

Two Dimensions of Convergence: National and International Wage Adjustment Effects of Cross-Border Outsourcing in Europe

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June 18, 2002

Abstract

This paper proposes to distinguish the two dimensions of convergence - between countries and between industries within a country - when analysing the impact of outsourcing on real wage rates in the EU15 and the CEEC. In the CEEC, outsourcing has impeded the adjustment of real wage rates at the manufacturing industry level, but it has led to a closure of the gap within a typical EU economy. Between country convergence is likewise fostered by cross-border outsourcing, supporting the hypothesis that outsourcing enhances the trend towards factor price equalisation.

Keywords: Convergence, Real Wages, Outsourcing, Panel Econometrics

JEL: F11, F15, J31

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1 Introduction

The driving forces of international factor price convergence and the international distribution of income has attracted a lot of interest in the last decades. Especially, the role of international trade in final goods, but also of trade in intermediate goods resulting from cross-border outsourcing of production processes, have been discussed as forces towards factor price equalization between the developed (the North) and the less developed economies (the South). Nowadays, researchers widely agree upon the notion that goods trade per se does not provide a sufficient explanation for the change in factor prices (Krugman, 1995; Feenstra & Hanson, 2001). However, the changing *composition* of trade and the growing importance of *intermediate input trade* in particular seems much more important regarding both theory and evidence (compare Feenstra & Hanson, 2001, for an overview).

Baier & Bergstrand (2001) derive simulation results from a stylized computable general equilibrium model. Using reasonable parameter estimates, they find that outsourcing might account for about one sixth of the growth of world trade in between 1960-1990. Although interesting in its own right, this finding does not allow to derive firm conclusions about the effects of intermediate goods trade on income in general and wages in specific.

Deardorff (2001) focuses on the impact of outsourcing on incomes *within* and *between* countries. He concludes that if there are some impediments to factor price equalization (e.g. transportation costs, tariff or non-tariff barriers to trade, etc.), outsourcing may drive factor price equalization to "the extent that factor prices are not equalized internationally without outsourcing" (ibid., p. 135).

There are, however, arguments against the presumption of factor price convergence between countries. In Feenstra & Hanson (1997), firms in the North specialize in skill intensive tasks and outsource the least skill intensive activities to the South. As a result, the average skill intensity and, therefore, average wages rise in both countries, contributing to more global wage inequality between skilled and unskilled workers. Arndt's (1997) small economy Heckscher-Ohlin type model can also explain factor price divergence due to outsourcing. Specifically, outsourcing results in real wage growth in both the North and the South, when the unskilled labor intensive fragment of the unskilled labor intensive sector (imported by the North) is outsourced from North to South, while the skilled intensive fragment of the unskilled labor intensive sector (exported by the South) is outsourced from the South to the North. Kohler (2001) provides a rigorous analysis of the impact of outsourcing on the national income distribution in a specific factors model. Regarding anecdotal evidence, his model can explain national income divergence within the North, but convergence within the South. Generally, however, outsourcing may or may not be a force towards factor price equalization between countries, depending on which industry (the exporting or import competing one) fragments its production process, on the labor intensity of both the outsourced fragments and the remaining locally produced fragments, and on whether outsourcing is accompanied by foreign direct investment (Kohler, 2001).

The empirical evidence at the industry level for both the US and Europe mainly supports the Heckscher-Ohlin view on outsourcing: Feenstra & Hanson (1996, 1999), Greenaway et al. (1999), Egger & Egger (2001) and others

identify a clear positive impact of outsourcing on the skilled-to-unskilled wage and/or employment ratio in high wage countries. Feenstra & Hanson (1997) provide evidence that outsourcing raises skilled-to-unskilled wage ratio in both the North (the US) and the South (Mexico). These shifts in relative labor demand and in relative wages mainly occur within-industries rather than between industries.

