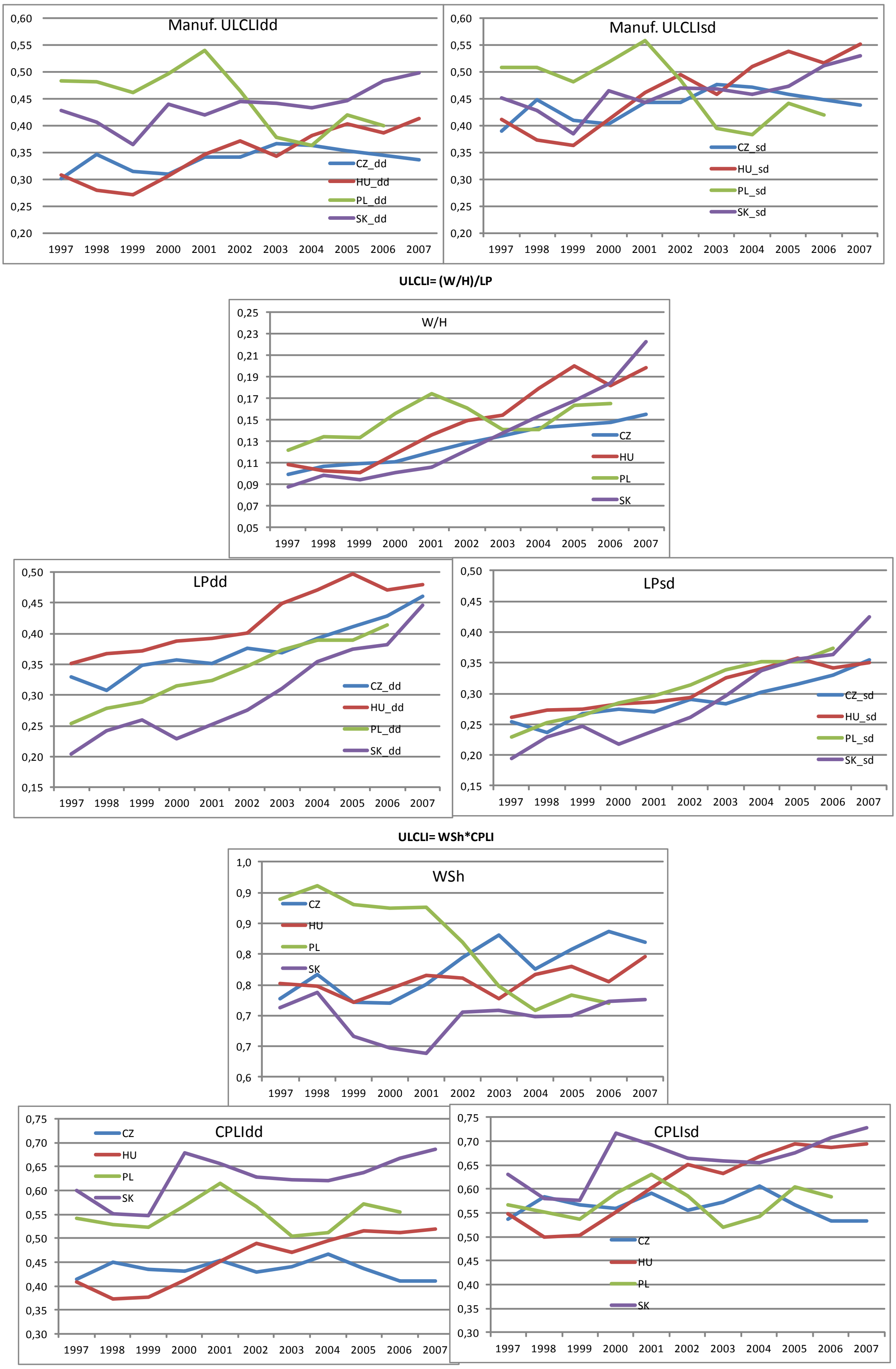
*/For Poland, 1997-2006.
Notations: LP: the volume of value added per hour, W/H: labor cost per hour (in euro), WSh: the fraction of labor cost in nominal value added, CPLI: comparative price level index; all indicators are measured relative to Germany's corresponding indicators. Indices *sd* and *dd* refer to single and double deflated values.
Regarding the *logarithms* of the variables, the following relationships hold: column (1) = (4)-(6) or (9)+(11); column(2) = (4)-(7) or (9)+(12). Regarding the *actual value* of the variables, column (3)≈(5)-(8) or (10)+(13).

Table 18 shows that the reason why average *ULCLIdd*-s were lower than *ULCLIsd*-s in the Czech Republic and Hungary is that double deflated labor productivity levels (*LPdd*-s) were much lower than single deflated ones (*LPsd*-s) in these two countries; for Poland and Slovakia there is no notable difference between the two types of indicators, while average W/H-s were practically the same. The inverse of this pattern can be observed in the case of CPLIs, while average wage shares display substantial diversity (82% for PL and 70% for SK). As for changes in the components of ULCs, country-specific experiences are rather diverse. E.g., Hungary's largest increase in ULC can be decomposed into a sizable increase in labor costs (W/H) accompanied by the lowest increase in labor productivity (LP), or into a very modest increase in wage share (WSh), associated with the largest increase in its comparative price level (CPLI). Poland's fall in ULC, in turn, can be decomposed into the lowest increase in W/H and the second highest growth in LP, or into a huge fall in WSh and a very small change in CPLI.

Developments in these indicators for the CEE4 are displayed in *Figure 19*, which reveals several country-specific developments (the fall in the wage share is especially striking in Poland), but it is not meant for detailed analysis. It rather intends to express two important points. First, each country has its own story regarding changes in ULCs, and these individual stories can be viewed quite differently, depending on which of the two decompositions (W/H and LP vs. WSh and CPLI) is considered to be more relevant from the perspective of the analysis. Second, the story of the CEE4, *as a group*, can be told in two different ways, depending on whether single or double deflated variables are used in comparison of levels. In the following, we focus at the latter question: disregarding country-specific issues, what are the common patterns shown by indicators based on double and single deflation? In this, admittedly narrow, perspective, we discuss two issues based on industry-level data: first, the relation of the average value of the two measures of ULCLIs to their components and second, whether there is convergence in the components of ULCLIs. Finally we discuss the association of exchange rate changes with changes in ULCs.

