Economics Program Working Paper Series

International Comparisons of Manufacturing Unit Labor Costs: Sources, Trends, and New Directions

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The Conference Board

January 2016

EPWP #16 - 02

THE CONFERENCE BOARD

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International Comparisons of Manufacturing Unit Labor Costs: Sources, Trends, and New Directions

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Abstract

Unit labor cost (ULC), defined as labor compensation per unit of output, is a widely used measure of international cost competitiveness. ULC trends, however, differ widely across countries and, traditionally, have been explained in terms of underlying movements in productivity, compensation, and exchange rates. This paper attempts to investigate three issues. First, it examines the availability of ULC, productivity, and compensation data used for assessing international competitiveness. Three major data sources are reviewed: The Conference Board International Labor Comparisons (ILC) program, the OECD Structural Analysis Database (STAN), and the EU KLEMS Growth and Productivity Accounts. For each source, the paper derives and compares measures of manufacturing ULCs for overlapping countries. Despite some methodological and computational differences, the three databases yield similar conclusions about changes in competitiveness over time, as well as similar rankings of competitiveness relative to the US. Second, using the ILC database, the paper presents ULC trends and levels for detailed manufacturing industries to shed light on variations in industry cost competitiveness. And, third, the paper makes a first attempt to adjust unit labor cost measures for product quality differences in export baskets between countries, using unit values of exported products. The exercise reveals that the adjusted unit labor cost in many high-income countries are lower than the original measures, thus suggesting a stronger competitiveness for these countries in the international market as they produce higher quality products vis-à-vis low-income countries.

Key Words: international, competitiveness, unit labor cost, productivity, manufacturing, industry, product quality

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1. Introduction

Since 2008, the global economy has been wracked by economic crises that have resulted in monetary and financial imbalances, weak labor markets, and political uncertainty as nations try to find the right combination of policies to return to sustainable growth. Maintaining, and increasing, international competitiveness is one path to recovery and a key driver of living standards. Competitiveness is determined by both productivity and the cost of inputs, and importantly the cost of labor because it accounts for a significant share of production cost. While there are other costs of production, labor costs dominate the cost structure in several manufacturing industries and can vary markedly across geographical locations. Competitive advantage, even from the labor cost perspective, however, is not determined by wage rates alone. What matters is the wage rate relative to productivity, or unit labor costs (ULCs). ULCs, defined as compensation costs per unit of output, are therefore a commonly used measure of international competitiveness.

This paper seeks to address three issues with regard to international competeveness in the context of internationally comparable datasets of productivity and unit labor costs. First, following a review of the literature on ULCs and their use in assessing competitiveness across countries in Section 2, the paper examines three sources of international competitiveness statistics: The Conference Board International Labor Comparisons (ILC) program, the OECD Structural Analysis Database (STAN), and the EU KLEMS Growth and Productivity Accounts. For each source, Section 3 compares the country and industry coverage and the methodology used in calculating competitiveness measures. Are available sources up to the task of assessing and explaining competitiveness? To address this, the paper derives measures of ULCs from each database and compares results for overlapping countries, including the United States, Belgium, Finland, France, Germany, Italy, the Netherlands, and Sweden.

The second part of the paper uses the ILC database to examine trends and levels of manufacturing ULCs for the selected countries plus additional countries in the database (sections 4-5). ULCs for both sector and sub-sector industries are decomposed into trends and levels of hourly compensation costs, productivity, and exchange rates to identify which industries across countries are gaining and losing competitiveness relative to the corresponding industry in the US.

The third part of the paper makes an attempt to adjust the ULCs for product quality differences within an industry across countries, using a methodology based on unit values for export products, suggested by Hausmann, Hwang, and Rodrik (2005, hereafter HHR) and extended by Minondo (2010) (Section 6). Finally, in Section 7 the paper concludes by identifying future applications and extensions of competitiveness databases for the economic research community.

2. Literature Review

The traditional view of international competitiveness focuses on the negative relationship between growth in ULCs and growth in export shares as the major factor affecting differences in competitiveness and growth across countries. However, this approach to competitiveness has long been criticized as being overly simplified. Various studies analyzing differing time periods from the 1960s to the mid-1990s have found that countries with the fastest economic growth and increases in trade flows have also experienced the fastest growth in ULCs. In the literature, this counterintuitive result is known as "Kaldor's Paradox," after Kaldor (1978), who identified a positive relationship between ULC growth and export growth in analyzing 12 countries for the period 1963 to 1975 (Fagerberg 1996 reached similar results for 1978-1994). More recent studies, however, have focused on assessing competitiveness of emerging economies such as Senegal (Mbaye and Golub 2003) and South Africa (Edwards and Golub 2004) and have found the traditional view of competitiveness to hold.

Competing findings on the impact of ULCs on export shares by Kaldor and others highlighted the importance of non-price factors as determinants of international competitiveness. A related literature, for example, focuses on the specific goods that countries produce and trade, and the implications for growth and competitiveness. As Hausmann, Hwang, and Rodrik (2005) so eloquently put it, "What you export matters." They develop a quality index for a country's export basket that reflects each product's associated level of income, measured as a weighted average of the per capita GDP of countries exporting the given product. Using this framework, the authors show that certain goods are associated with higher productivity levels than other goods and that developing capabilities in the higher value added products yields better growth performance (see Section 6 for more details). Building on this work, Hidalgo, Klinger, et al. (2007) define the "product space" where higher quality goods are situated in a dense highly interconnected core while lower quality goods are located in a sparse periphery with fewer nearby products. They argue that a country's product structure is not only determined by factor endowments (per traditional trade theory), but also by a country's ability to jump to higher quality goods that are closely related to its current export basket. Thus, to the extent that poor countries are trapped in the periphery of the product space explains their inability to catch up to rich countries at the more sophisticated core. Felipe, Kumar, and Abdon (2010) take this a step further by defining the "low product trap" and identifying specific "good" and "bad" products based on their income content and their connectivity to other products. This product quality literature recognizes the role of a country's product structure as a major determinant of international competitiveness. In Section 6 we move this forward by introducing a new method to introduce quality adjustment to our ULC measures.

A large part of the literature that focuses directly on the measurement of ULCs explains ULC growth in terms of the underlying movements in productivity, compensation, and exchange rates (Lewney, et al. 2012). A common "finding" is that relative exchange rates have a dominant influence on ULC trends in the short run. Several studies (Hooper and Vrankovich 1995; van Ark, Stuivenwold and Ypma 2005; Broeck, Guscina and Mehrez 2012) develop estimates of ULC levels for manufacturing industries to assess competitiveness at the industry level. In these analyses, a primary theme is how to convert the ULC output denominator into a common currency (often a debate between using purchasing power parities and unit value ratios). Even when the same countries are examined, level ULC estimates differ markedly across the studies and appear sensitive to the time period, data sources, measures of national price levels, and the benchmark country used.

There appears to be very little research done to explain differences in ULCs as the main driver of cost competitiveness. One exception is De Broeck, Guscina, and Mehrez (2012), who develop a measure of manufacturing industry competitiveness for Slovakia and other central and Eastern European countries. They regress relative industry-to-sector ULCs on real GDP per capita, the lagged unemployment rate, and the industry's export share, and use the model's residual to indicate deviations in industry ULCs from the manufacturing sector "norm." That is, deviations below (above) the "norm" signal that the industry is more (less) competitive relative to the sector as a whole. Further, changes in an industry's deviation from the sector norm imply changes in competitiveness over time. One limitation of the study is that it focuses on intra-country industry competitiveness and does not explicitly explain differences in competitiveness across countries. Rather, it identifies industries within countries that are becoming more or less competitive relative to the sector as a whole.

Thus, with the exception of De Broeck, Guscina, and Mehrez (2012), there is a lack of econometric analysis using ULCs as the independent variable. This means that there has been no real attempt to explain the structural determinants of ULCs, and how such structural differences across countries affect differences in international competitiveness. While an econometric analysis of this nature is beyond the scope of this paper, it begins by identifying and building upon existing sources of competitiveness indicators that will facilitate such studies.

