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Abstract

This paper analyzes the effects of international fragmentation in terms of intermediate goods trade on the dynamics of skill-specific real wage bills in manufacturing of three Central and Eastern European countries. Both intermediate goods exports and imports of the CEEC exhibit a positive impact on the unskilled workers' wage bill. Since 1993, intermediate goods trade with the EU alone has accounted for a reduction of about 58 percent of the predicted annual change in the skilled-to-unskilled wage bill ratio in Hungary's manufacturing. The corresponding contribution was 31 percent in Czech Republic and 30 percent in Poland.

Key words: International outsourcing; Wage effects; Panel Econometrics

JEL classification: C33; F14; F15; F16; F40

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1 Introduction¹

Both the political and the economic discussions focus increasingly on the relevance of cross-border fragmentation of the value added chain (outsourcing) for wages and/or employment. To a large extent, these interests concentrate on the effects of outsourcing from the industrialized countries to low-wage economies on the domestic, industrialised countries' labour markets (compare Arndt, 1997; Feenstra & Hanson, 1999; Kohler, 2001). However, evidence for the impact of outsourcing on the foreign, less developed countries' labour markets is scarce (Feenstra & Hanson, 1997).

Concerning the theoretical hypotheses, two basic approaches have been followed. One-sector models of fragmentation in the tradition of Feenstra & Hanson (1999) underpin the importance of the *factor bias* resulting from cross-border outsourcing. Outsourcing of unskilled labour intensive fragments to unskilled labour abundant countries results in a decrease of relative wages (and/or employment) of unskilled labour in the developed sending country and in an increase in the relative wages (and/or employment) in favour of unskilled labour in the less developed destination country, if unskilled labour is used intensively in the outsourced fragment abroad. Two-sector (and multi-sector) models of fragmentation in the tradition of Arndt (1997) or Deardorff (2001) underpin the importance of the *sector bias* rather than the *factor bias*, and the associated effects on the labour markets are reversed if the factor intensities are assumed as above². According to the

¹We should like to thank Hartmut Egger and Michael Pfaffermayr for their helpful comments

²In multi-sector models this is a possible but not necessarily the only outcome

general equilibrium mechanisms at work, outsourcing of the mentioned type leads to an increase in the relative wages in favour of unskilled workers in the sending economy and to a decrease abroad. Kohler (2001) analyzes outsourcing in a specific-factors framework and comes to different conclusions on its impact on relative wages and welfare as compared to the traditional Heckscher-Ohlin model outcomes, which are to some extent similar to the one-sector models' outcome: unskilled labour loses in a country, where the unskilled-labour intensive fragment is outsourced to a foreign economy.³

This paper sets up an empirical study and investigates the impact of international outsourcing on skill-specific real wage bills in three Central and Eastern European Countries (CEEC).⁴ We base our hypotheses on a one-sector model of outsourcing. This decision is motivated by the empirical observation of large within-country-and-skill-group differentials of wage rates in each of the countries under consideration. We interpret this as an indicator for only limited mobility of labour between sectors in the short-run favouring the one-sector model over the other approaches. We apply dynamic panel econometric methods in order to analyze the short-run and long-run effects of outsourcing in terms of intermediate goods exports of 14 manufacturing industries in the three CEEC on the shift in the skilled-to-unskilled wage bill between 1993 and 1998. In a simulation analysis we demonstrate the effects of CEEC-EU integration in terms of intermediate goods trade.

We find a clear positive effect of both intermediate goods exports and in-

³This is the outcome when associating skilled labour with the sector specific factor and unskilled labour with the mobile factor. Kohler (2001) treats capital as immobile between sectors and labour as mobile.

⁴Czech Republic, Hungary, and Poland.

intermediate goods imports on the wage bill of unskilled workers in the CEEC. Intermediate goods trade with the EU accounts for a reduction of 58 percent in the predicted growth of the skilled-to-unskilled workers wage bill ratio since 1993 in Hungary, 31 percent in Czech Republic and 30 percent in Poland.

The next section sets out the theoretical background, section 3 presents the empirical model and the estimation and simulation results, and section 4 concludes.

2 Theoretical Background

For simplicity, we base our theoretical hypotheses on a one-sector, endowment based model of trade, where production can be fragmented into two stages. We assume that a relatively skilled labour-abundant home country (H) to be associated with the European Union, fragments its goods production across borders and outsources part of it to a foreign economy (F), which we associate with Central and Eastern Europe. We concentrate on the wage bill effects of skilled (s) and unskilled (u) labour in the latter.