Figure 20.

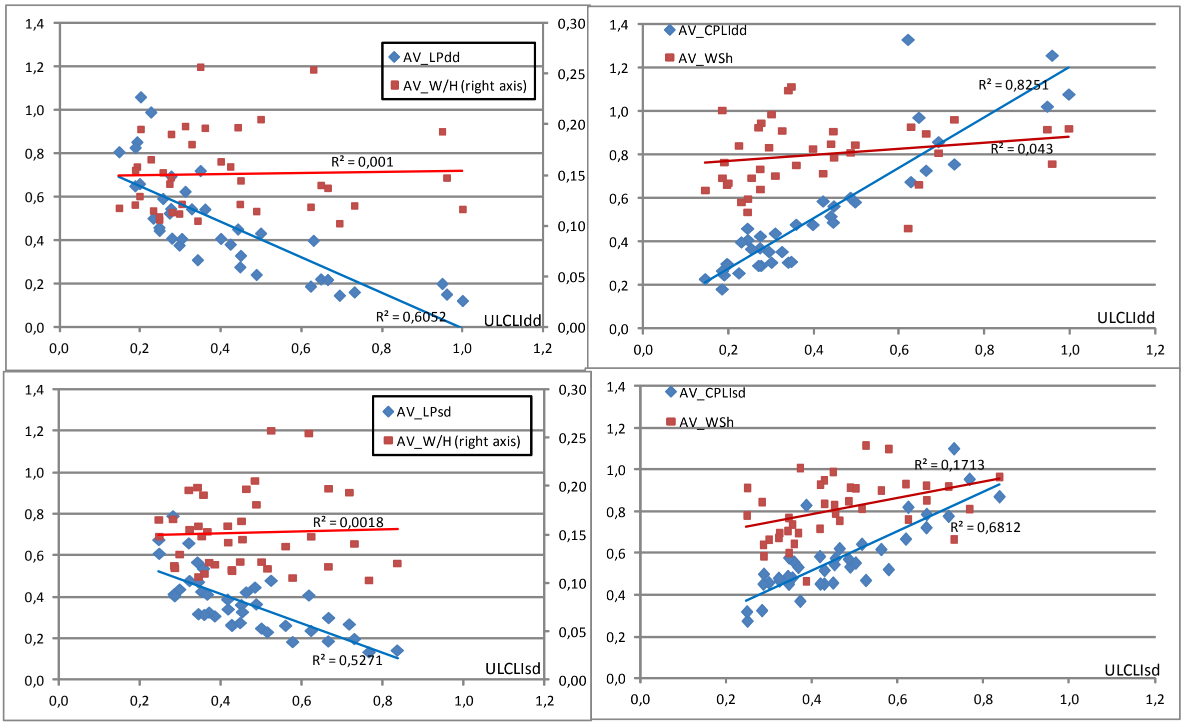
Components of double and single deflated manufacturing ULC levels



The following figure illustrates the partial correlation between the mean values of sectoral ULCLIs and their components in the pooled sample of the CEE4.

Figure 21.a.

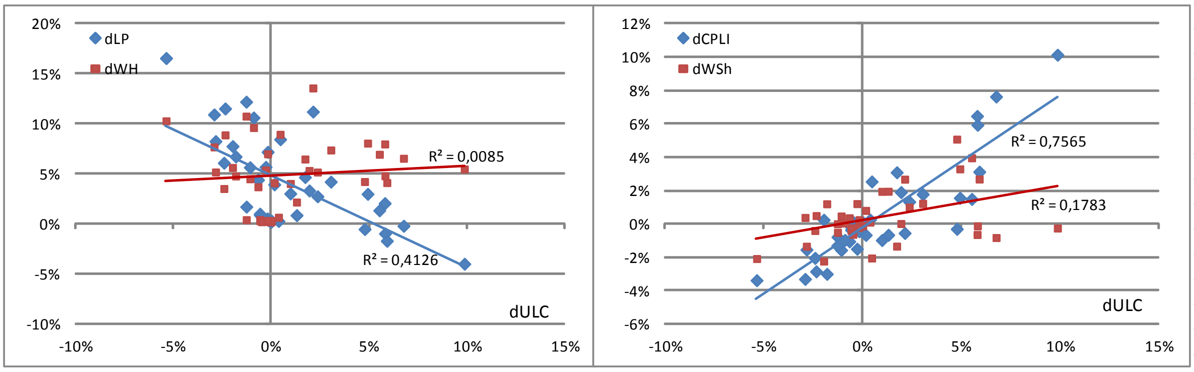
The components of double deflated (upper panes) and single deflated (lower panes) ULCLIs: labor productivity (LP) and labor costs (W/H) –left panes; vs. wage shares (Wsh) and comparative price levels (CPLI) – right panes



The figure clearly shows that while the level of labor productivity and comparative price levels are closely correlated with ULCLIs, the level of labor costs is not, and wage shares are loosely (positively) related to ULCLIs. Thus, the variance in ULC levels has much more to do with "real" magnitudes. The picture is rather similar in the case of annual average change in these indicators, as shown by Figure 21.b.

Figure 21.b.

The components of changes in ULC: annual average changes in labor LP and W/H (left pane) vs. changes in Wsh and CPLI (right pane)



Thus, according to the "big picture", sectoral and country-specific differences in labor productivities (and their changes) are hardly reflected in opposite differences (changes) in labor costs, so basically differences in labor productivities account for the differential levels/changes in ULCs. As for the alternative decomposition, the "responsibility" for the level of (change in) ULCs is shared by comparative price levels (CPLIs) and wage shares, but the former is visibly more important.