It would be preferable to analyze the evolution of the skilled-to-unskilled wage differential directly. However, the availability of industry level data on skill premia, which are comparable across a large sample of countries, dictates an indirect approach, which looks at the variation of *average* wage rates across industries *within* a country on the one hand, and *between* countries on the other. In the long run, average wage rates (comprising both that of skilled and unskilled workers) may differ across industries because a different mix of skilled and unskilled workers is used, e.g. due to worker quality variation even within skill groups. In the short run, the lack of labor mobility between sectors within a country due to national barriers to mobility (e.g. because of industry specific knowledge of workers) and adjustment costs may impede the effects of outsourcing on incomes to take place immediately. It is a stylized fact that wage differentials vary systematically across industries with capital intensive industries paying higher wages, and that these wage differentials are quite persistent over time (Krueger & Summers, 1988). However, in the steady state, one would expect that the wages of skilled and unskilled workers grow at the same rate and wage differentials between industries within a country as well as between countries do not change.

If outsourcing of production on average increases the demand for skilled

workers relative to that of unskilled workers in the North and reduces it in the South in course of adjustment, one might observe increasing interindustry average wage differentials *within* the North and diminishing ones *within* the South. This is the first hypothesis this paper aims to test empirically. Simultaneously, one may find a tendency towards international factor price equalization leading to convergence of average wages *between* countries, which is the second issue we concentrate on.

Given that in the steady state wage differentials are constant, outsourcing may be expected to affect the speed of convergence, but not to induce differences in steady state growth rates. We contrast convergence in average real wage rates *between countries* with that between industries *within a (typical) country* and propose an empirical model to assess the impact of outsourcing in these two dimensions using 2-digit industry level data of the 15 EU members and 5 CEEC¹ covering the period 1993-1999. We start from a traditional β -convergence model as proposed by Barro & Sala-i-Martin (1995), which is designed to analyze dynamic adjustment processes with one-way cross-sectional units - e.g., countries, regions, firms. However, to decompose the outsourcing effect into its *within* and *between* countries component, we account for the two-way character of the cross-sections and come up with a bivariate system of differential equations, which drives the country-by-industry evolution of real wage rates.

According to our main empirical results, *between* country convergence dominates the adjustment of real wage rates and outsourcing tends to reinforce this. *Within* country convergence, in contrast, is much slower. Out-

¹Czech Republic, Hungary, Poland, Slovenia and Slovak Republic.

sourcing accelerates within country convergence in the EU15, while it leads to divergence in the CEEC, where it fosters interindustry wage differentials within the typical economy. Our results support the notion that outsourcing facilitates factor price equalization (Deardorff, 2001). Furthermore, they are in line with those models predicting convergence of average wages between industries in the North due to rising wages of unskilled workers, which more than compensate the increase in the demand for skilled workers due to outsourcing of mainly unskilled labor intensive production stages (compare Arndt, 1997).

The paper proceeds as follows. The next section introduces the concept of the two dimensions of convergence, while Section 3 discusses the data base, the econometric specification, and the estimation results. The last section summarizes the main findings and concludes.

2 Two Dimensions of Convergence

To measure the speed convergence of real wages *between countries* and across industries *within countries*, we propose an extension of the standard β -convergence equation. Specifically, we hypothesize that the speed of convergence differs between the within country (between industries) dimension (b_1) and the between country dimension, where we observe the same rate of real wage changes for all industries within a particular country (b_2). If $b_1 < b_2$, the overall catching up in real wage rates between countries dominates. If, on the other hand, $b_1 > b_2$ the interindustry wage rate differentials disappear quickly, but overall (between countries) catching up is slow.

For a typical industry i in country c , convergence requires that the growth rate of a country's real wage rate is negative proportional to its initial level (Barro & Sala-i-Martin, 1995). Formally, the log linearization around the steady-state is given by the following system of linear first order differential equations:

$$\frac{d\omega_{ic}(t)}{dt} - \frac{d\omega_{.c}(t)}{dt} = -b_1 [\omega_{ic}(t) - \omega_{.c}(t)] \quad (1)$$

$$\frac{d\omega_{.c}(t)}{dt} - \frac{d\omega^*(t)}{dt} = -b_2 [\omega_{.c}(t) - \omega^*(t)] \quad (2)$$