3. Comparing Sources of International Competitiveness Statistics

The lack of internationally comparable data for economic analysis is not a new challenge. The need for a larger number of countries, additional industries, and longer historical time series can limit the comparability and reach of economic research. To address the needs of the research community, The Conference Board International Labor Comparisons (ILC) program, the OECD Structural Analysis Database (STAN), and the EU KLEMS Growth and Productivity Accounts continue to improve and expand their datasets for assessing industrial performance and competitiveness across countries. Table 1 and the following sections provide a brief overview of each dataset.

Table 1: Comparing Sources of International Competitiveness Statistics

	The Conference Board International Labor Comparisons (ILC) program	**OECD Structural Analysis (STAN) Database**	**EU KLEMS Growth and Productivity Accounts**
Countries	16	15	12
Years	1950-2014	1970-2011	1970-2012
Mfg Industries	ISIC Rev 4	ISIC Rev 4	ISIC Rev 4
subsections	9	15	9
divisions	22	22	2
Variables	value added, real (VaR) labor cost, employed (LC) hours worked, employed (HrA)	value added, volumes (VALK), compensation, employees (LABR) hours worked, employees (HRSE) hours worked, employed (HRSN)	value added, real (VA_Q05) labor cost, employed (LAB) hours worked, employed (H_EMP)
Sources	National statistical agencies: National accounts National industrial surveys/censuses		
Methodology	Estimates for self-employed (labor cost, hours worked) Employment taxes and subsidies accounted for in labor cost	Data on self-employed available to adjust to total employed concept	Estimates for self-employed (labor cost, hours worked)

Source: The Conference Board, International Labor Comparisons program, May 2015 update; OECD Structural Analysis Database, November 2012 update; EU KLEMS Growth and Productivity Accounts, 2012-2013 release

3.1 The Conference Board International Labor Comparisons Program

The Conference Board ILC program, previously a division of the US Bureau of Labor Statistics, publishes trends (indexes) of total manufacturing labor productivity and ULCs for 21 countries across North America, Europe, and Asia Pacific. Preliminary estimates of ULCs by manufacturing sub-industry are available for 16 countries.[1] Indexes for underlying series on real gross value added, total hours worked, total compensation, and total employment are also available. Time series for the total manufacturing sector begin in 1950 and are updated annually to include data through the previous year.

[1] ILC productivity and ULC series for total manufacturing cover: North America: US and Canada; Europe: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Norway, Spain, Sweden, United Kingdom; Asia Pacific: Australia, Japan, Singapore, South Korea, and Taiwan. Industry level data exclude Ireland, Australia, Singapore, South Korea, and Taiwan.

Since the 1960s, the ILC program has published productivity and ULC trends referring to the manufacturing sector only. In 2015, ILC published estimates of competitiveness indicators for 31 manufacturing industries (9 subsections and 22 divisions) based on the International Standard Industrial Classification, Revision 4 (ISIC Rev.4). As an additional extension, ILC has developed level estimates of productivity (US dollar-based) and ULCs by converting underlying data on value added to 2005 US dollars using sector specific purchasing power parities (PPPs) derived from the Groningen Growth and Development Centre (GGDC). The PPPs were estimated by combining GGDC[2] gross output relative prices for the manufacturing sector and sub-industries with corresponding exchange rates from the Penn World Tables (PWT).[3]

3.2 OECD Structural Analysis Database

The OECD STAN database includes underlying measures of output, labour input, investment, and international trade that allow users to construct indicators for assessing productivity, growth, and competitiveness. Data cover 15 OECD countries[4] and historical estimates go back to 1970. For the purpose of developing competitiveness indicators, data on real gross value added are supplemented by employment and hours worked series referring to both total employment and employees. The number of self-employed is also available. Labor cost data refer to compensation of employees only. STAN provides comprehensive coverage for the manufacturing sector under ISIC Rev.4, publishing measures for 37 manufacturing industries (15 subsections and 22 divisions).

STAN originated in the early 1990s as a resource for developing international input-output tables, for assessing technology diffusion across countries, and for general structural analyses. Indicators were initially available for manufacturing industries only, but over various iterations the database has grown to cover the whole economy and over 100 industries across all sectors. Country data are updated on a rolling basis as they become available. Further, while STAN provides measures necessary for growth accounting exercises, the database is increasingly used only for labor productivity analysis due to various methodological limitations (as discussed in O'Mahony and Timmer 2009).

3.3 EU KLEMS Growth and Productivity Accounts

The EU KLEMS database is designed for advanced growth accounting and international comparisons of the sources of output and productivity growth. The latest update of the database (2012-2013) provides output and input measures from 1970 to 2009, 2010 or 2011 for the US, Japan, and 10 countries in Europe.[5] Detailed breakouts of inputs are available for capital (K), labor (L), energy (E), material (M), and service inputs (S). For constructing competitiveness indicators, data are available on real gross value added, as well as employment, hours worked, and labor compensation referring to total employed persons. While coverage of the manufacturing sector is limited to 11 industries (9 subsections and 2 divisions), EU KLEMS provides measures for the total economy and

[2] GGDC relative prices from Inklaar and Timmer (2012).
[3] PWT exchange rates from Feenstra, Inklaar and Timmer (2013).
[4] OECD STAN covers: Austria, Belgium, Czech Republic, Denmark, Germany, Finland, France, Hungary, Italy, Netherlands, Norway, South Korea, Slovenia, Sweden, and the US.
[5] European coverage in the latest update of EU KLEMS includes: Austria, Belgium, Finland, France, Germany, Italy, Netherlands, Spain, Sweden, and the United Kingdom. EU KLEMS offers additional country coverage in the earlier ISIC Rev.3 version of the database (2008) with data up to 2005 (www.euklems.net).

47 distinct sector and industry groupings under ISIC Rev.4. A defining characteristic of EU KLEMS is that it is based on growth accounting methodology that is rooted in neo-classical production theory (O'Mahony and Timmer 2009). The underlying theoretical framework yields productivity and growth indicators that are consistent across countries and industries, thus enhancing the international comparability of calculated measures. Database updates occur on an ad hoc basis (generally every two or three years) and are dependent on special funding grants by the European Commission.

3.4 Comparing ILC, STAN, and EU KLEMS

All three databases—ILC, STAN, and EU KLEMS—offer indicators for assessing industrial performance and competitiveness across countries. While ILC focuses directly on measures of competitiveness, STAN and EU KLEMS also provide variables required for growth accounting (including gross output, intermediate inputs, and capital). With minor differences, however, the country, industry, and historical coverage are consistent across all three. Countries included are predominantly mature European economies, with US data also available to make key comparisons. While two of three sources include Japan and South Korea, other parts of Asia, and Latin America in its entirety, are missing. All three databases have converted industry estimates to an ISIC Rev.4 basis and provide industry breakdowns for the manufacturing sector. STAN offers by far the most industry detail, while EU KLEMS publishes only highly aggregated manufacturing industries (subsections).[6] ILC provides the longest historical time series back to 1950 for the manufacturing sector. Even within databases, however, coverage differs across countries, industries, and variables due to data limitations.

3.4.1 Methodological Comparison

The sources and methodology used in constructing the databases are also consistent and conform to international standards in this area. Underlying data are predominantly obtained from the National Accounts programs of national statistical agencies. The majority of countries included follow guidelines of the System of National Accounts (SNA08), or its European equivalent (ESA2010), which ensures conceptual harmonization of basic data series. Other official government sources, such as establishment or labor force surveys, are used when series are not available from national accounts. These alternative data sources are often used to fill missing industry detail or other gaps. Longer historical time series are frequently constructed by linking series based on different vintages of national accounts or different industrial classification systems. Further, in the latest version of EU KLEMS, data on output, value added and employment are made fully consistent with corresponding series in STAN.

ILC and EU KLEMS make additional adjustments to labor compensation data from national accounts, which refer to employees only. The compensation of self-employed persons is not captured as labor income in national accounts, but rather grouped as "other income" (van Ark, Stuivenwold, and Ypma 2005). ILC and EU KLEMS therefore estimate total labor compensation by assuming that the average compensation of the self-employed equals that of employees. When other variables for the self-employed are missing (e.g. hours worked) a similar approach is followed where average characteristics of employees are applied to the self-employed. While labor compensation series available in STAN refer to employees only, an adjustment could be made using other variables in the database and similar assumptions.