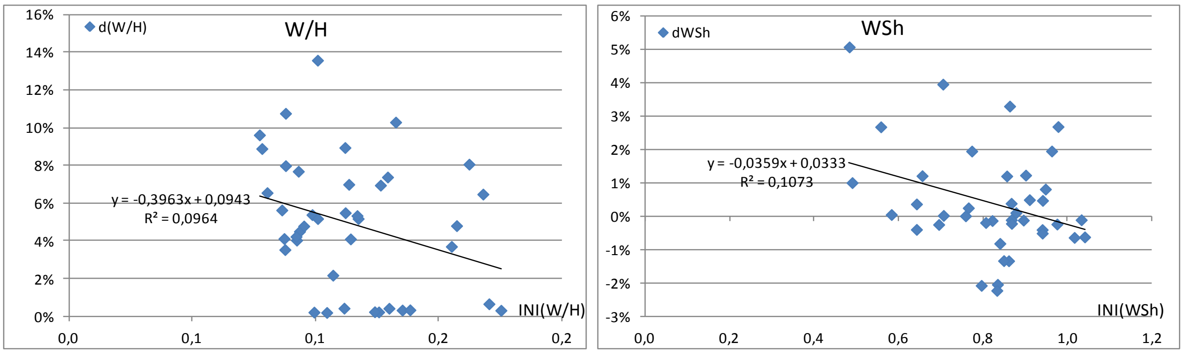
Convergence

After having clarified that ULC levels do not display convergence in the sense of a significant negative relationship between growth rates and initial levels, we now ask whether the lack of convergence (in the same sense) also applies to the components of ULCLIs. Without discussing the details, we just report our main finding: while neither labor productivities, nor comparative price levels show convergence,[20] labor costs and (W/Hs) and wage shares (WSh-s) significantly do.

[20] By regressing the growth rate on „initial" values, the coefficients of CPLIs (both definitions) are positive, while those of LPs are slightly negative, but none of the coefficients are significantly different from zero.

Figure 22.

The relation between growth rates (1997-2007)*/ and initial values: labor costs (left pane) and wage shares (right pane)



*/For Poland, 1997-2006. The coefficients of the initial values are significant in both cases at 5%.

The observation that there are signs of catching up in sectoral labor costs and wage shares, unaccompanied by signs of convergence in sectoral labor productivity and comparative price level indices, reinforces our previous account regarding the dominance of labor productivity and comparative price levels in determining ULC levels and their changes over time.

Changes in ULCs and the exchange rate

As a final point, we briefly review an important issue, neglected so far: the relationship between changes in ULCs (their components) and changes in the exchange rate. The foregoing discussion focused on longer-term issues: we considered average levels and annual average changes over time. The longer-term impact of the exchange rate was implicitly taken into account in discussing matters related to CPLIs (the ratio of PPPs to the exchange rate). However, annual changes have to be considered for clarifying the importance of exchange rate changes in explaining changes in ULCs.

Our analysis focuses on annual *changes* in total manufacturing ULC, and considers the following explanatory variables: change in the exchange rate (dER), change in labor productivity (dLP) and change in wage shares (dWSh). The latter two are the variables not directly affected by the level of (changes in) the exchange rate. The table reveals that short-term changes in the exchange rate have a powerful effect on short-term developments in ULCs. This finding is robust: it survives, if we control for changes in labor productivity or those in wage shares.

Table 17.

Dependent variable: annual changes in manufacturing ULC

	1	2	3
dE	0.841***	0.808***	0.524***
	(0.194)	(0.155)	(0.199)
dLP		-0.722***	
		(0.153)	
dWSH			0.822***
			(0.2562)
Constant	0.008	0.046***	0.0100
	(0.011)	(0.012)	(0.010)
R squared	0.336	0.589	0.484
No. of observations.	39	39	39

Notations: dE, dLP and dWS indicate, respectively: annual changes in the exchange rate, labor productivity and wage share.
Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

6.4. THE RELATIONSHIP BETWEEN ULCLIS, EXPORT UVS AND RELATIVE TRADE PERFORMANCE

6.4.1. ULCLIs and export UVs

Merging the results of the Hummels-Klenow decomposition with unit labor cost indices enables one to analyze the strength of the relationship between these two variables. As a preliminary exercise, we estimated the cross-sectional relationship at the country-industry level. In particular, we estimated the following equation:

$$P_{jk}^{DE} = \beta ULC_{jk} + \mu_j + \varepsilon_{jk}$$

where P_{jk}^{DE} is the relative unit value level calculated by the Hummels-Klenow methodology for German exports of country j and industry k, ULC_{jk} represents the unit labor cost level of the same country-industry pair while μ_j is the set of exporter dummies.

The results are reported in Table 20, for the years 2000, 2004 and 2007 together with decompositions of the UVs. The first part of the table shows the relationship between UV and ULC. In the next two parts we decompose ULC in two different ways, and include its components as explanatory variables to see whether there is a stronger relationship between the individual components and unit values. In the second part of the table, ULC is decomposed into labor productivity and the wage level, while in the third part we included the wage share and CPLI.

Table 20.