Assume that goods production is linearly homogeneous of degree one concerning both the aggregation of fragments as well as the technology in each fragment, which uses skilled and unskilled labour exclusively. Wages of skilled and unskilled labour are denoted by w_s and w_u , and the price of each fragment ($i = 1, 2$) is given by

$$p_i = a_{si}w_s + a_{ui}w_u, \quad i = 1, 2. \quad (1)$$

For simplicity, we assume the input coefficients (a_{si}, a_{ui}) as fixed.⁵ Accord-

⁵However, it can be demonstrated that the results are similar for variable input coeffi-

ingly, the factor constraints for fixed labour supply (L_s and L_u , respectively) are

$$L_s = a_{s1}q_1 + a_{s2}q_2 \quad (2)$$

$$L_u = a_{u1}q_1 + a_{u2}q_2,$$

with " q_i " denoting the output of fragments. Assuming that q_1 is the skill-intensive fragment in both economies, we have

$$\frac{a_{s1}}{a_{u1}} > \frac{a_{s2}}{a_{u2}} \quad (3)$$

In the case of identical, linearly homogeneous production technologies in both countries, comparative advantage due to relative factor endowments implies

$$\left(\frac{p_1}{p_2}\right)^F > \left(\frac{p_1}{p_2}\right)^H \quad \text{if} \quad \left(\frac{L_s}{L_u}\right)^F < \left(\frac{L_s}{L_u}\right)^H. \quad (4)$$

Hence, if fragments become tradable the foreign country specializes in the production of the unskilled labour intensive fragment, if it is relatively better endowed with unskilled labour. According to the Stolper-Samuelson theorem, this results in the following pattern of relative wage rates:

$$\left(\frac{w_s}{w_u}\right)^F > \left(\frac{w_s}{w_u}\right)^* > \left(\frac{w_s}{w_u}\right)^H, \quad (5)$$

with the integrated equilibrium wage rate ratio denoted by " $*$ ". Hence, if cross-border specialization at the fragment level becomes possible as markets integrate, this results in an increase in the skilled-to-unskilled relative wage rate in *home* and a decrease in *foreign*. Due to fixed factor supply, this immediately turns over into identical hypotheses for relative wage bills.

cients as long as factor intensity reversal is excluded.

The theoretical hypotheses can be summarized as follows. If factor markets are sector-specific for all involved factors, increasing market integration in terms of cross-border outsourcing implies a decline in both the skilled-to-unskilled workers' wage rate and wage bill ratio in that country, which is relatively better endowed with unskilled labour. Associating the Central and Eastern European countries with such an economy as compared to the EU, we would expect to observe a decline in the skilled-to-unskilled workers' wage bill ratio according to increased outsourcing activity between the EU and the CEEC.

3 Data and Estimation Results

Due to data availability we focus on the effects of intermediate goods trade on the skill-specific wage bills in fourteen NACE 2-digit industries of Czech Republic, Hungary, and Poland over the period 1993-1999.⁶ We distinguish between final goods trade and intermediate goods trade using UNO SITC 5-digit Broad Economic Categories trade data (compare Fontagné et al., 1998). The data are converted to NACE 2-digit numbers according to the correspondence table used by EUROSTAT and kindly provided by Statistics Austria.⁷ Data on real goods production are available from the industrial database provided by the Vienna Institute for International Economic Stud-

⁶Skill-specific employment data for Poland cover only the period 1994-99. Manufacturing industries are aggregated from NACE Revision 1 2-digit industries to 14 industries following EUROSTAT and labelled as DA-DN.

⁷The original table of EUROSTAT is used in order to maintain the correspondence sheet between the SITC classification at 5-digit levels and the NACE industry classification.

ies (WIIW). Wages and employment of manual and non-manual workers are collected from each country's Statistical Yearbook. Due to the lack of more detailed data, we associate manual workers with unskilled workers and non-manual workers with skilled ones. The share of multinational enterprises in the total number of firms is used as an additional control for the wage bill in order to cover the effects of horizontal MNEs in the CEECs, which are simultaneously present. All data are in real figures at constant prices and US dollars of 1996. All estimated specifications include time dummies to account for common cycle effects. In order to save space, descriptive statistics on the growth of intermediate goods trade and skill-specific wage bills in manufacturing in the three CEECs under consideration (average annual change) are presented together with the simulation results below (Table 3).