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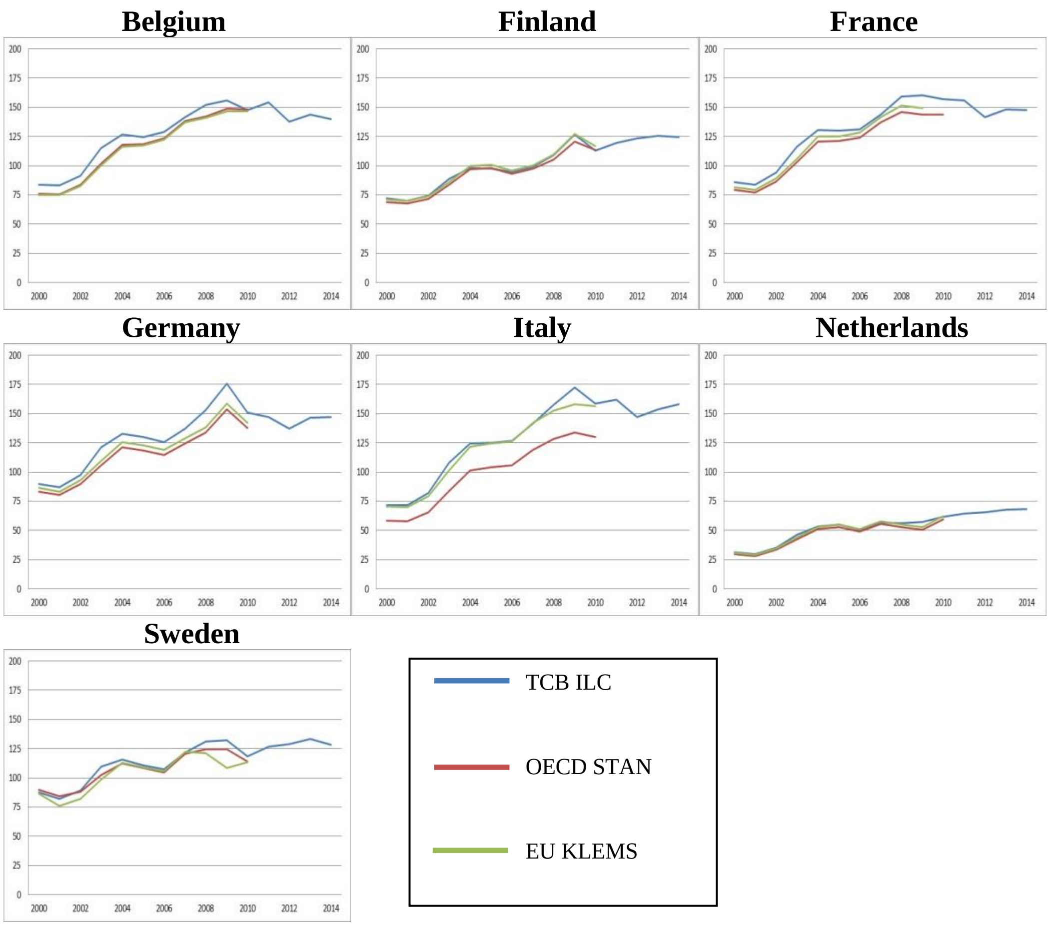
[6] EU KLEMS offers more detailed industry breakouts for manufacturing and other sectors in the earlier ISIC Rev.3 version of the database (2008) with data up to 2005.

3.4.2 Empirical Comparison

For assessments of competitiveness, the ILC, STAN, and EU KLEMS databases contain the variables needed to construct estimates of ULCs and related measures of labor productivity and hourly compensation costs. Figure 1 presents manufacturing ULC levels relative to the US calculated from each source by dividing labor compensation by real value added. Compensation is converted to US dollars using market exchange rates from the International Monetary Fund (IMF) and value added is converted to 2005 US dollars using derived PPPs from the GGDC, as described previously. Countries selected—Belgium, Finland, France, Germany, Italy, the Netherlands, and Sweden—are those with overlapping coverage across all three databases and with conversion factors available from the IMF and GGDC.

Figure 1: Manufacturing unit labor costs relative to the United States (US=100), 2000-2014



Note: Productivity converted at manufacturing level PPP; compensation at nominal exchange rate

Source: The Conference Board, International Labor Comparisons program, May 2015 update; OECD Structural Analysis Database, November 2012 update; EU KLEMS Growth and Productivity Accounts, 2012-2013 release; calculations by The Conference Board

As shown in Figure 1, the three databases of competitiveness measures yield similar trends in ULCs but different levels. Common trends are partially the result of a common source of exchange rate data for converting compensation to US dollars. Similar levels for STAN and EU KLEMS are also expected due to the use of identical series for value added. Any remaining differences between these two sources are the result of differences in the coverage of compensation series. As mentioned earlier, the published STAN labor compensation variable refers to employees only; no adjustment for the self-employed is made. In Figure 1, the STAN-EU KLEMS gap for each country thus primarily reflects the magnitude of the adjustment for the self-employed. The gap is widest for Italy, where the incidence of self-employment in manufacturing is quite large.

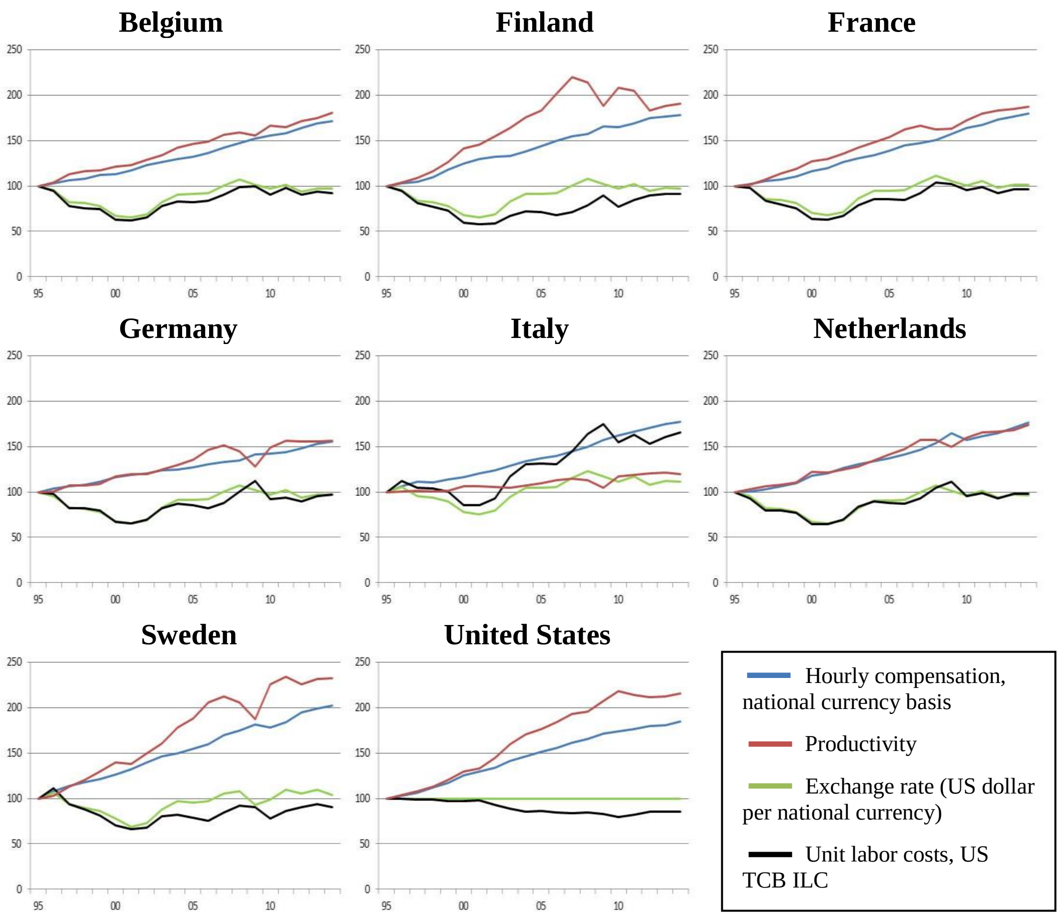
The ILC database yields the highest ULC levels for all countries shown. These consistently higher results are likely due to a combination of factors, such as differences in the vintage of national accounts data used and technical discrepancies in the way gaps for the self-employed, hours worked, or other missing variables are filled.