The relationship between UVs, ULCs and components of ULCs

Independent variable: ULC			
	2000	**2004**	**2007**
ULC	0.012	0.055	0.156
	(0.072)	(0.087)	(0.113)
HU	1.003***	1.063***	1.088***
	(0.046)	(0.064)	(0.092)
PL	0.767***	0.779***	
	(0.058)	(0.065)	
SK	0.845***	0.937***	0.971***
	(0.055)	(0.072)	(0.104)
CZ	0.766***	0.926***	0.988***
	(0.047)	(0.063)	(0.088)
Observations	52	52	39
R-squared	0.316	0.232	0.080
Independent variable: LP and W/H			
	2000	**2004**	**2007**
LP	-0.090	-0.057	-0.094
	(0.071)	(0.057)	(0.070)
W/H	0.458	-0.627	-0.679
	(0.613)	(0.524)	(0.622)
HU	0.995***	1.229***	1.355***
	(0.081)	(0.104)	(0.135)
PL	0.738***	0.938***	0.874***
	(0.110)	(0.098)	(0.069)
SK	0.828***	1.094***	1.293***
	(0.076)	(0.096)	(0.152)
CZ	0.758***	1.090***	1.245***
	(0.081)	(0.104)	(0.135)
Observations	52	52	39
R-squared	0.341	0.277	0.228
Independent variables: wage share and CPLI			
	2000	**2004**	**2007**
Wage share	-0.200	-0.105	-0.364
	(0.136)	(0.157)	(0.263)
CPLI	0.042	0.051	0.080
	(0.042)	(0.039)	(0.055)
HU	1.148***	1.147***	1.442***
	(0.122)	(0.152)	(0.260)
PL	0.922***	0.849***	
	(0.136)	(0.135)	
SK	0.948***	0.993***	1.253***
	(0.113)	(0.139)	(0.227)
CZ	0.894***	1.002***	1.310***
	(0.111)	(0.139)	(0.237)
Observations	52	52	39
R-squared	0.374	0.276	0.179

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

The results do not show a significant relationship in the cross section between the UVs and ULCs. The results remain insignificant, if we include industry dummies, investigate other years or use different definitions of the explanatory variables. This, however, may be a consequence of the small sample size: increasing the number of exporters or export destinations may lead to significant results.

6.4.2. ULCs and relative export performance

Finally, we aim to clarify whether there is a relationship between ULCLIs and two indicators of relative export performance: i) the change in market share (i.e., share in Germany's imports) and ii) the change in the quantity margin (i.e., volume of exports to Germany). In the regression analyses that follow, we pool all observations of the CEE4, and in contrast with the approach of the previous subsection, no country or industry dummies are used; we handle unobserved heterogeneity with the inclusion of the lagged dependent variable. This means that here we are interested in the general relation of ULCs with trade performance, rather than in country-specific features. We focus on changes of the variables between 2000 and 2006 (the latter is the last year for which data is available for all of the countries), taking their level in 2000 into account.

For explaining changes in market shares and volumes, we use their respective "initial" levels, as well as the initial level of, and changes in, ULCs. For market shares (*SH*), we estimate the following equation (volume changes are estimated analogously):

$$\Delta SH_{jk} = \alpha + \beta_1 SH_{jk}^{2000} + \beta_2 ULCLI_{jk}^{2000} + \beta_3 \Delta ULCLI_{jk} + \varepsilon_{jk}$$

Notations are the same as above, except that the upper index refers to the value of the variables in 2000. All variables are in logs, so *Δ* refers to relative changes between 2000 and 2006.

At this point it should be recalled that we have two measures for each $ULCLI_{jk}$: one based on double deflated (ULCLI1), and another one, based on single deflated (ULCLI2) industry-specific PPPs. We run regressions with both types of ULCLIs; this may help in clarifying which of the two is more relevant in explaining export performance of the four countries taken together. In addition to estimating the equation above, we shall also use the two decompositions of ULCLIs [i.e., (W/H ÷ Y/H) and (CPLI*W/Y)], with alternative values for Y/H and CPLI, corresponding to values of ULCLI1 and ULCLI2, respectively. Moreover, we also check whether this kind of specification and the omission of the exporter dummies modify our previous (negative) results regarding the effect of ULCs on export UVs. Tables 21 to23 summarize our results. (Results on the extensive margin are not significant; they are not reported here.)

The general impression one gets from the results presented in the three tables below are as follows: (1) ULC changes have *some association* with all of the three dependent variables considered, if initial values are controlled for. (2) The explanatory variables based on single deflation (ULC2 etc.) appear to explain export performance somewhat better than the (conceptually superior) double deflated values of the variables (ULC1 etc.) regarding the significance of the coefficients, but the picture is less clear, if the value of R^2, is also considered. (3) "Aggregate" ULCs seem to be more relevant explanatory variables than the two combinations of their components: even where ULCs are significant, one of the two components of ULCs is not significant.

Turning to the specific results, Table 21 shows that the change in ULC2 is positively associated with the change in UV, though the coefficient is only slightly significant. However, the initial values of both UV and ULC2 are significant and have the expected sign. This calls for a modulation of our previous result which indicated no relationship between UVs and ULCs.

Table 22 shows that initial shares and ULCs are persistent (there is no sign of convergence), however, if controlled for these initial values, an increase in ULC is negatively (and significantly) associated with the change in market share. The picture regarding the components of ULC is mixed: whenever one of them is significant, the other one is not.

Finally, Table 23 indicates that though the initial value of the quantity margin is not significant, there is a clear negative relationship between volume change and the change in ULC. It should be noted that in this case there is no particular difference in the coefficient of ULC1 and ULC2, or in their significance, while the R^2 is higher for ULC1.

Table 21.

Change in unit values and change in ULCs (and its components)

	Dependent variable: change in log UV					
Variables (logs)	1	2	3	4	5	6
INI UV	-0.281*	-0.318**	-0.252*	-0.276**	-0.273**	-0.293**
	(0.141)	(0.132)	(0.130)	(0.122)	(0.134)	(0.131)
INI ULC1	-0.137*					
	(0.073)					
INI ULC2		-0.450***				
		(0.156)				
CHANGE ULC1	0.165					
	(0.110)					
CHANGE ULC2		0.252*				
		(0.141)				
INI W/H			-1.391**	-2.015***		
			(0.530)	(0.555)		
INI LP1			0.099			
			(0.088)			
INI LP2				0.550***		
				(0.196)		
CHANGE W/H			0.707	0.530		
			(0.517)	(0.480)		
CHANGE LP1			-0.168**			
			(0.079)			
CHANGE LP2				-0.197*		
				(0.102)		
INI WAGE SH.					-0.188	-0.268*
					(0.143)	(0.140)
INI CPLI1					-0.115*	
					(0.059)	
INI CPLI2						-0.342**
						(0.136)
CHANGE WAGE SH					0.169	0.193
					(0.152)	(0.146)
CHANGE CPLI1					0.177*	
					(0.103)	
CHANGE CPLI2						0.241*
						(0.133)
Constant	0.465***	0.632***	0.518***	0.488***	0.603***	0.814***
	(0.127)	(0.141)	(0.137)	(0.129)	(0.173)	(0.200)
Observations	52	52	52	52	52	52
R-squared	0.134	0.223	0.225	0.313	0.201	0.245

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 22.