In our empirical analysis, we envisage the effect of intermediate goods trade in CEEC manufacturing on the real wage bills of skilled workers, unskilled workers and the skilled-to-unskilled workers' wage bill ratio. The

estimated dynamic specifications are:⁸

$$\Delta b_{ijt}^s = \beta_0 + \beta_1 \Delta b_{ij(t-1)}^s + \beta_2 \Delta Y_{ij(t-1)} + \beta_3 \Delta S_{ij(t-1)}^{MNE} + \quad (6)$$

$$\beta_4 \Delta X_{ij(t-2)}^i + \beta_5 \Delta M_{ij(t-2)}^i + \beta_6 \Delta X_{ij(t-2)}^f + \beta_7 \Delta M_{ij(t-2)}^f + \lambda_t + \varepsilon_{ijt},$$

$$\Delta b_{ijt}^u = \beta_0 + \beta_1 \Delta b_{ij(t-1)}^u + \beta_2 \Delta Y_{ij(t-1)} + \beta_3 \Delta S_{ij(t-1)}^{MNE} + \quad (7)$$

$$\beta_4 \Delta X_{ij(t-2)}^i + \beta_5 \Delta M_{ij(t-2)}^i + \beta_6 \Delta X_{ij(t-2)}^f + \beta_7 \Delta M_{ij(t-2)}^f + \lambda_t + \varepsilon_{ijt},$$

$$\Delta \left(\frac{b_{ijt}^s}{b_{ijt}^u} \right) = \beta_0 + \beta_1 \Delta \left(\frac{b_{ij(t-1)}^s}{b_{ij(t-1)}^u} \right) + \beta_2 \Delta Y_{ij(t-1)} + \beta_3 \Delta S_{ij(t-1)}^{MNE} + \quad (8)$$

$$\beta_4 \Delta X_{ij(t-2)}^i + \beta_5 \Delta M_{ij(t-2)}^i + \beta_6 \Delta X_{ij(t-2)}^f + \beta_7 \Delta M_{ij(t-2)}^f + \lambda_t + \varepsilon_{ijt},$$

where "b" are real wage bills (i.e. $b^s = w_s L_s$, etc.), "Y" is real goods production, " S^{MNE} " is the share of MNEs in total industry firms, "M" ("X") are imports (exports), and λ_t is a matrix of time-specific dummy variables. Superscript "i" refers to intermediate goods trade, and "f" denotes final goods trade. Subscript i is the industry index ($i = 1, \dots, 14$), "j" is a country index ($j = 1, 2, 3$), and "t" refers to time. The " Δ " indicates annual changes in logs of the respective variables, only ΔS^{MNE} measures percentage point changes. Due to the availability of data we are restricted in the choice of lags. In order to remove the asymptotic bias, which is especially severe if time series are short (compare Nickell, 1981, or Ridder & Wansbeek, 1990), we follow the lines of Arellano & Bond (1991) and estimate the model by GMM, using values of lag-order two or higher of the dependent variable as instruments. Table 1 presents the regression results.

⁸See also Konings & Vandenbussche (1995) or Abraham & Konings (1999) for related specifications in the analysis of the effects of globalization on the wages in Western European countries. Anderton & Brenton (1999) estimate wage bill regressions in order to analyze the effects of trade on wages in UK industries.

> Table 1 <

In all estimated models, the lagged growth in industry production exhibits a positive impact on current growth of the wage bill. Both skilled and unskilled workers significantly lose from an increase in the share of MNEs.⁹ Trade variables enter the model lagged twice and do not exhibit a significant impact earlier, which is probably due to the presence of adjustment costs. Final goods exports affect relative wage bills similar to intermediate goods exports. Both intermediate goods exports and imports lead to a positive impact on the unskilled workers' wage bill. This results in a decline of the skilled-to-unskilled labour wage bill ratio. According to our evidence, intermediate goods exports account for the largest part of the change in the shift of the relative wage bill in favour of unskilled workers. We provide evidence that outsourcing in the CEEC indeed uses unskilled workers more intensively. From an econometric perspective, the estimation results are robust and reliable in terms of the tests for second order autocorrelation and over-identification.

