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 **WORKING PAPERS**

**International Outsourcing and Labour
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INTERNATIONAL OUTSOURCING AND LABOUR **WITH SECTOR-SPECIFIC HUMAN CAPITAL**

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Abstract:

This paper attempts to quantify the impact of outsourcing on production patterns and the labour market in a two sector specific factors model with skilled labour (specific factor) and unskilled labour (mobile factor). Outsourcing can be compared to the case, where trade liberalization leads to trade in final goods and a change in relative prices. In the latter case a downward pressure on the wage rate for skilled labour in one sector and a wage rise for skilled labour in the other sector indicate significant adjustment costs, whereas with outsourcing an outcome of rising wage rates for skilled labour in both sectors is feasible. The full impact of outsourcing depends on the relative weight of the 'factor savings' and the 'cost savings' effect. The negative impact on the unskilled wage rate is similar in both cases and depends on the macroeconomic relevance of the respective shocks.

Key words: Outsourcing, trade liberalization, specific factors model.

JEL Code: F11, F15, D20

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1. Introduction

Fragmentation of the value added chain and international outsourcing have been the most important recent issues in the public debate about negative consequences of globalization for labour, especially for low skilled labour.¹ In general, in the scientific debate about outsourcing the use of the Heckscher-Ohlin model dominates. Besides the overall welfare impact also the consequences for income distribution have been discussed exhaustively. Arndt (1997, 1999) has emphasized the positive welfare effects of outsourcing due to an outward shift of the production possibility curve, although combined with changes in the income distribution. Other recent studies clearly isolate factor intensities of fragments and of integrated production as the determining parameters for the impact on wages, as Jones and Kierzkowski (2001) and Deardorff (2001). General results in the Heckscher-Ohlin model for outsourcing in both sectors and different outsourcing equilibria can be found in other recent studies (Egger, 2002, Egger and Falkinger, 2003). Egger (2002) has shown how outsourcing in both sectors affects the income distribution and that the magnitude of the cost savings effect together with factor intensities of fragments play the determining role. This analysis has been extended in Egger and Falkinger (2003) to a Heckscher-Ohlin model with different diversified and specialized equilibria. The main finding there is a potential Pareto-improving impact, which depends on the interplay of the factor substitution and the cost savings effect. Jones and Kierzkowski (2001) describe the state of research on the impact of outsourcing on labour with the 'almost anything can happen'-statement, as most studies conclude with a welfare improvement and unclear distributional effects of outsourcing. One remaining open question in this framework therefore mainly concerns the empirical determination of parameter values and variables (e.g. factor intensities of fragments).

¹ In this debate the terms 'fragmentation' and 'outsourcing' have often been used synonymously. This study follows the terminology of Egger and Falkinger (2003), where fragmentation only describes the splitting up of the value added chain and (international) outsourcing describes the dislocation of part of the production leading to arm's-length transactions. Fragmentation therefore is a precondition for international outsourcing.

In some recent studies, where the specific factors model developed by Jones (1971, 1975) has been applied (Kohler 2001, 2004) the interplay between income distribution changes and the welfare effect of outsourcing represent the focus of analysis. The most important result in Kohler (2004) is that net welfare increases from outsourcing are larger, when the cost savings effect (given by the wage differential between home and abroad) is larger ('the higher the gain, the lower the pain'). Kohler (2004) confronts this finding with opposite results from the analysis of income distribution impacts of trade liberalization ('the higher the gain, the higher the pain'). He finds out that outsourcing creates a macroeconomic surplus with income distribution changes similar to the 'immigration surplus'.

This paper takes up the concept of 'outsourcing surplus' in a specific factors framework and focusses on the fundamental difference between final goods trade (FGT) and outsourcing (OS). As the distributional changes brought about by trade translate into adjustment costs at the labour market, the specific factors model capturing these short term impacts within a consistent long term framework (Neary, 1978) seems adequate. An important part of the literature on imperfect labour markets and trade concentrates on downward wage rigidity for unskilled labour. This analysis is based on Brecher (1974) and generally shows that the unemployment impact of wage rigidity might fully erode the welfare gain from trade (Davis, 1998). This has generally been formulated for FGT and has been discussed intensively for the case of Germany (see for example: Seidel, 2005). Egger and Egger (2003) have shown the impact of OS in a model with skilled and unskilled labour and wage rigidity.