Change in market shares and change in ULCs (and its components)

	Dependent variable: change in log share					
Variables (logs)	1	2	3	4	5	6
INI share	0.049 (0.042)	0.081* (0.043)	0.108** (0.050)	0.118** (0.049)	0.059 (0.044)	0.085* (0.045)
INI ULC1	0.018*** (0.005)					
INI ULC2		0.030** (0.011)				
CHANGE ULC1	-0.028*** (0.007)					
CHANGE ULC2		-0.034*** (0.010)				
INI W/H			0.080* (0.042)	0.107** (0.046)		
INI LP1			-0.007 (0.007)			
INI LP2				-0.028* (0.016)		
CHANGE W/H			-0.043 (0.045)	-0.025 (0.044)		
CHANGE LP1			0.016** (0.006)			
CHANGE LP2				0.019** (0.008)		
INI WAGE SH.					0.007 (0.010)	0.010 (0.011)
INI CPLI1					0.013*** (0.004)	
INI CPLI2						0.024** (0.010)
CHANGE WAGE SH					-0.024** (0.011)	-0.026** (0.011)
CHANGE CPLI1					-0.024*** (0.007)	
CHANGE CPLI2						-0.026** (0.010)
Constant	-0.001 (0.003)	-0.007 (0.006)	-0.004 (0.006)	-0.003 (0.007)	-0.005 (0.009)	-0.015 (0.012)
Observations	52	52	52	52	52	52
R-squared	0.435	0.366	0.283	0.298	0.393	0.356

Standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 23.

Change in the quantity margin (volume change) and change in ULCs (and its components)

	Dependent variable: change in log quantity margin					
Variables (logs)	1	2	3	4	5	6
INI X	-0.050 (0.049)	0.004 (0.049)	0.057 (0.054)	0.064 (0.053)	-0.032 (0.051)	0.008 (0.052)
INI ULC1	0.034*** (0.008)					
INI ULC2		0.054*** (0.020)				
CHANGE ULC1	-0.040*** (0.013)					
CHANGE ULC2		-0.040** (0.018)				
INI W/H			0.165** (0.069)	0.217*** (0.074)		
INI LP1			-0.012 (0.011)			
INI LP2				-0.052* (0.026)		
CHANGE W/H			0.012 (0.074)	0.037 (0.071)		
CHANGE LP1			0.022** (0.010)			
CHANGE LP2				0.025* (0.014)		
INI WAGE SH.					0.021 (0.017)	0.026 (0.018)
INI CPLI1					0.024*** (0.007)	
INI CPLI2						0.041** (0.018)
CHANGE WAGE SH					-0.027 (0.019)	-0.030 (0.020)
CHANGE CPLI1					-0.035*** (0.013)	
CHANGE CPLI2						-0.031* (0.017)
Constant	-0.008* (0.005)	-0.020** (0.009)	-0.022** (0.010)	-0.018* (0.011)	-0.024 (0.015)	-0.040* (0.020)
Observations	52	52	52	52	52	52
R-squared	0.332	0.226	0.199	0.235	0.282	0.212

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

7. SUMMARY, CONCLUSIONS AND DIRECTIONS OF FURTHER RESEARCH

A major motivation of our study was our dissatisfaction with the general reliance on index numbers – indicating changes over time, but neglecting levels – regarding foreign trade prices, unit values (UVs) and unit labor costs (ULCs). Our point of departure was that that these indices cannot (and should not) be interpreted without having some sense on the *level* of these indicators. We pointed out that in lack of information regarding levels, it is impossible to decide whether different changes across countries involve convergence or divergence in the level of the indicators. In addition, explanations of trade performance based on changes in UVs and ULCs do not make sense without an approximate idea regarding their comparative levels.

In this respect, our study clarified and empirically demonstrated an important point: there is no unique measure of comparative levels. More specifically, average export unit values can be calculated by different weighting schemes and, even more importantly, they can be measured from data of the country of origin and destination. The two often diverge. Regarding ULCs, here again, there are two approaches to calculating levels indices, one based on double, and one relying on single deflated PPPs. The results from the two approaches often significantly differ. Having more indicators may appear to be confusing, but, in our view, it is better to have alternative measures for expressing the same economic concept than having none of them.

Regarding empirical issues, we analyzed various aspects of export performance at the German market, as well as its drivers, in four Central European countries, Poland, Hungary, Czech Republic and Slovakia (the CEE4). Using unit values (UVs) at the product level from the Comext database, both from the destination and the origin side, we compared UVs and their changes during the 2000s, emphasizing the post EU-accession period of 2005-2010. Applying the Hummels-Klenow methodology, we dissected nominal shares in German imports into margins, one of which indicates UV levels. In addition, by combining productivity level indicators for 1997 with the EU KLEMs database, we calculated unit labor cost levels and their components in the four countries relative to Germany. We merged the Comext and EU-KLEMS datasets to clarify what factors may explain UV levels, investigated the relationship between UVs and ULCs, as well as their respective impact on trade performance. We focused on a single export market and compared only four countries; this should be kept in mind when interpreting our findings.

We found that differential changes in UVs are partly explained by convergence in levels. There appears to be a negative correlation between changes in UVs and volumes at low levels of aggregation; this suggests that UVs may be considered as proxies of prices.

Moreover, there is a negative association between UV levels and market size. The relationship between the level of UVs and ULCs is ambiguous, but changes in UVs are positively correlated with changes in ULCs. The level of ULC and that of labor productivity does not show convergence, but the level of labor costs and wage shares do. We found some evidence of a negative relationship between ULC changes and trade performance, controlling for initial ULC levels.