Overall, trends in ULCs constructed using ILC, STAN, and EU KLEMS indicators are largely consistent whereas some deviations in ULC levels can be explained by methodological or computational differences. All three databases contain the fundamental tools for international comparisons of manufacturing competitiveness and would yield similar conclusions about changes in competitiveness over time, as well as similar rankings of competitiveness relative to the US.

4. Comparing ILC Unit Labor Cost Trends

This and the following section employ the ILC database to further assess trends and levels of manufacturing ULCs, both for the sector as a whole and for its sub-industries. Although ULCs are defined as total compensation per unit of output, they can also be expressed as hourly compensation (converted to US dollars using nominal exchange rates) divided by labor productivity. This relationship emphasizes that competitiveness is not only determined by wage rates, but also by the relative productivity of a country's workforce. As exchange rates are used to convert compensation to a common currency, ULC trends are also substantially affected by exchange rate fluctuations.

Figure 2: Manufacturing unit labor cost trends decomposed (1995=100), 1995-2014



Source: The Conference Board, International Labor Comparisons program, International Comparisons of Manufacturing Productivity and Unit Labor Cost Trends, May 2015 update

In Figure 2, manufacturing ULC trends constructed from the ILC database are decomposed into underlying trends in hourly compensation (total compensation per hour worked), labor productivity (value added per hour worked), and exchange rates (US dollar per national currency unit). Trends (1995=100) are presented for the US and seven European economies for the period 1995 to 2014. Increases in ULCs (black line) represent declines in manufacturing competitiveness. As shown in Figure 2, after several years of decreasing ULCs through the late 1990s, the trend reversed beginning in the new millennium and competitiveness across the European economies shown above began to deteriorate. In Belgium, France, and the Netherlands, where increases in compensation (blue line) were predominantly offset by increases in productivity (red line), rising ULCs were driven by the appreciation of the Euro. ULC trends are nearly identical to exchange rate trends for Belgium, France, and the Netherlands, but the strong link between exchange rates (green line) and ULCs denominated in US dollars (black line) is visible for all countries compared. In Finland, Germany, and Sweden, productivity growth outpaced compensation growth for most of the period and muted increases in ULCs, despite national currency appreciations after 2000. In 2008 and 2009, in the wake of the global economic and financial crisis, productivity declined suddenly for all countries shown and resulted in a temporary spike in ULCs. In Italy, compensation growth outpaced gains in productivity and, coupled with the appreciation of the Euro, led to large increases in ULCs after bottoming out in the early 2000s. In the United States, the growing gap between productivity and labor income continued to drive down manufacturing ULCs.

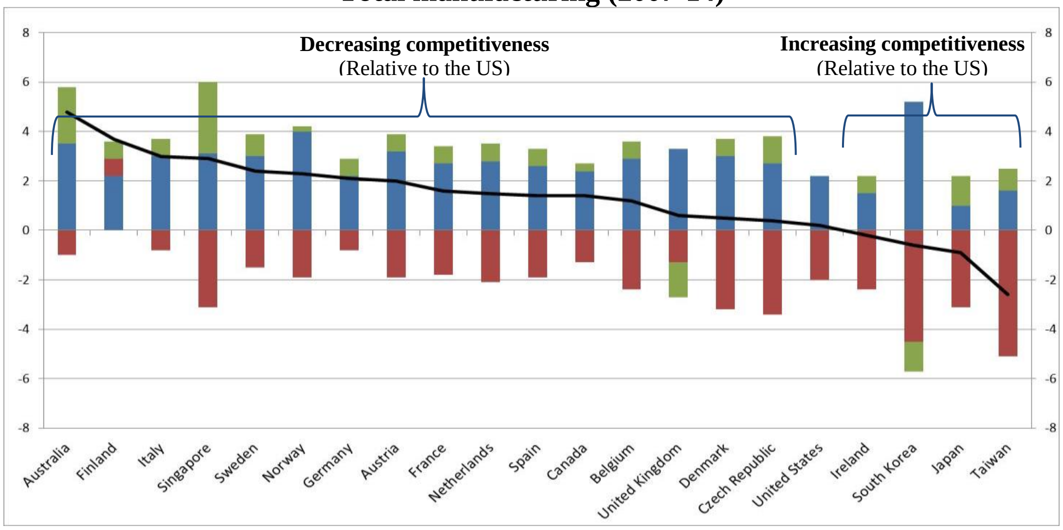
A similar ULC trend decomposition can be done for manufacturing sub-industries. Figure 3 presents the average annual growth rate of ULCs for both the manufacturing sector and for select manufacturing industries. Similar to Figure 2, growth in ULCs (black line) is decomposed into the underlying growth in hourly compensation (blue bars), labor productivity (red bars), and exchange rates (green bars). But in contrast to Figure 2, Figure 3 charts the *inverse* of productivity growth so that increases in productivity are reflected below the zero axis. Thus, bars *above* the zero line contribute to *increases* in in ULCs, while bars *below* the zero line contribute to *decreases* in ULCs. ULC growth (black line) is equal to the difference between the bars above and below the zero axis.

On average during 2007-2014, ULCs in total US manufacturing increased only slightly (0.2 percent). In Figure 3, all countries to the right of the US (Ireland, South Korea, Japan, and Taiwan) saw declines in ULCs over the period and thus experienced increasing manufacturing competitiveness relative to the US. In contrast, countries to the left of the US had larger increases in ULCs and thus experienced decreasing manufacturing competitiveness. Generally, for a country where manufacturing competitiveness deteriorated, increases in productivity (red bars below zero) were outpaced by increases in compensation (blue bars). In some cases, such as Singapore and Australia, large currency appreciations exacerbated ULC growth. Finland was the only country compared that experienced declines in manufacturing productivity (red bars above zero) and, coupled with modest growth in compensation, resulted in substantial ULC increases.

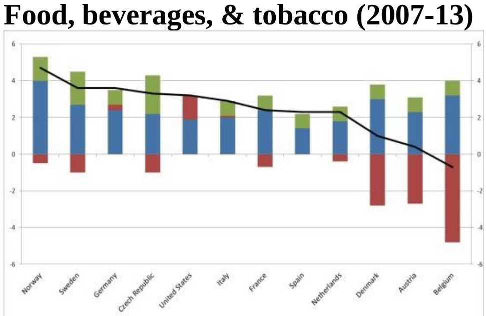
For countries that gained a competitive edge in manufacturing compared to the US, high productivity growth during 2007-2014 drove ULCs down. In South Korea, compensation growth was overshadowed by both increases in productivity and large national currency depreciations.