Contrary to that the perspective on imperfections in the labour market chosen here is based on adjustment costs of labour reallocation. This is in line with the literature on intra-industry trade (IIT) with limited mobility of the labour force between industries, so that IIT leads to 'smooth adjustment' compared to inter-industry trade. This hypothesis has recently also been exposed in the framework of the specific factors model (Brülhart and Elliott, 2002, Greenaway, Haynes and Milner, 2002, Lovely and Nelson, 2002). Brülhart and Elliott (2002) as well as Greenaway, Haynes and Milner (2002) have shown that labour market imperfections due to downward wage rigidity can be easily integrated into this framework leading to unemployment instead of distributional changes and labour reallocation. We will

not explicitly introduce unemployment in our analysis, but we will instead show the completely different distributional impacts of FGT and OS and interpret them as the necessary flexibilities in the skilled and unskilled labour market in terms of wage flexibility and labour mobility in both cases. The essence of FGT liberalization is a price decrease, whereas OS – as other studies have already shown – is similar to technological change. The general equilibrium impact of OS will be decomposed within the specific factors framework into a factor saving and a ('pure') cost saving effect similar to the analysis of Kohler (2004). This analysis will be carried out applying both a theoretical model as well as a numerical example based on the stylized facts of OS from Austria to (former) Eastern European countries (now new EU member states). It can be clearly derived, that the interplay of the factor and the cost savings effect determines the distributional changes. In the FGT case as well as in the OS case the potential negative impacts for unskilled labour mainly depend on the 'macroeconomic significance' of the shock. For FGT this is measured by the magnitude of the price shock and for OS by the proportion of the unskilled labour force used in the fragment that is sourced out. The comparison of OS with FGT reveals similarities with respect to the impact on unskilled labour, but important differences with respect to the impact on sector specific labour and production patterns. These different results can be translated into differences in factor adjustment costs, which might be relevant for European labour markets. The paper is organized as follows. In section 2 a specific factors model is set up for FGT and for OS and is solved for factor prices and output in order to analyse the comparative statics of both cases. In section 3 a numerical example is chosen according to the stylized facts for outsourcing from Austria to Eastern European countries (new member states) after the fall of the Iron Curtain. Section 4 summarizes the main results and concludes.

2. 1. Final Goods Trade and Labour

The specific factors model (Jones, 1971, 1975) with two sectors (1,2), sector specific human capital H_1 and H_2 and unskilled labour L as the mobile factor exhibits constant returns to scale production functions for outputs X_1 and X_2 :

$$X_1 = F_1(L_1, H_1) \quad X_2 = F_2(L_2, H_2) \quad (1)$$

As the fixed endowment for sector specific human capital determines output in each sector for given input coefficients, the marginal product schedules for labour in both sectors determine the equilibrium wage rate for unskilled labour. Input coefficients for each factor and output levels adjust, so that for given endowments the full employment conditions hold:

$$h_1 X_1 = \bar{H}_1 \quad (2)$$

$$h_2 X_2 = \bar{H}_2 \quad (3)$$

$$l_1 X_1 + l_2 X_2 = \bar{L} \quad (4)$$

The input coefficients h_1 ; h_2 ; l_1 and l_2 depend for a given technology on relative factor prices for unskilled labour w_U and for skilled labour w_1 and w_2 :

$$h_1 = h_1 \left(\frac{w_U}{w_1} \right); h_2 = h_2 \left(\frac{w_U}{w_2} \right); l_1 = l_1 \left(\frac{w_1}{w_U} \right); l_2 = l_2 \left(\frac{w_2}{w_U} \right) \quad (5)$$

with $h_1 \succ 0$, $h_2 \succ 0$, $l_1 \succ 0$ and $l_2 \succ 0$.