Overall, this study shows that our approach based on the integration of data on trade UV and industry ULC levels helps understanding factors contributing to changes in UVs, as well as trade performance of countries. However, to reach more general and robust results, the approach needs to be extended to more countries and destinations (to other new EU-member countries and other, especially extra-EU, markets) and import UVs should also be taken into consideration in explaining export UVs.

Finally, we stress that our endeavor to combine foreign trade UVs with productivity and ULC level data is very much in line with the effort to create the "next generation" of the Penn World Tables (PWT). The most important prospective innovations to the PWT consist of the inclusion of comparative price levels for exports and imports, as well as including international volume comparisons from the industry side. Our study – based on similar data, albeit on a limited dataset – indicates the types of analyses that may be performed for a broader group of countries, once the next generation of PWT becomes accessible.

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APPENDIX

1. VARIABLES
Database used by the regression analysis of UVs:

- based on monthly tables of export
- aggregated to HS8 level
- destination country : Germany
- reporter countries included: Hungary, Poland, Slovakia, Czech Republic
- product categories: all hs8 categories exported in 2005 or in 2010 by a given country
- variables:
    - q2005 -- quantity exported in 2005 (100 kg)
    - v2005 -- value of exported products in 2005 (Euro)
    - uv2005 -- unit value for the given hs6 category and country in 2005 (=v2005/q2005)
    - q2010 - quantity exported in 2010 (100 kg)
    - v2010 - value of exported products in 2005 (Euro)
    - uv2010 - unit value for the given hs6 category and country in 2010 (=v2010/q2010)
    - all_2010 -- product (hs6 category) is exported by both the CEE4 countries and Austria in 2005
    - all_2005 - product (hs6 category) is exported by both the CEE4 countries and Austria in 2010
    - all - product (hs6 category) is exported by both the CEE4 countries and Austria both in 2005 and 2010 (=all_2005 + all_2010)
    - uv2005_AT -- unit value in Austria in 2005 for the given hs6 category
    - uv2010_AT - unit value in Austria in 2010 for the given hs6 category
    - total_2005_all -- aggregate value of export in 2005 in those hs6 categories for which all=1, by country
    - total_2010_all - aggregate value of export in 2010 in those hs6 categories for which all=1, by country
    - x_2005 -- value weight of the hs6 category within common (all=1) products in 2005 (=v2005/ total_2005_all)
    - x_2010 -- value weight of the hs6 category within common (all=1) products in 2010 (=v2010/ total_2010_all)
    - p_2005 -- weighted average of uv levels of common (all=1) hs6 categories in 2005 (weight: x_2005), by country
    - p_2010 -- weighted average of uv levels of common (all=1) hs6 categories in 2010 (weight: x_2010), by country
    - p_2010_2 -- weighted average of uv levels of common (all=1) hs6 categories in 2010 with 2005 weights (weight: x_2005), by country
    - d_uv -- change in uv level from 2005 to 2010
    - d_v -- change in export value from 2005 to 2010
    - sh_2005 -- market share out of CEE4 countries in 2005 (as defined below)
    - sh_2010 - market share out of CEE4 countries in 2010 (as defined below)
    - germany_import_2005 -- Germany's total imports in hs6 from all eu26 in 2005
    - germany_import_2010 -- Germany's total imports in hs6 from all eu26 in 2010

Market share: $$\mathrm{MS(H, hs)} = \frac{\mathrm{X_{H,2010}(hs)}}{\sum_{c} \mathrm{X_{c,2010}(hs)}}$$

2. SUPPLEMENTARY TABLES

Table A1.

Dependent variable: log unit value in 2005

	I. Full sample		II. Restricted sample	
VARIABLES	**Dependent variable: log unit value in 2005**			
log quantity in 2005	-0.423***	-0.423***	-0.552***	-0.553***
	(0.0393)	(0.0392)	(0.0735)	(0.0738)
log value of total import of Germany	0.320***	0.320***	0.452***	0.452***
	(0.0483)	(0.0480)	(0.114)	(0.114)
ulc2_2005	0.0482		-0.205	
	(0.268)		(0.203)	
w_h_2005		1.092		-0.759
		(1.195)		(1.983)
CZ	0.371***	0.401***	0.586***	0.577***
	(0.0853)	(0.0981)	(0.0762)	(0.0764)
SK	-0.295***	-0.273***	-0.171*	-0.192
	(0.0807)	(0.0803)	(0.0842)	(0.118)
PL	0.168**	0.182**	0.353**	0.360**
	(0.0762)	(0.0628)	(0.124)	(0.126)
Constant	1.221**	0.969	1.434	1.184
	(0.456)	(0.596)	(1.595)	(1.464)
Observations	14,978	14,978	1,808	1,808
R-squared	0.482	0.482	0.666	0.665

Notes: HS8 level. Restricted sample means sample of commonly exported goods. All regressions include industrial sector dummies (based on NACE classification). Standard errors, clustered at industry level, in parentheses. *** p < 0,01, ** p < 0,05, * p < 0,1

Table A2.

Dependent variable: log unit value in 2005

	I. Full sample				
VARIABLES	**Dependent variable: log unit value in 2005**				
log quantity in 2005	-0.526*** (0.00454)	-0.464*** (0.0046)	-0.464*** (0.0046)	-0.466*** (0.00459)	-0.466*** (0.0046)
log value of total import of Germany	0.516*** (0.00814)	0.407*** (0.00833)	0.410*** (0.00832)	0.414*** (0.00829)	0.415*** (0.00838)
market share among CEE4 countries in 2005	2.022*** (0.046)				
difference in wage share		1.602*** (0.197)			
ulc1_2005			0.430*** (0.0706)		
ulc2_2005				-0.655*** (0.0977)	
w_h_2005					-0.118 (0.44)
CZ	0.0265 (0.0447)	0.415*** (0.0464)	0.459*** (0.0463)	0.377*** (0.0476)	0.446*** (0.0483)
SK	-0.193*** (0.0531)	-0.316*** (0.0562)	-0.402*** (0.0583)	-0.282*** (0.0564)	-0.312*** (0.0571)
PL	-0.135*** (0.0443)	0.203*** (0.0464)	0.157*** (0.0466)	0.0953** (0.0483)	0.184*** (0.0469)
Constant	-0.543*** (0.136)	1.385*** (0.138)	1.170*** (0.138)	1.656*** (0.149)	1.288*** (0.151)
Observations	14,978	14,978	14,978	14,978	14,978
R-squared	0.484	0.42	0.418	0.419	0.417

Notes: HS8 level. Regressions do not include industrial sector dummies. Standard errors in parentheses. *** p < 0,01, ** p < 0,05, * p < 0,1

Table A3.