Figure 3: Unit labor cost trends decomposed, average annual percent change

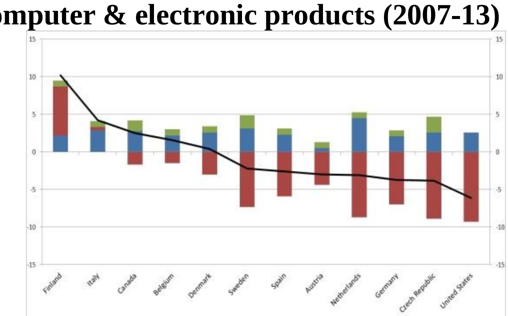
Total manufacturing (2007-14)



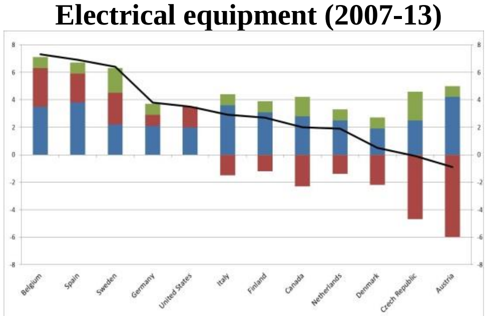
Food, beverages, & tobacco (2007-13)



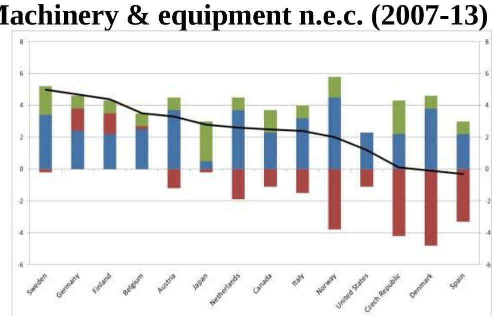
Computer & electronic products (2007-13)



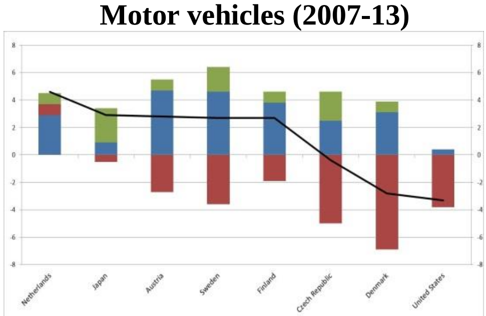
Electrical equipment (2007-13)



Machinery & equipment n.e.c. (2007-13)



Motor vehicles (2007-13)



Hourly compensation, national currency basis, percent change

Inverse of productivity percent change

Exchange rate percent change (US dollar per national currency)

Unit labor costs percent change, US dollar basis

Source: The Conference Board, International Labor Comparisons program, International Comparisons of Manufacturing Productivity and Unit Labor Cost Trends, May 2015

Similar competitiveness analyses can be done for sub-industries within manufacturing. Figure 3 presents ULC growth decompositions for five manufacturing industries. Average annual growth rates of industry ULCs, hourly compensation, labor productivity, and exchange rates refer to the period 2007-2013. During the period, US ULCs increased in food beverages and tobacco manufacturing and electrical equipment manufacturing due to declines in productivity coupled with compensation increases. However, US ULCs decreased in computer and electronics and motor vehicle manufacturing as a result of modest to large productivity gains. Declines in US ULCs in these industries were the largest of all countries compared such that most economies lost competitive ground in these areas. In contrast, US competitiveness deteriorated in food beverages and tobacco and electronic equipment manufacturing when compared to several Euro Area countries. In machinery and equipment manufacturing, the US only lost ground against the Czech Republic, Denmark, and Spain, where large increases in productivity, despite modest compensation growth, lowered overall unit labor costs compared to the US.

5. Comparing ILC Unit Labor Cost Levels

The most competitive economies not only improve competitiveness over time, but also operate at relatively low cost levels. Figure 4 presents ILC estimates of manufacturing ULC levels relative to the US (US=100). Sector estimates refer to 2014, while data for select industries refer to 2013. As in Figure 1 above, compensation is converted to US dollars using IMF market exchange rates and value added is converted to 2013 US dollars using derived manufacturing PPPs from the Groningen Growth and Development Center (GGDC).

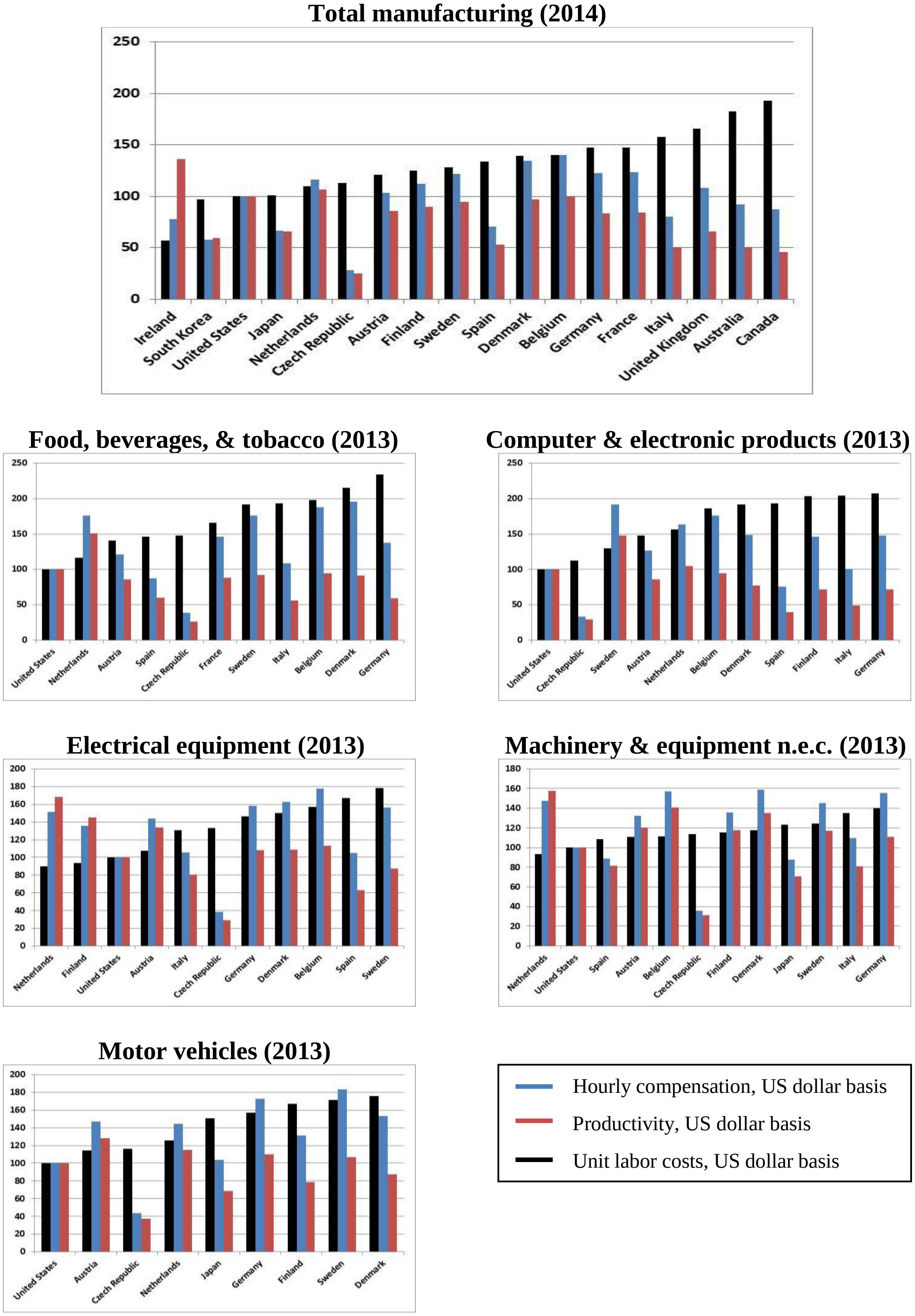
On the whole, European manufacturing is generally less competitive on costs compared to American manufacturing. While hourly compensation costs across Europe varied for each country, low labor productivity rates drove ULCs above the US level. Ireland, however, was the only European economy to have lower unit labor costs levels than the US. Overall, Irish manufacturing was also the most competitive relative to US manufacturing: Ireland experienced a decrease in ULCs over the 2007-2014 period, and ULC levels over 40 percent lower than US levels in 2014.

Outside of Europe, Japan, which experienced a modest increase in competitiveness during 2007-2014, remained more competitive in 2014 than the largest economies in the Euro Area. South Korea was the more competitive against US manufacturing with large labor cost and labor productivity growth, yet its overall unit labor costs level was less than the US. In Australia and Canada, hourly compensation was also lower than in the US, but productivity in these countries was more than proportionally lower, resulting in ULC levels nearly twice those of the US.