$$\frac{d\omega^*(t)}{dt} = g \quad (3)$$

$\omega_{ic}(t) = \log w_{ic}(t)$ is the log of the real wage rate of industry i in country c , $\omega_{.c}(t) = \frac{1}{I} \sum_{i=1}^I \omega_{ic}(t)$, where I denotes the number of industries. $\omega^*(t)$ denotes the log of the 'world wide' steady-state of the real wage rate at time t with assumed constant growth rate g . (2) states that the difference between a country's real wage growth ($\frac{d\omega_{.c}(t)}{dt}$) and the steady-state growth rate $\frac{d\omega^*(t)}{dt}$ is higher, the higher the distance of the average log real wage rate of country c ($\omega_{.c}(t)$) from its steady-state counterpart ($\omega^*(t)$) at time t . (1) implies that the real wage rate in industry i grows faster, the more it lags behind the average country wide real wage rate. For simplicity, we assume that a single industry is too small to influence the country average. Hence, the system is only an approximation of the true, by far more complicated, system, where the real wages of all industries show up on the right hand side of (1). Solving this system of differential equations, results in the following equation for the growth rate of wages over a period of length T :

$$\omega_{ic}^T = e^{-b_1 T} (\omega_{ic}^0 - \omega_{.c}^0) + e^{-b_2 T} (\omega_{.c}^0 - \omega^{0,*}) + \omega^{T,*} \quad (4)$$

(3) implies that the steady-state real wage rate in logs is defined by $\omega^*(t) = gt + \omega^{0,*}$ with $\omega^{0,*}$ as the exogenously given steady-state log wage rate at time 0. Subtracting the initial value ω_{ic}^0 from both sides of (4), rearranging and dividing by T , and adding an iid error term u_{it} , we get a natural extension of the traditional convergence equation (Barro & Sala-i-Martin, 1995) for the annual average growth rate of real wages in industry i over a period of length T :

$$\begin{aligned} \frac{1}{T} (\omega_{ic}^T - \omega_{ic}^0) &= g - \frac{1}{T} (1 - e^{-b_1 T}) (\omega_{ic}^0 - \omega_{.c}^0) - \\ &\quad \frac{1}{T} (1 - e^{-b_2 T}) (\omega_{.c}^0 - \omega^{0,*}) + u_{it} \end{aligned} \quad (5)$$

β -convergence is a necessary, however not sufficient condition for convergence (Barro & Sala-i-Martin, 1995). Therefore, we additionally look at σ -convergence and investigate, whether the standard deviation of real wage rates decreased over time, again both *within* and *between* countries. Formulating the system (1)-(3) in discrete time, substituting (2) and (3) in (1) and adding a random iid error term, which is uncorrelated with right hand side variables, gives:

$$\omega_{ic}^t = \beta_1 (\omega_{ic}^{t-1} - \omega_{.c}^{t-1}) + \beta_2 (\omega_{.c}^{t-1} - \omega^{t-1,*}) + \omega^{t,*} + u_{it}, \quad (6)$$

where $\beta_1 = 1 - b_1$ and $\beta_2 = 1 - b_2$. The standard deviation of ω_{ic}^t can be easily calculated, when assuming that the overall mean of the real wage rate approximately corresponds to the steady-state: $\frac{1}{IC} \sum_{c=1}^C \sum_{i=1}^I \omega_{ic}^t = \omega_{..}^t = \omega^{t,*}$, where I denotes the number of industries, C the number of countries, and IC is the overall number of (country-by-industry) observations. Since $\omega_{..}^t = \frac{1}{IC} \sum_{c=1}^C \sum_{i=1}^I \omega_{ic}^t = \frac{1}{IC} \sum_{c=1}^C \beta_1 (\omega_{.c}^{t-1} - \omega_{.c}^{t-1}) + \frac{1}{C} \sum_{c=1}^C \beta_2 (\omega_{.c}^{t-1} - \omega^{t-1,*}) + \omega^{t,*} = \omega^{t,*}$, we have:

$$\begin{aligned}
\sigma_t^2 &= \frac{1}{IC} \sum_{c=1}^C \sum_{i=1}^I (\omega_{ic}^t - \omega_{..}^t)^2 + \sigma_u^2 \\
&= \frac{1}{IC} \sum_{c=1}^C \sum_{i=1}^I [\beta_1 (\omega_{ic}^{t-1} - \omega_{.c}^{t-1}) + \beta_2 (\omega_{.c}^{t-1} - \omega^{t-1,*})]^2 + \sigma_u^2 \\
&= \frac{1}{IC} \sum_{c=1}^C \sum_{i=1}^I [\beta_1^2 (\omega_{ic}^{t-1} - \omega_{.c}^{t-1})^2 + 2\beta_1\beta_2 (\omega_{ic}^{t-1} - \omega_{.c}^{t-1}) \cdot \\
&\quad (\omega_{.c}^{t-1} - \omega^{t-1,*}) + \beta_2^2 (\omega_{.c}^{t-1} - \omega^{t-1,*})^2] + \sigma_u^2 \\
&= \beta_1^2 \sigma_{t-1,W}^2 + \beta_2^2 \sigma_{t-1,B}^2 + \sigma_u^2 \tag{7}
\end{aligned}$$

where $\sigma_{t,W}^2 = \frac{1}{IC} \sum_{c=1}^C \sum_{i=1}^I (\omega_{ic}^t - \omega_{.c}^t)^2$ and $\sigma_{t,B}^2 = \frac{1}{C} \sum_{c=1}^C (\omega_{.c}^t - \omega^{t,*})^2$.

Hence, there are three principal opportunities to estimate the parameters of the two dimensions of convergence in real wage rates. First, we can use (5) to estimate the speed of convergence in a cross-section of industries and countries. Second, one can estimate (6) in a panel with industry, country and time variation using the procedure proposed by Arellano & Bond (1991). Third, one could look at σ -convergence based on a regression of (7). Since the time series dimension of our data is rather short, the latter is not feasible. Rather, we look at a plot of σ_t^2 , $\sigma_{t,W}^2$ and $\sigma_{t,B}^2$ against time and follow Carree & Klomp (1997) to test, whether the variance of real wage rates decreased over the period 1993 and 1999.

We assume that the speed of convergence depends on the volume of intermediate goods trade as percent of gross production (outsourcing: o_{ic}), whose impact may differ *within* and *between* countries and also between the CEEC and the EU15. Noteworthy, we rule out that the possibility that the *level* of outsourcing exerts any impact on the steady-state *growth* of wage

rates. Rather, we assume that it affects only the *level* and the corresponding *transition* path. Hence, the wage growth effects of outsourcing are assumed to be transitory. The rationale is the analogy to the impact of exogenous, labor augmenting technical progress on the *level* of labor productivity in a Solow-Swan type neoclassical growth model (see Barro & Sala-i-Martin, 1995).

3 Data and Estimation Results

Data: Our data comprise 14 manufacturing industries, which are slightly higher aggregated than NACE 2-digit ones. For simplicity, we refer to them as 2-digits. The real wage data for the EU countries are taken from New Cronos Products (EUROSTAT). The CEEC wages are kindly provided by the Vienna Institute of Comparative Economic Studies (WIIW). Wages are expressed in constant prices and US dollars using 1995 as the base year. For the EU-countries, we have to estimate the 1999 values from production data using a fixed industry-by-country within estimator. All wages are deflated by country specific GDP-deflators and expressed in 1995 dollars, and we calculate average growth rates in line with the bulk of the convergence literature.

To construct the outsourcing variable, we use data on bilateral intermediate goods trade volumes at the 5-digit Standard International Trade Classification level from UNO's Broad Economic Categories (compare Fontagné et al., 1996) and aggregate them to come up with NACE 2-digit manufacturing industry input trade volumes of each country with the EU and the CEEC.

We aggregate each country's bilateral trade in intermediate goods with the EU and CEEC as the destination countries. For example, the outsourcing measure of a specific, German NACE 2-digit manufacturing industry is the sum of Germany's exports and imports of intermediate goods of this industry to all other EU-countries and the CEEC, and similarly for all other economies in the sample. In this way, we capture the impact of the overall volume of intermediate goods trade on the convergence of real wage rates and treat all countries symmetrically. We express European 2-digit industry input trade volumes in percent of a country's gross production to obtain a (wide) measure of the country specific European (intra-sample) level of cross-border outsourcing of production. A couple of missing values are interpolated, especially for Greece. In the regressions below, the initial value refers to 1993.