The results in Table 1 represent only short-term influences of the exogenous variables on the wage bill. The presence of adjustment costs as indicated by the significant positive impact of the lagged relative wage bill in Model III implies that a shock in intermediate goods trade lasts longer than only a single period. Hence, the long-run effect of such a shock is higher than its short-run counterpart. The long-run effect of each exogenous variable k

⁹This indicates that the labor productivity increase induced by MNEs is larger than their impact on output and wage rates through high-wage policy as compared to domestic firms.

with parameter β_k is given by $\beta_k/(1 - \beta_1)$. According to Bårdsen (1989), the matrix of the corresponding standard deviations can be calculated by $\widehat{V(K)} = J\widehat{V}J'$, where $J = \partial K/\partial\beta$ and K is the vector of the long-run multipliers. The long-run results are presented in Table 2. A 10 percent change in CEEC intermediate goods exports results in a 3 percent change in the relative wage bill in favour of unskilled labour. This effect is about triple as high as that one of a change in intermediate goods imports. This indicates that intermediate exports use unskilled labor relatively more intensive than the assembly of intermediate imports from abroad

> Table 2 <

With the estimation results at hand, we can now turn to our simulation analysis. Below, we concentrate on the results of Model III and ask, how changes in relative wage bills in CEEC manufacturing would have looked like without the observed annual growth of intermediate goods exports to the EU and of intermediate imports from the EU alone. In the first thought experiment, we hold intermediate goods exports to the EU *ceteris paribus* constant at their 1993 value. Hence, non-EU intermediate exports and other variables develop as observed. The second thought experiment assumes that intermediate imports from the EU were constant at their 1993 value. Again, non-EU intermediate imports and other variables are assumed to grow as observed. Table 3 summarizes the results from the two experiments.

> Table 3 <

First, CEEC intermediate goods exports to the EU on average grow slower than intermediate imports goods from the EU. But, this effect on the rela-

tive wage bill is more pronounced as compared to the latter, since the corresponding elasticity is much higher. In the average year and manufacturing industry, relative wage bills grew by 1.4 percent in Hungary, by 3.3 percent in Czech Republic, and by 3.6 percent in Poland over the period under consideration. Growth of intermediate goods exports per annum would have been 13.1 percent lower in Hungary's (10.5 percent in Czech Republic's and 7.6 percent in Poland's) manufacturing, if intermediate goods exports to the EU were constant at their 1993 values. The relationship with the EU alone accounts for a reduction in the predicted growth of the skilled-to-unskilled labour wage bill ratio of about 41.0 percent per year in Hungary (about 19.2 percent in Czech Republic and 14.1 in Poland). However, this effect is a composite of the short-term impact from a shock in each period and the long-term effect because of the importance of adjustment costs. Average annual growth of intermediate goods imports would have been 14.3 percent lower in Hungary (20.5 percent Czech Republic and 13.6 percent in Poland) than the observed growth if intermediate goods imports from the EU had not changed since 1993. Thereby, intermediate goods import growth from the EU alone accounts for a reduction of about 16.9 percent of the predicted average annual change in the skilled-to-unskilled labour wage bill ratio in Hungary (12.1 percent in Czech Republic and 15.5 percent in Poland). Altogether, integration with the EU in terms of intermediate goods trade in the 3 CEEC's manufacturing accounts for a significant closure of the gap in the wage-bill distribution across skill groups. Roughly 58 percent of the closure of the predicted wage bill differential in Hungary can be attributed to its intermediate goods trade with the EU since 1993 (31 percent in Czech

Republic and 30 percent in Poland). Accordingly, outsourcing is identified as a major source of the decline in income distribution across skill-groups in CEEC manufacturing in terms of relative wage bills.

4 Conclusions

Major part of the literature on the labour market effects of outsourcing has taken a sending (developed) country's perspective. The present paper focuses on the outsourcing effects on the skilled-to-unskilled labour wage bill ratio in Czech Republic, Hungary, and Poland. The hypotheses are derived from a one-sector, endowment based model of outsourcing. We find that both intermediate goods exports and intermediate goods imports support unskilled labour in terms of wage bill growth.