Extending the analysis to manufacturing sub-industries reveals that, in 2013, the US was most competitive in food beverages and tobacco, computer and electronic products, and motor vehicle manufacturing (Figure 4). However, in electrical equipment manufacturing, where the US saw an increase in unit labor costs in the 2007-2013 time period, the unit labor costs level was lower in the Netherlands and Finland. Unit labor costs in US machinery manufacturing similarly grew during the 2007-2013 period and by 2013 the corresponding Dutch industry was more competitive given a lower unit labor costs level. In contrast, the recent growth in unit labor costs for food beverage and tobacco manufacturing did not affect US competiveness as the US still had the lowest level compared to all other countries.

The international comparisons of manufacturing ULC trends and levels at both the sector and industry levels suggest that comprehensive assessments of country competitiveness should include both directional and absolute indicators of competitiveness. In other words, it is insightful to know how does competitiveness evolve over time and how do absolute unit labor costs compare across countries at any given point in time.

Figure 4: Unit labor costs relative to the United States (US=100)



Note: Productivity converted at manufacturing level PPP from the Groningen Growth and Development Centre; compensation at nominal exchange rate

Source: The Conference Board, International Labor Comparisons program, May 2015

6. Adjusting Unit Labor Cost for Product Quality

Measures of competitiveness, such as ULCs are of great importance to understand how competitive a country is in the international market. The traditional view of ULC analysis assumes negative effects of rising labor cost and a positive impact from productivity growth on competitiveness. However, as discussed in Section 2, Kaldor's paradox suggests that rising labor costs can be associated with rising exports shares, and thus would indicate that economic growth is not always slowed by rising labor costs. One factor that can help firms acquire higher market share even with high labor cost is higher quality of products for which they can charge higher prices. There is ample evidence that not all products are created equally when it comes to their impact influencing economic growth. Most of the existing literature on product quality focuses on how export and market shares influence economic growth. For example, Hausmann, Hwang, and Rodrik (HHR 2005) show that countries that specialized in higher productivity goods, relative to their per capita income level, experienced faster economic growth due to the "cost discover" effect. Growth occurs when entrepreneurs "discover" those higher productivity goods and as more resources are devoted to those goods.

In this section we aim to refine ULC measures by adjusting the productivity measure to better reflect the quality of those products which are part of industry output destined for exports. The productivity of the latter could be significantly different or even biased relative to the productivity of all products produced in a country. To do this we seek an adjustment factor to the original productivity measures in the ULC equations to take account of different export baskets between countries.

6.1 Methodology for Product Quality

Following Hausmann, Hwang, and Rodrik (2005, hereafter HHR) we first develop an export productivity measure for each country, assuming that if a product is exported from a country with a relatively high per capita income, that product will have a relatively high productivity compared to a product which is mostly exported from a country with a low per capita income. HHR develop such a measure of implied productivity for any given export product *i* ($\boldsymbol{PRODY_i}$), defined as a weighted average of GDP per capita of all countries *j* producing product *i*, with the weights being the revealed comparative advantages for product *i* in each country *j* relative to the aggregated revealed comparative advantages of all countries *j*:

$$\boldsymbol{PRODY_i} = \sum_j \left[\frac{\left(\frac{x_{i,j}}{\sum_i x_{i,j}} \right)}{\sum_j \left(\frac{x_{i,j}}{\sum_i x_{i,j}} \right)} \right] \boldsymbol{Y_j} \qquad \textbf{(1)}$$

where $\boldsymbol{X_{i,j}}$ is the export of product *i* from country *j*, $\sum_i \boldsymbol{X_{i,j}}$ is the total exports (of all commodities) from country *j*, and $\boldsymbol{Y_j}$ is the per capita GDP in country *j*. The use of RCA ensures that the per capita income of countries with a relatively strong representation in a specific product receive a higher weight.

Next, one can obtain an aggregate measure of productivity for all exports from country j ($\boldsymbol{EXPY_j}$) by taking all $\boldsymbol{PRODY_i}$'s of that country weighted by the share of export value of each product *i* in total exports from country *j*, i.e.

$$EXPY_j = \sum_i \left(\frac{X_{i,j}}{\sum_i X_{i,j}}\right) PRODY_i \qquad \textbf{(2)}$$

The weight in (2), $\frac{X_{i,j}}{\sum_i X_{i,j}}$, the same as the numerator of the weight in equation (1). representing the export of all products from country j. $EXPY_j$ is therefore a measure of productivity level for country j' exports for all products.

Equation (2) provides the productivity of a country's aggregate export basket regardless of the quality of products it exports. Since our objective is to adjust for quality differences in exported products across countries, we need to measure the quality adjusted export productivity for each country. In obtaining this adjustment factor to our original productivity measure, we follow Minondo (2010) by taking into account the fact that each country *j* may produce different quality levels of product *i*. If a country is exporting higher productivity exports, it is likely that a typical export product *i* is characterized by higher unit values reflecting higher quality relative to the same product being exported from a country producing low productivity exports.

Minondo (2010) introduced the quality adjustment by dividing an export product into Low quality (33 percentile and below the average unit value of product *i* across all countries), Middle quality (34 percentile to 66 percentile) and High quality (67 percentile and above). This allows for the construction of three measures of implied productivity for each product ($PRODY_{i,q}$, where q=1, 2, 3) to determine to what product quality each country's product *i* belongs:

$$PRODY_{i,q} = \sum_j \left[\frac{\left(\frac{X_{i,j,q}}{\sum_{i,q} X_{i,j,q}}\right)}{\sum_j \left(\frac{X_{i,j,q}}{\sum_i X_{i,j,q}}\right)}\right] Y_j \qquad \textbf{(3)}$$

Again, the weights correspond to the revealed comparative advantage of country *j* for any given product *i*, but now further identified as quality category *q*. Next, the quality adjusted export productivity of country *j* is defined as the sum of productivity of different quality goods the country exports, weighted by that product's export share in the overall export basket of country j.

$$EXPY_j^Q = \sum_i \left(\frac{X_{i,j}}{\sum_i X_{i,j}}\right) PRODY_{i,q} \qquad \textbf{(4)}$$

This allows us to create a new quality adjusted EXPY^Q (4), which represents the productivity level of a country's exports that has been adjusted for difference in product quality.

In the current version of the paper, we apply the abovementioned methodology to industry data, where we obtain measures of PRODY (both adjusted and unadjusted for quality) for 2-digit ISIC revision 4 industries. Therefore, in our empirical implementation of equations (1) through (4), *i* represents 2-digit industries rather than products.[7] Also, since the data in the ILC productivity database is confined only to the manufacturing sector, we consider only manufacturing exports. This implies that in the measurement of both PRODY and EXPY, total exports is the total exports of manufacturing goods only.

6.2 Data sources for product quality adjustment

For adjusting our unit labor cost for the productivity of exports, we constructed the export productivity indicator based on the methodology introduced by Hausmann, Hwang, and Rodrik (equation 2) and the quality adjusted productivity based on Minondo (equation 4). In order to create these series we collected import and export data from Eurostat's COMEXT database from 2002-2014. This contained export and import value (measured in Euros) and volume (measured in kilograms) for all 28 member countries and for trade within the European Union, outside of the European Union, and to the US. In order to maintain consistency in our data source we utilized EU imports from the US as a proxy for US exports. We created a concordance that mapped the 2-digit SITC product code to the 2-letter ISIC Rev 4 manufacturing sectors. This allowed us to aggregate the export data into the manufacturing sectors and total manufacturing, thus calculate all exports for a country that were related to manufacturing. To differentiate for quality, as in Minondo, we use unit values (value/volume) as a proxy for product quality. After calculating unit values, and removing all values above the 99 percentile and below the 1 percentile to reduce the impact of measurement error, we calculated the average unit value from 2002-2014. These are then reclassified as Low quality (33 percentile and below the unit value ratios), Middle quality (34 percentile to 66 percentile) and High quality (67 percentile and above), to construct $\boldsymbol{PRODY_{i,q}}$, as described in equation (3).