Our data are heavily prone by outliers, so we have to restrict the sample in several ways. We excluded all country-by-industry cross-sections (i) with a maximum average annual *growth rate* of real wages exceeding 50% in absolute value, (ii) with a maximum *level* of the outsourcing measure above the 95-percentile in a single year, and (iii) industries with an annual increase in our outsourcing measure of more than 300%. The latter two criteria likely capture misclassifications or data errors in the trade or industry statistics.

Table 1 presents the summary statistics of average annual growth rates of both European outsourcing in percent of gross production and that of the

real wage rate in the EU15 area and 5 CEEC.²

> Table 1 <

Starting from significantly lower wage rates after the Fall of the Iron Curtain and the first step of systemic transformation, real wages grew substantially faster in the CEEC than in the EU. Outsourcing in terms of gross production by the EU countries increased faster during 1993 and 1999 as compared to the CEEC. Noteworthy, this pattern is largely due to the increase in imports of manufacturing inputs originating from the CEEC.

Econometric Specification: We estimate (5), allowing outsourcing to affect the adjustment process (i.e., the speed of adjustment) to the steady-state real per capita wage rate both within and between countries. The associated β -convergence regression reads as follows:

$$\begin{aligned} \Delta\omega_{ic} &= \gamma_0 + \gamma_1\tilde{\omega}_{ic}^0 + \gamma_2\tilde{\omega}_{ic}^0 o_{ic}^0 D_{EU} + \gamma_3\tilde{\omega}_{ic}^0 o_{ic}^0 D_{CEE C} \\ &\quad \gamma_4\omega_{.c}^0 + \gamma_5\omega_{.c}^0 o_{ic}^0 D_{EU} + \gamma_6\omega_{.c}^0 o_{ic}^0 D_{CEE C} + u_{ic} \\ \Delta\omega_{ic} &= \frac{\ln w_{ic}^t - \ln w_{ic}^0}{T} \\ \tilde{\omega}_{ic}^0 &= (\omega_{ic}^0 - \omega_{.c}^0) \\ o_{ic}^0 &= \frac{(\text{Intermediates goods trade volume})_{ic}^0}{(\text{gross production})_{ic}^0}. \end{aligned}$$

D_{EU} is a dummy variable, which takes the value 1 if a country belongs to the EU and 0 otherwise, and $D_{CEE C} = 1 - D_{EU}$ is the CEEC dummy. According to the discussion above, we allow European cross border outsourcing

²We exclude Bulgaria and Romania from the available sample because of the missing trade data problems. Additionally, the wages in these two economies seem to follow a rather different growth pattern than in the included CEEC.

to exert a different impact on the convergence *within* countries (i.e., between industries within a country: γ_2, γ_3) than on *between* country convergence (γ_5, γ_6). Furthermore, we allow outsourcing to exert a different impact on the EU economies (γ_2, γ_5) than on the CEEC (γ_3, γ_6). γ_0 is the common steady-stage growth of real wages. In this form, the specification implies *unconditional convergence*. In a second specification, we add industry dummies implying *conditional convergence*. The resulting long run differences in real wage growth rates across industries common to all countries may arise from shifts in the skill composition, and, inter alia, also from short run asymmetric business cycle effects.

Figure 1: Density Estimates of the Log Real Wage Rate 1993 and 1995

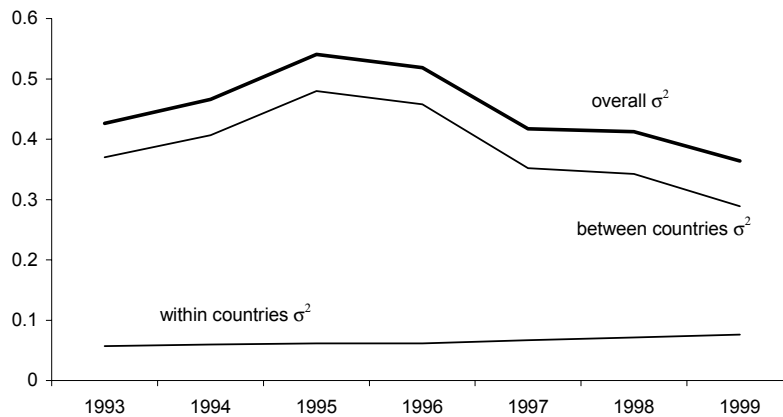


As discussed in Quah (1993), β -convergence is not sufficient to guarantee overall convergence to a common steady-state. Therefore, additional evidence

on the distribution of real wages must be considered to assess the information obtained from the above regressions. Convergence to a single-peaked distribution supports results from β -convergence regressions.