We run dynamic wage bill regressions for a panel of NACE two-digit industries over the period 1993-1999. Using the regression results, we simulate the impact of EU-CEEC trade in intermediate goods on the skilled-to-unskilled wage bill ratio in Central and Eastern European manufacturing. The impact is more pronounced for intermediate goods exports than for intermediate goods imports. Intermediate goods trade with the EU alone accounts for a 58 percent reduction of the predicted annual change in the skilled-to-unskilled wage bill ratio in Hungary, for 31 percent in Czech Republic and 30 percent in Poland. In general, outsourcing significantly reduces the skill specific wage gap in CEEC manufacturing.

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Table 1: Outsourcing and the Skill-specific Wage Bill in Eastern Europe

Independent Variables:	Model I	Model II	Model III
$\Delta \log(b_{t-1}^S)$	0.314 *** (0.034)	-	-
$\Delta \log(b_{t-1}^U)$	-	0.131 *** (0.039)	-
$\Delta \log(b_{t-1}^S/b_{t-1}^U)$	-	-	0.695 *** (0.054)
$\Delta \log(Y_{t-1})$	0.220 *** (0.081)	0.167 ** (0.070)	0.198 *** (0.039)
$\Delta \log(S_{t-1}^{MNE})$	-0.775 *** (0.172)	-0.614 *** (0.230)	-0.146 (0.118)
$\Delta \log(X_{t-2}^i)$	0.011 (0.048)	0.071 ** (0.028)	-0.101 *** (0.020)
$\Delta \log(M_{t-2}^i)$	0.040 *** (0.009)	0.043 *** (0.009)	-0.026 *) (0.013)
$\Delta \log(X_{t-2}^f)$	-0.016 (0.030)	-0.081 *** (0.022)	-0.045 *** (0.010)
$\Delta \log(M_{t-2}^f)$	0.015 (0.023)	0.029 (0.018)	0.014 (0.011)
Constant	-0.018 (0.011)	-0.008 (0.008)	-0.011 (0.007)
Observations	171	171	171
R ²	0.22	0.17	0.29
Time effects: $\chi^2(4)$	158.66 ***	83.02 ***	51.47 ***
1 st order autocorrelation	-1.62	-1.02	-1.78 *)
2 nd order autocorrelation	1.87 *)	1.56	0.64
Sargan test: $\chi^2(20)$	26.59	27.40	19.29

Standard errors in parentheses. ***) significant at 1%; **) significant at 5%; *) significant at 10%.

Table 2: Long-run Parameter Estimates

Independent Variables:	Model I	Model II	Model III
$\Delta \log(Y)$	0.321 *** (0.113)	0.192 *** (0.076)	0.652 *** (0.127)
$\Delta \log(S^{MNE})$	-1.129 *** (0.262)	-0.707 *** (0.281)	-0.479 (0.397)
$\Delta \log(X^i)$	0.017 (0.070)	0.081 ** (0.034)	-0.331 *** (0.070)
$\Delta \log(M^i)$	0.059 *** (0.014)	0.049 *** (0.010)	-0.086 ** (0.044)
$\Delta \log(X^f)$	-0.023 (0.044)	-0.094 *** (0.027)	-0.147 *** (0.036)
$\Delta \log(M^f)$	0.022 (0.034)	0.033 (0.022)	0.046 (0.035)
Constant	-0.026 (0.016)	-0.009 (0.009)	-0.036 (0.022)

Standard errors in parentheses. *** significant at 1%; ** significant at 5%.

Table 3: Growth of Intermediate Exports to the EU and Their Effect on the Relative Wage Bill in CEEC Manufacturing (1993-1999)

Variables:	Hungary	Czech Republic	Poland
	Average Annual Change as %		
Real Intermediate Goods Exports	18.71	12.55	8.69
Real Intermediate Goods Imports	19.03	20.39	20.66
Relative Wage Bill of Skilled to Unskilled Workers	1.38	3.32	3.58
	Observed Minus Simulated Change		
Scenario 1: Zero Change in Intermediate Goods Exports to the EU			
Real Intermediate Goods Exports	13.07	10.45	7.61
Relative Wage Bill of Skilled to Unskilled Workers	-0.96	-0.79	-0.59
Scenario 2: Zero Change in Intermediate Goods Imports to the EU			
Real Intermediate Goods Imports	14.33	20.47	13.62
Relative Wage Bill of Skilled to Unskilled Workers	-0.28	-0.46	-0.66

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