The elasticity of substitution is given by $\sigma_i = \frac{\hat{h}_i - \hat{l}_i}{\hat{w}_U - \hat{w}_i}$ with $i = 1, 2$ (sectors), where an $\hat{}$ over a variable describes relative change ($\hat{h}_1 = dh_1/h_1$). From the unit price equations

$p_1 = l_1 w_U + h_1 w_1$ and $p_2 = l_2 w_U + h_2 w_2$ the well known equations for price changes can be derived:

$$\hat{p}_1 = \vartheta_{L1} \hat{w}_U + \vartheta_{H1} \hat{w}_1 \quad (6)$$

$$\hat{p}_2 = \vartheta_{L2} \hat{w}_U + \vartheta_{H2} \hat{w}_2 \quad (7)$$

where θ_{ji} are the factor shares ($\theta_{Li} = w_U L_i / p_i X_i$ and $\theta_{Hi} = w_i H_i / p_i X_i$) and λ_{ji} are the proportions of the mobile factor (unskilled labour) used in the two sectors ($\lambda_{Li} = l_i X_i / \bar{L}$). The price

equations (6) and (7) have been derived by applying the conditions for cost minimization (s.: Jones, 1971, 1975):

$$\vartheta_{L1}\hat{l}_1 + \vartheta_{H1}\hat{h}_1 = 0 \quad \vartheta_{L2}\hat{l}_2 + \vartheta_{H2}\hat{h}_2 = 0 \quad (8)$$

The comparative static analysis is carried out here for fixed endowment of skilled and unskilled labour, i.e.: $\hat{H}_1 = 0$, $\hat{H}_2 = 0$ and $\hat{L} = 0$. In that case output changes are determined by changes in input coefficients of the specific factor:

$$\hat{X}_1 = -\hat{h}_1 \quad ; \quad \hat{X}_2 = -\hat{h}_2 \quad (9)$$

Using (9) as well as the definition of the substitution elasticity we derive the following expression from the full employment condition for unskilled labour ($\hat{L} = 0$):

$$\lambda_{L1}\sigma_1(\hat{w}_1 - \hat{w}_U) + \lambda_{L2}\sigma_2(\hat{w}_2 - \hat{w}_U) = 0 \quad (10)$$

This model with fixed endowments can be solved explicitly for factor prices and outputs. A deviation from the full employment condition could be introduced by wage rigidity concerning the unskilled as well as the two skilled wage rates. In that case ($\hat{w}_U = 0$, $\hat{w}_1 = 0$, $\hat{w}_2 = 0$) factors were not fully employed and the model had to be solved for unemployment instead of factor prices. The price equations (6) and (7) can be inserted into the full employment condition (10) to derive the solution for the wage rate (s. Jones, 1971, 1975):

$$\hat{w}_U = \frac{1}{\Delta} \left[\hat{p}_1 \lambda_{L1} \frac{\sigma_1}{\vartheta_{H1}} + \hat{p}_2 \lambda_{L2} \frac{\sigma_2}{\vartheta_{H2}} \right] \quad (11)$$

where Δ is the sum $\lambda_{L1} \frac{\sigma_1}{\vartheta_{H1}} + \lambda_{L2} \frac{\sigma_2}{\vartheta_{H2}}$. Therefore the change in the unskilled wage rate is a

weighted average of changes in commodity prices and the term $\frac{\sigma_i}{\vartheta_{Hi}}$ represents the 'elasticity of the marginal product' (Jones, 1975) of the mobile factor in each industry. Combining the wage equation (11) with the price equations (6) and (7) we derive the solution for each skilled wage rate:

$$\hat{w}_1 = \frac{1}{\Delta} \left[\hat{p}_1 \left(\lambda_{L1} \frac{\sigma_1}{\vartheta_{H1}} + \lambda_{L2} \frac{\sigma_2}{\vartheta_{H2}} \frac{1}{\vartheta_{H1}} \right) - \hat{p}_2 \lambda_{L2} \frac{\sigma_2}{\vartheta_{H2}} \frac{\theta_{L1}}{\vartheta_{H1}} \right] \quad (12)$$