6.3 Results for product quality adjustment

Since our objective is to obtain unit labor cost adjusted for quality differences in productivity we calculate the ratio between the EXPY series and the EXPY^Q series for each country and each year for a given industry k to create a "product quality" adjustment factor Q_j.[8]

$$Q_j = \boldsymbol{EXPY_j^Q / EXPY_j}$$

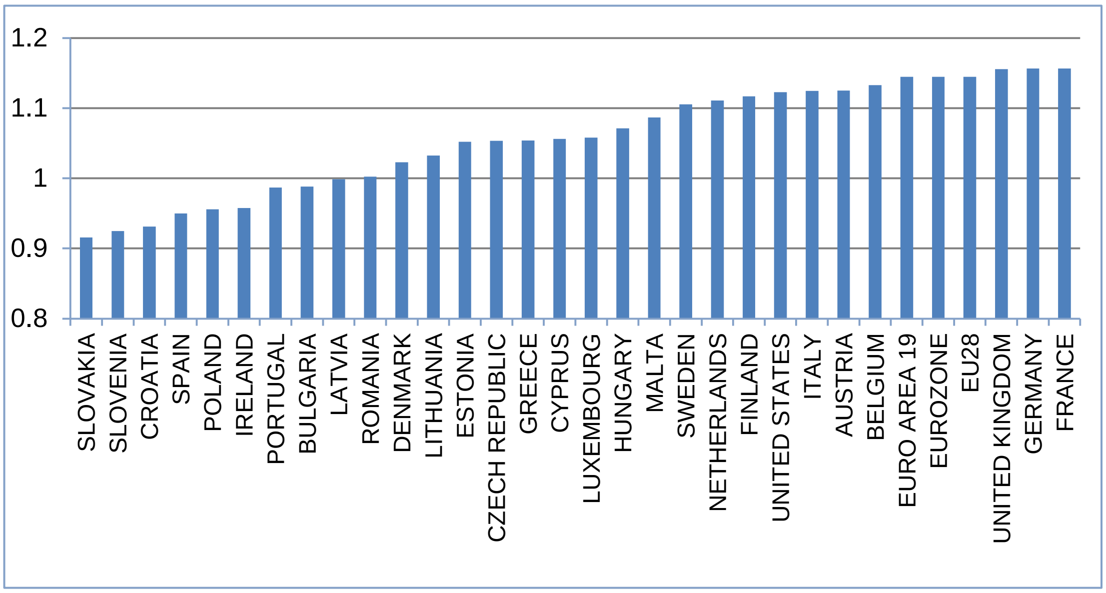
If a country is concentrated in high productivity activities (in its export basket), Q will be greater than one, and will therefore will have a positive effect on competitiveness (by increasing its quality adjusted productivity) as measured by conventional productivity measures.

[7] PRODY and EXPY are ideally calculated using product level data. However, in the current version of the paper, we made a short-cut assuming that there is a $\boldsymbol{PRODY_k}$ for each industry *k*, which equals the aggregate revealed comparative advantage of all products in industry k. Similarly we calculated three quality adjusted $\boldsymbol{PRODY_{k,q}}$ for each industry k which is obtained by the average unit value of all products in industry *k*. Using industry level data, where all product indexes *i* in equations (1) through (4) are now industry indexes. This indeed does discount possible heterogeneities across products, but is a first step towards adjusting for quality differences in export baskets across countries.

[8] For simplicity, time subscript is suppressed.

Figure 6 shows the average of the "product quality" adjustment for the 2002-2014 time period for the aggregate manufacturing sector. For many of the countries that we expect having higher product quality (for example, the US and Germany), Figure 6 shows that the $\mathbf{EXPY^Q}$ is higher than the original EXPY variable. For countries with lower product quality, the $\mathbf{EXPY^Q}$ is lower. We see that the "product quality" adjustment is positive and largest for the highest income, mature economies and lower for economies which still have lower income levels. But among the highest income countries, there are striking differences, for example, with France, Germany, and the UK (as well as the Eurozone as a whole) showing a larger positive quality adjustment than the United States. On the other hand, Spain is among the countries with the largest negative adjustment for lower comparative quality.

Figure 6: Average ratio of adjusted EXPY to unadjusted EXPY, 2002-14



Source: The Conference Board

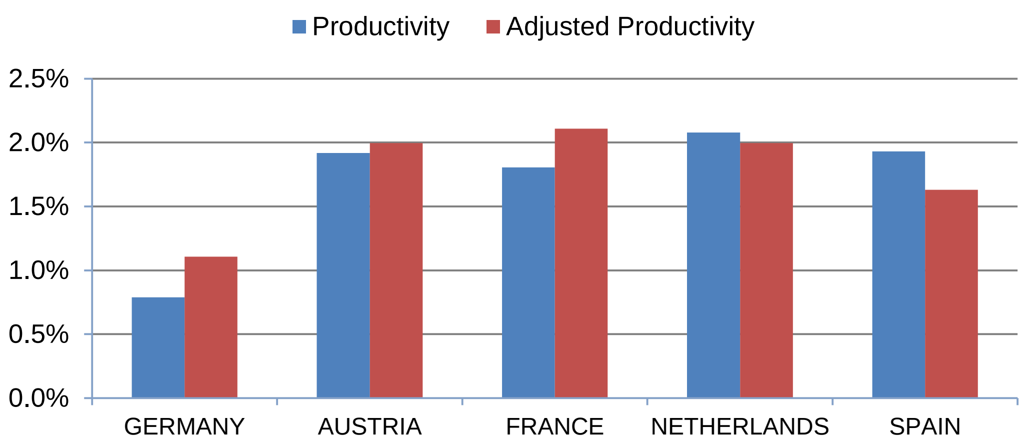
The difference in these series allows us to measure the effect that product quality can have on the productivity of exports. We adjust our standard measure of unit labor costs in the ILC database, the ratio of nominal wage rate to labor productivity, for this measured "product quality". A higher product quality would mean that a country's output would need to be inflated by the "product quality" adjustment factor. Since productivity, as described earlier in the paper, is output per hour, higher product quality would increase output and thus increase productivity. Using this adjusted productivity level we recalculate the unit labor costs level measures adjusted for quality differences:

$$ULC_j^Q = \boldsymbol{ULC}_j/\boldsymbol{Q}_j$$

where $\mathrm{ULC_j}$ is the unadjusted unit labor cost in country *j*. We also recalculate the growth in unit labor costs for a country based on the quality adjusted ULC data.

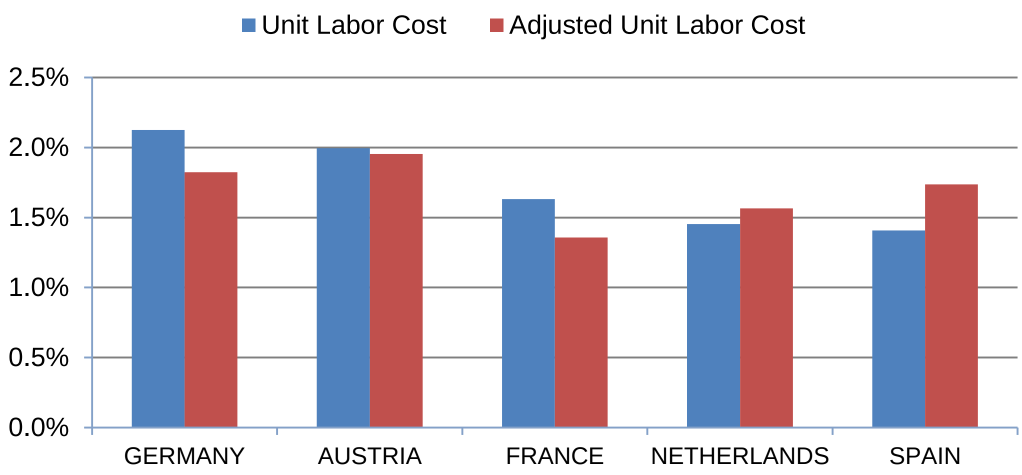
Figures 7-9 show the adjusted productivity and ULC results for a select number of countries. We find that the quality adjustment reduced the growth in unit labor costs for the higher income countries. For example, when adjusted for quality, Germany's unit labor costs growth dropped from 2.1 percent to 1.8 percent whereas Spain's unit labor cost growth increased from 1.4 percent to 1.7 percent. Ireland presented the largest change in that it experienced a unit labor cost decrease of -0.2 percent to an increase of 0.4 percent.