Figure 1 illustrates that the distribution of real wage rates exhibits a two-peaked pattern in our initial period (1993) with the CEEC lagging considerably behind. But in course of the transitional process of the CEEC, the left peak of the distribution moved towards the right one. From this perspective, convergence of the real wage distribution to a single peak, i.e. a common steady-state, seems not unlikely and β -convergence analysis is informative.

Figure 2: σ -Convergence of EU15 and CEEC Real Wage Rates and Its Components



Assuming single-peakedness, we further look at the distribution of wages and compute the associated variance (σ^2) of real wages both across countries and industries to see whether the distribution of real wages significantly collapses over time. As mentioned above, the small time dimension of our data does not allow to apply regression analysis in this context. However, Figure 2 illustrates that the dispersion of real wages is falling since 1995. This

process is driven by convergence of average wages *between* economies rather than *within* them. According to the t_2 -statistic by Carree & Klomp (1997), differences in real wage rates *between* countries were significantly larger in 1993 than in 1999 ($t_2 = 40.2$, $p = 0.00$). Also, the *overall* decrease in the variance is significant ($t_2 = 12.8$, $p = 0.00$). However, *within* the typical economy we observe a slightly increasing dispersion between industries.

Estimation Results: Comparing the results between the conditional and the unconditional convergence regression in the table, we find that the hypothesis of a common steady-state across industries is rejected. This points to long run differences in real wage growth rates across industries common to all countries and/or short run asymmetric business cycle effects not explicitly addressed in the theoretical models discussed above. Nevertheless, the resulting point estimates of the convergence parameters are relatively similar, with some important exceptions.

The evidence suggests that outsourcing in the CEEC has impeded the pace of adjustment to the industry steady-state *within countries*. However, this result is only significant in case of unconditional convergence. In contrast, outsourcing has led to a closure of the gap between observed and steady-state wage rates within the typical EU economy (however, significantly so only in case of conditional convergence).

All estimated between country convergence parameters are significantly different from zero, and we find that outsourcing fosters convergence of the CEEC (i.e., convergence *from below*) stronger than it speeds up convergence in the EU area (on average, convergence *from above*). This finding is sig-

nificant and independent of whether we assume conditional or unconditional convergence (compare the corresponding F-test of $(c) - (d) = 0$ in Table 2). In both estimated models, the marginal *between* country convergence effects of outsourcing are significantly more pronounced than their *within* country counterparts (compare the last row of F-tests in the table).

> Table 2 <

We should mention that we have assessed the robustness of the estimation results in several ways.³ First, we applied median regressions to check for the influence of potential remaining outliers. In fact, the results are very close to the OLS outcome and we may conclude that our results are not driven by a view influential observations. Second, we ran dynamic panel GMM regressions in the spirit of Arellano & Bond (1991) and found - though the time period is rather short for single-equation GMM - that the coefficients of the interaction terms by and large are rather robust in terms of both their sign and significance. However, to obtain reliable GMM estimates in terms of Sargan's over-identification test, we had to control for country-specific time effects, which wipe out the direct impact of the lagged between country effect, rendering any further discussion of long-run between country differences impossible. Given these results, we can proceed with the analysis on the basis of the estimates in Table 2.

> Table 3 <

³We do not report all of our results for the sake of brevity. However, they are available from the authors upon request.