Dependent variable: log unit value in 2005

	II. Restricted sample				
VARIABLES	**Dependent variable: log unit value in 2005**				
log quantity in 2005	-0.718*** (0.01)	-0.598*** (0.0111)	-0.602*** (0.0111)	-0.596*** (0.0111)	-0.603*** (0.0111)
log value of total import of Germany	0.644*** (0.0204)	0.556*** (0.0244)	0.565*** (0.0243)	0.549*** (0.0245)	0.567*** (0.0244)
market share out of CEE4 countries in 2005	3.595*** (0.126)				
difference in wage Share		1.305*** (0.375)			
ulc1_2005			0.193 (0.138)		
ulc2_2005				-0.708*** (0.181)	
w_h_2005					-0.65 (0.834)
CZ	0.145* (0.0758)	0.651*** (0.0885)	0.658*** (0.0887)	0.605*** (0.0895)	0.640*** (0.0917)
SK	-0.158** (0.073)	-0.208** (0.0877)	-0.243*** (0.0926)	-0.165* (0.0881)	-0.211** (0.0887)
PL	0.0233 (0.075)	0.445*** (0.0885)	0.413*** (0.0896)	0.352*** (0.0906)	0.420*** (0.0897)
Constant	-0.706** (0.353)	0.478 (0.423)	0.294 (0.426)	0.979** (0.449)	0.46 (0.439)
Observations	1,808	1,808	1,808	1,808	1,808
R-squared	0.743	0.628	0.626	0.629	0.626

Notes: HS8 level. Restricted sample means sample of commonly exported goods. Regressions do not include industrial sector dummies. Standard errors in parentheses.
*** p < 0,01, ** p < 0,05, * p < 0,1

Table A4.