Figure 7: Growth in manufacturing productivity, average annual percent change, 2007-2014



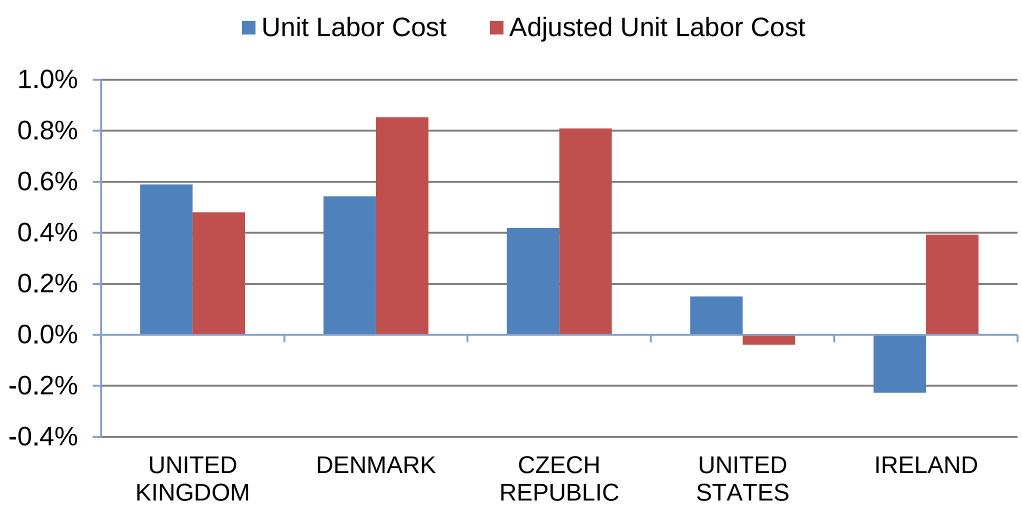
Source: The Conference Board

Figure 8: Growth in manufacturing unit labor cost, average annual percent change, 2007-2014



Source: The Conference Board

Figure 9: Growth in manufacturing unit labor cost, average annual percent change, 2007-2014



Source: The Conference Board

7. Closing Remarks

This paper has reviewed three sources of international competitiveness indicators: The Conference Board International Labor Comparisons (ILC) program, the OECD Structural Analysis Database (STAN), and the EU KLEMS Growth and Productivity Accounts. All three datasets offer comparable country, industry, and historical coverage and provide the necessary indicators for constructing ULCs. Calculated ULCs from these sources follow similar trends, but ILC level estimates are consistently higher than those from the other two sources. The ILC deviation is largely due to computational differences, as well as discrepancies in the precise vintage of national accounts data used. All three databases would yield similar conclusions about changes in competitiveness over time, as well as similar rankings of competitiveness relative to the US.

Comprehensive assessments of country competitiveness should address both how competitiveness evolves over time (whether competiveness is increasing or decreasing) and how absolute costs compare across countries and industries (is country or industry X more or less competitive than the US or the corresponding US industry?). Thus, a country or industry's overall competitive position vis-à-vis the US could be summarized by constructing a matrix using both trends and levels of ULCs where countries are grouped in terms of already being (un) competitive (compared to the US), but gaining or losing competitiveness over years. More in-depth treatment of ULCs as a key driver of differences in competitiveness across countries is necessary, but in the meantime the existing sources of competitiveness indicators fulfill a great need.

Finally, the paper has attempted to tackle the issue that countries with higher income levels tend to match higher wage levels with higher productivity, as those countries' export baskets typically produce higher quality varieties of the same product. While those adjustments for product quality cannot fully account for the issues identified in Kaldor's paradox, this exercise does show that differences in product quality do matter for ULC comparisons. Lower unit labor cost is not the only factor that can affect competitiveness. Raising product quality, when compared to other countries, could make a difference in staying competitive on the world market.

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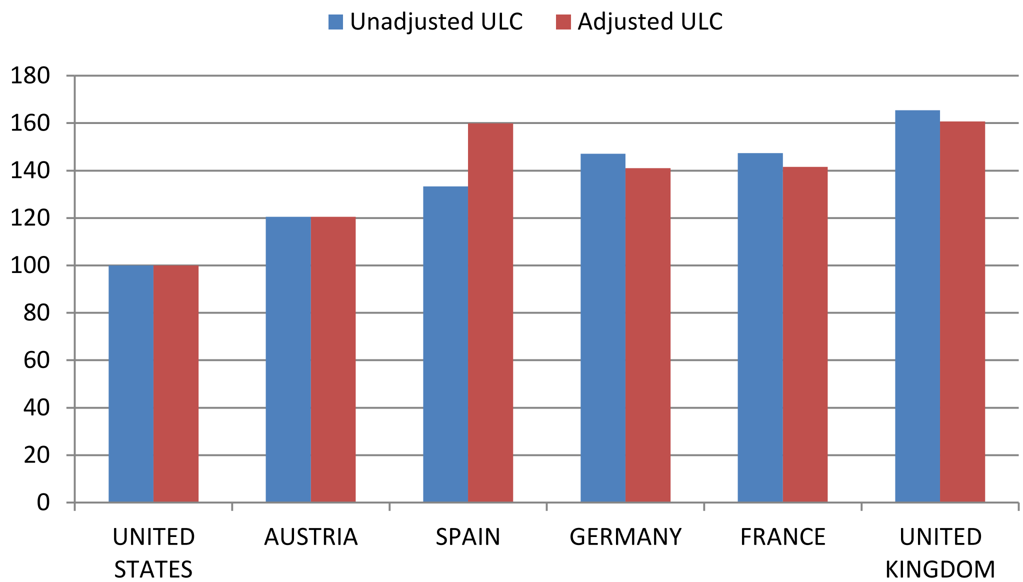
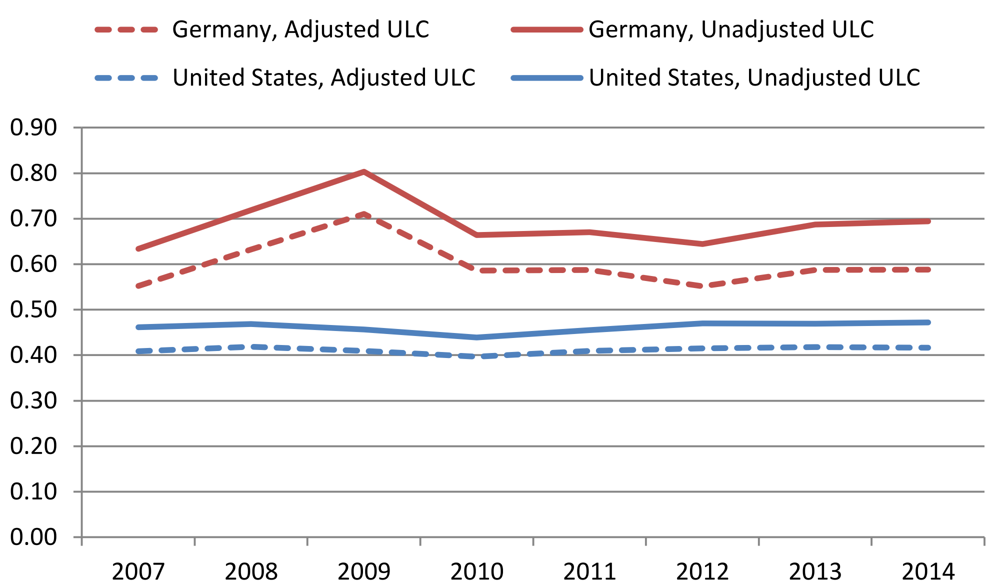
Appendix

Figure 10: Adjusted and unadjusted unit labor cost (USA = 100), 2014



Source: The Conference Board

Figure 11: Adjusted and unadjusted unit labor cost, 2007 - 2014



Source: The Conference Board