Table 3 collects information on the speed of adjustment - expressed as the average annual closure of the gap between actual and steady-state real wage rates for the EU and the CEEC. To illustrate the role of outsourcing, we report the estimated speed of adjustment for outsourcing as observed and a counterfactual situation with zero outsourcing in the initial period. Since unconditional convergence is rejected at convenient levels of significance, we concentrate on the results assuming conditional convergence (i.e., the lower bloc of results in the table) and leave the interpretation of the remaining results to the reader. Outsourcing significantly speeds up the convergence of real wage rates *within countries* (between industries) in the EU15 economies to 6.86% per year when evaluated at variable means, whereas there is no such effect within the CEEC. Hence, in the EU15 outsourcing puts a significant pressure on industries with above average real wage rates in the typical economy, while it leads to faster adjustment in industries below the country average. Further, outsourcing significantly accelerates the speed of convergence *between countries* in both the EU (the difference between 3.56% and 3.08% is significant at 1%) and the CEEC (the difference between 4.37% and 3.08% is significant at 1%). Finally, the impact on the speed of adjustment in the CEEC is somewhat stronger (though only at $\alpha = 14\%$).

Summing up, our results support Deardorff's (2001) notion that outsourcing facilitates factor price equalization across countries. They are also in line with the models predicting convergence of average wages within countries (between industries) in the North due to higher wages of unskilled workers combined with minor increases in the demand for skilled workers as a result of outsourcing of unskilled labor intensive production stages.

4 Conclusions

This paper proposes a new concept to distinguish the two dimensions of convergence - *between* and *within* countries. We analyze the impact of outsourcing on the adjustment of real wage rates in manufacturing of the EU15 and 5 CEEC at the NACE 2-digit industry level. Specifically, we treat the impact of outsourcing transitorily and look at its effect on the speed of adjustment, thereby allowing for an effect on the steady-state *level* of real wage rates but not on their *growth*.

The availability of data dictates to investigate the evolution of average real wages, which is nevertheless informative for the debate on the impact of outsourcing on the distribution of income within and between countries. We find pronounced *conditional convergence* in both the EU15 and the CEEC. Our estimation results furthermore suggest that outsourcing in the CEEC has impeded the pace of adjustment to the industry steady-state *within* these economies. In contrast, outsourcing has led to a closure of the gap between observed and steady-state wage rates *within* the EU countries. This is in line with the models of Arndt (1997) and others, which predict that the wage rates of unskilled workers may catch up despite the increased relative demand for skilled workers in the North in response to outsourcing of unskilled labor intensive production stages.

Looking at *between* country convergence, outsourcing strongly fosters convergence *from below* for the CEEC and *from above* for most of the EU countries. Hence, our empirical estimates inter alia support the hypothesis put forward by Deardorff (2001), namely that outsourcing fosters the trend towards factor price equalization.

5 References

- Arellano, Mario and Stephen Bond (1991), Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations, *Review of Economic Studies* 58(2), pp. 277-297.
- Arndt, Sven W. (1997): Globalization and the Open Economy, *North American Journal of Economics and Finance* 8(1), pp. 71-79.
- Baier, Scott and Jeffrey H. Bergstrand (2001), The Growth of World Trade: Tariffs, Transport Costs, and Income Similarity, *Journal of International Economics* 53(1), pp. 1-27.
- Barro, Robert and Xavier Sala-i-Martin (1995), *Economic Growth* (McGraw-Hill, New York).
- Carree, Martin and Luuk Klomp (1997), Testing the Convergence Hypothesis: A Comment, *Review of Economics and Statistics* 79(4), pp. 683-686.
- Deardorff, Alan V. (2001), Outsourcing in Simple Trade Models, *North American Journal of Economics and Finance* 12(2), pp. 121-137.
- Egger, Hartmut and Peter Egger (2001), Cross Border Outsourcing: A General Equilibrium Perspective and Evidence for Outward Processing in EU Manufacturing, *North American Journal of Economics and Finance* 12(3), pp. 243-256.
- Feenstra, Robert C. and Gordon H. Hanson (1996), Foreign Investment Outsourcing and Relative Wages, in: R.C. Feenstra, G.M. Grossman