Two decompositions of ULCLIdd and ULCLIsd in manufacturing

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	INI_W/H	AV_W/H	d(W/H)	INI_LPdd	AV_LPdd	INI_LPsd	AV_LPsd	dLP	INI_WSh	AV_WSh	dWSh	INI_CPLIdd	AV_CPLIdd	INI_CPLIsd	AV_CPLIsd	dCPLI
CZ																
EL	0,09	0,11	4,0%	0,34	0,38	0,24	0,26	3,0%	0,77	0,84	2,0%	0,35	0,36	0,51	0,52	-1,0%
FO	0,16	0,19	3,7%	0,53	0,70	0,41	0,54	4,4%	0,64	0,64	0,4%	0,46	0,43	0,59	0,56	-1,0%
TX	0,09	0,12	4,5%	0,30	0,41	0,20	0,28	5,7%	0,94	0,99	0,5%	0,33	0,31	0,49	0,46	-1,6%
WO	0,11	0,14	4,1%	0,40	0,53	0,26	0,34	3,9%	0,95	0,93	0,8%	0,30	0,29	0,46	0,45	-0,7%
PU	0,13	0,19	7,0%	0,19	0,20	0,25	0,27	1,4%	0,70	0,92	4,0%	0,97	1,02	0,73	0,78	1,5%
CH	0,09	0,12	4,2%	0,88	0,81	0,45	0,41	-0,5%	0,48	0,64	5,1%	0,22	0,23	0,42	0,45	-0,3%
RU	0,12	0,16	5,2%	0,56	0,86	0,31	0,47	8,3%	0,86	0,77	-1,3%	0,24	0,25	0,44	0,45	-1,5%
NM	0,12	0,16	5,3%	0,76	0,83	0,44	0,48	3,3%	0,71	0,70	0,0%	0,22	0,27	0,38	0,47	1,9%
MN	0,10	0,12	4,8%	0,22	0,28	0,20	0,25	6,7%	0,86	0,91	1,2%	0,50	0,49	0,56	0,55	-3,0%
TR	0,09	0,11	3,5%	0,35	0,45	0,25	0,32	6,1%	0,64	0,60	-0,4%	0,39	0,41	0,55	0,58	-2,0%
mean	0,11	0,14	0,05	0,45	0,54	0,30	0,36	0,04	0,76	0,79	0,01	0,40	0,41	0,51	0,53	-0,01
SD	0,020	0,030	0,010	0,216	0,226	0,092	0,100	0,025	0,141	0,135	0,019	0,210	0,221	0,096	0,096	0,014
HU																
EL	0,10	0,13	5,4%	0,43	0,66	0,28	0,44	5,7%	0,66	0,66	1,2%	0,35	0,30	0,53	0,46	-1,5%
FO	0,16	0,20	4,8%	0,48	0,45	0,31	0,30	-0,9%	0,90	0,85	-0,1%	0,37	0,52	0,56	0,79	5,9%
TX	0,09	0,11	4,1%	0,33	0,31	0,19	0,18	-1,7%	0,98	1,10	2,7%	0,27	0,31	0,46	0,52	3,1%
WO	0,11	0,11	2,2%	0,36	0,41	0,23	0,27	0,9%	0,96	0,95	2,0%	0,31	0,29	0,48	0,45	-0,7%
PU	0,16	0,26	8,1%	0,61	0,72	0,41	0,48	3,0%	0,86	1,12	3,3%	0,31	0,31	0,46	0,47	1,6%
CH	0,11	0,14	5,5%	0,31	0,22	0,27	0,20	-4,0%	0,70	0,67	-0,2%	0,52	0,97	0,59	1,10	10,1%
RU	0,13	0,18	7,4%	0,41	0,55	0,28	0,37	4,2%	0,90	0,91	1,2%	0,35	0,36	0,52	0,53	1,8%
NM	0,17	0,20	6,5%	0,51	0,55	0,39	0,42	4,7%	0,85	0,75	-1,3%	0,39	0,48	0,50	0,62	3,1%
MN	0,09	0,15	7,7%	0,95	1,81	0,32	0,61	10,9%	0,87	0,91	0,4%	0,11	0,09	0,34	0,27	-3,3%
TR	0,10	0,12	5,2%	0,16	0,19	0,25	0,31	2,8%	0,49	0,46	1,0%	1,31	1,33	0,81	0,83	1,3%
mean	0,12	0,16	0,06	0,45	0,59	0,29	0,36	0,03	0,82	0,84	0,01	0,43	0,50	0,53	0,60	0,02
SD	0,029	0,046	0,017	0,203	0,440	0,063	0,126	0,040	0,146	0,194	0,013	0,308	0,355	0,116	0,227	0,036
PL																
EL	0,13	0,15	0,2%	0,12	0,15	0,19	0,24	0,4%	0,82	0,76	-0,1%	1,23	1,26	0,80	0,82	0,0%
FO	0,18	0,21	0,3%	0,30	0,44	0,31	0,45	0,9%	0,94	0,85	-0,4%	0,61	0,58	0,60	0,57	-0,2%
TX	0,10	0,12	0,2%	0,58	0,65	0,29	0,33	0,2%	1,03	1,01	-0,1%	0,17	0,18	0,35	0,37	0,1%
WO	0,12	0,15	0,2%	0,41	0,55	0,32	0,43	0,4%	0,81	0,74	-0,2%	0,38	0,37	0,49	0,48	0,0%
PU	0,17	0,25	0,7%	0,33	0,40	0,33	0,41	0,3%	0,88	0,93	0,1%	0,59	0,68	0,58	0,67	0,3%
CH	0,14	0,16	0,3%	0,36	0,41	0,31	0,36	0,3%	0,87	0,83	-0,1%	0,44	0,48	0,50	0,54	0,1%
RU	0,14	0,17	0,3%	1,22	1,72	0,48	0,68	0,5%	0,87	0,78	-0,2%	0,13	0,13	0,33	0,32	0,0%
NM	0,13	0,17	0,4%	0,38	0,99	0,30	0,79	1,7%	0,94	0,84	-0,5%	0,36	0,26	0,45	0,32	-0,8%
MN	0,11	0,14	0,4%	0,14	0,22	0,17	0,26	1,0%	0,98	0,90	-0,2%	0,81	0,73	0,69	0,62	-0,4%
TR	0,10	0,12	0,2%	0,16	0,25	0,15	0,23	0,7%	1,04	0,81	-0,6%	0,60	0,61	0,64	0,64	0,1%
mean	0,13	0,16	0,00	0,40	0,58	0,29	0,42	0,01	0,92	0,85	0,00	0,53	0,53	0,54	0,54	0,00
SD	0,024	0,039	0,001	0,304	0,444	0,092	0,176	0,004	0,078	0,078	0,002	0,306	0,314	0,140	0,155	0,003
SK																
EL	0,08	0,10	6,6%	0,17	0,15	0,16	0,14	-0,2%	0,84	0,81	-0,8%	0,55	0,86	0,61	0,95	7,6%
FO	0,13	0,20	10,3%	0,48	1,06	0,30	0,66	16,6%	0,80	0,67	-2,1%	0,35	0,30	0,56	0,48	-3,4%
TX	0,09	0,12	8,0%	0,17	0,17	0,15	0,14	2,1%	1,02	0,96	-0,6%	0,52	0,76	0,60	0,87	6,5%
WO	0,09	0,15	10,8%	0,19	0,33	0,19	0,33	12,2%	0,76	0,79	0,0%	0,61	0,57	0,62	0,57	-1,3%
PU	0,10	0,20	13,6%	0,37	0,63	0,33	0,57	11,2%	0,56	0,71	2,7%	0,49	0,44	0,55	0,49	-0,5%
CH	0,08	0,12	9,6%	0,30	0,50	0,24	0,41	10,6%	0,58	0,58	0,1%	0,44	0,40	0,55	0,50	-1,0%
RU	0,11	0,16	7,0%	0,23	0,38	0,23	0,39	7,2%	0,77	0,72	0,3%	0,65	0,59	0,64	0,58	-0,4%
NM	0,11	0,15	8,9%	0,42	0,60	0,29	0,41	8,5%	0,83	0,70	-2,0%	0,32	0,37	0,46	0,53	2,5%
MN	0,08	0,12	8,9%	0,07	0,13	0,11	0,19	11,5%	0,91	0,92	0,5%	1,22	1,08	0,81	0,72	-2,8%
TR	0,09	0,11	5,6%	0,24	0,46	0,17	0,32	7,8%	0,83	0,54	-2,2%	0,43	0,46	0,62	0,68	0,3%
mean	0,10	0,14	0,09	0,26	0,44	0,22	0,35	0,09	0,79	0,74	0,00	0,56	0,58	0,60	0,64	0,01
SD	0,017	0,033	0,022	0,120	0,269	0,071	0,164	0,047	0,130	0,128	0,014	0,241	0,235	0,085	0,157	0,035

Notations: EL: Electrical and optical equipment; FO: Food products, beverages and tobacco; TX: Textiles, textile products, leather and footwear; WO: Wood and products of wood and cork; PU: Pulp, paper, paper products, printing and publishing; CH: Chemicals and chemical products; RU: Rubber and plastics products; NM: Other non-metallic mineral products; MN: Machinery, nec; TR: Transport equipment.
W/H, LP, Wsh and CPLI refer, respectively, to labor cost per hour, labor productivity, wage share and comparative price level index. *INI*: initial (1997); *AV*: average; *d*: change.