- and D.A. Irvin, eds., *Political Economy of Trade Policy: Essays in Honor of Jagdish Bhagwati* (MIT Press, Cambridge), pp. 89-127.
- Feenstra, Robert C. and Gordon H. Hanson (1997), Foreign Direct Investment and Relative Wages: Evidence From Mexico's Maquiladoras, *Journal of International Economics* 42(3-4), pp. 371-393.
- Feenstra, Robert and Gordon Hanson (1999), The Impact of Outsourcing and High-Technology Capital on Wages, 1979-1990, *Quarterly Journal of Economics* 114(3), pp. 907-940.
- Feenstra, Robert and Gordon Hanson (2001), Global Production Sharing and Rising Inequality: A Survey on Trade and Wages, in K. Choi and J. Harrigan, eds., *Handbook of International Trade* (Basil Blackwell), forthcoming.
- Fontagné, Lionel, Michael Freudenberg, and Deniz Ünal-Kesenci (1996), *Statistical Analysis of EC Trade in Intermediate Products* (EUROSTAT, Paris).
- Greenaway, David, Robert C. Hine, and Peter Wright (1999), An Empirical Assessment of the Impact of Trade on Employment in the United Kingdom, *European Journal of Political Economy* 15(3), pp. 485-500.
- Kohler, Wilhelm K. (2001), A Specific-Factors View on Outsourcing, *North American Journal of Economics and Finance* 12(1), pp. 31-53.
- Krueger, Alan B. and Lawrence Summers (1988), Efficiency Wages and the Inter-Industry Wage Structure, *Econometrica* 56(2), pp. 269-293.

Krugman, Paul R. (1995), Growing World Trade: Causes and Consequences;
Brookings Papers on Economic Activity 0(1), pp. 327-362.

Quah, Danny (1993), Galton's Fallacy and Tests of the Convergence Hypothesis, *Scandinavian Journal of Economics* 95(4), pp. 427-443.

Table 1: Descriptive Statistics (Average Annual Growth in Percent)

Region	Real Wage Rate	Intermediate Inputs Trade in % of Production
EU15	2.05	4.67
CEEC	4.91	3.66
Average	2.87	4.38

Table 2: Regression Results (β -Convergence)
 Dependent Variable is the Average Log Difference of Real Wages

Explanatory variables	Unconditional convergence		Conditional convergence	
	β	t-statistic	β	t-statistic
Within countries				
Initial level	0.007	0.41	-0.020	-0.72
Initial level x initial outsourcing x CEEC dummy (a)	0.104	2.31 **	0.057	1.02
Initial level x initial outsourcing x EU15 dummy (b)	-0.005	-0.73	-0.017	-1.96 *
Between countries				
Initial level	-0.031	-7.21 ***	-0.029	-7.05 ***
Initial level x initial outsourcing x CEEC dummy (c)	-0.014	-2.82 ***	-0.025	-3.96 ***
Initial level x initial outsourcing x EU15 dummy (d)	-0.001	-1.26	-0.002	-3.27 ***
Constant	0.114	10.91 ***	0.092	7.09 ***
Number of observations	240		240	
R ²	0.24		0.35	
Root mean square error	0.04		0.03	
Heteroskedasticity, Cook and Weisberg (1983): $\chi^2(1)$	5.11 **		7.44 ***	
F-tests:				
Industry effects: F(13,220)	-		3.26 ***	
Marginal outsourcing effects:				
(a) - (b) = 0; F(1,233)	5.00 **		0.82	
(a) - (c) = 0; F(1,233)	7.93 ***		15.71 ***	
(c) - (d) = 0; F(1,233)	7.25 ***		13.28 ***	
(b) - (d) = 0; F(1,233)	1.58		10.73 **	
(a) - (b) + (b) - (c) = 0; F(1,233)	8.11		17.26 ***	
(a) + (b) - (b) - (c) = 0; F(1,233)	7.25 ***		13.28 ***	

*** significant at 1%; ** significant at 5%; * significant at 10%. Reported t-statistics are heteroskedasticity corrected.

Table 3: Estimated Speed of Convergence - Annual Closure of the Gap in Percent

	Within countries		Between countries	
	Overall	Without outsourcing	Overall	Without outsourcing
	Unconditional convergence			
EU15	0.33	-0.66	3.49 ***	3.32 ***
CEEC	-4.52 ***	-0.66	4.07 ***	3.32 ***
	Conditional convergence			
EU15	6.86 **	2.10	3.56 ***	3.08 ***
CEEC	-0.43	2.10	4.37 ***	3.08 ***