$$\hat{w}_2 = \frac{1}{\Delta} \left[\hat{p}_2 \left(\lambda_{L2} \frac{\sigma_2}{\vartheta_{H2}} + \lambda_{L1} \frac{\sigma_2}{\vartheta_{H2}} \frac{1}{\vartheta_{H2}} \right) - \hat{p}_1 \lambda_{L1} \frac{\sigma_1}{\vartheta_{H1}} \frac{\theta_{L2}}{\vartheta_{H2}} \right] \quad (13)$$

As $\frac{1}{\vartheta_{H1}} > 1$ and $\frac{1}{\vartheta_{H2}} > 1$, a change in a commodity price induces a more than proportional change in the factor price of the specific factor in that sector and we get the *magnification effect* for factor prices: $\hat{w}_1 > \hat{p}_1 > \hat{w}_U > \hat{p}_2 > \hat{w}_2$. Here we assume that different countries specialize on different industries, which leads to the accumulation of sector specific skills. A country with higher output in a sector has attained more experience and sector specific knowledge accompanied by a higher factor reward to this sector specific - human capital. The foreign (low wage) economy is only able to produce a full composite unit of commodity 1 (in terms of the home economy), if enough sector specific capital is available. This is the prerequisite for the case of FGT, which leads to a decrease in the price of commodity 1. The impact of a reduction of commodity 1 price on specific factor rewards (in nominal terms) is straightforward from (12) and (13): the specific factor price in sector 1 (w_1) declines and the other (w_2) rises.

Changes in output induced by terms of trade changes can be easily derived by making use of condition (8), the elasticity of substitution definition and the price equations (s.: Jones, 1975 and Kohler, 1991):

$$\hat{X}_1 = \frac{\vartheta_{L1}}{\vartheta_{H1}} \sigma_1 (\hat{p}_1 - \hat{w}_U) \quad ; \quad \hat{X}_2 = \frac{\vartheta_{L2}}{\vartheta_{H2}} \sigma_2 (\hat{p}_2 - \hat{w}_U) \quad (14)$$

Equation (14) shows that expansion or contraction of commodity outputs depends on the difference between commodity price changes and changes in the unskilled wage rate. Therefore in the case of a price decrease for commodity 1, sector 1 contracts and sector 2 expands.

If we assume that due to unions wage flexibility of skilled labour is restricted in the short term, the change in terms of trade (decrease of commodity 1 price) would lead to an increase in equilibrium unemployment in sector 1 accompanied by a decrease of the unskilled wage rate (as outlined above). This is accompanied by a decline of production in sector 1 and an increase in sector 2. Obviously these results depend on the assumption of fully flexible wages for unskilled labour. If this were not the case the results in line with Davis (1998) would be applicable and unemployment would also increase in the unskilled segment with consequences for the welfare impact of trade liberalization. The outcome of FGT therefore clearly indicates long run adjustment costs, whereas the short term impact on unskilled labour might be positive in real terms due to the *magnification effect* and depending on consumption patterns. These potential gains for unskilled labour, the actual gains for sector 2 and the actual losses for sector 1 are directly proportional to the price decrease. Therefore for the FGT case the conclusion "the higher the gain, the higher the pain" can be drawn.

2.2 Outsourcing and Labour

The model framework has to be expanded in order to take into account fragmentation of the value added chain and international outsourcing. We start with the assumption that production in sector 1 is fragmented without (in the beginning) assuming that fragments are actually sourced out. Production is in a first instance organized as vertically integrated, but can be split up into two fragments. The setting is more restricted than in other recent studies that assume the feasibility of outsourcing in all sectors (e.g. Egger and Falkinger, 2003). Here we assume that only the more labour intensive sector (sector 1) will produce in a fragmented way and might source out part of his production. The new production functions are therefore given with fragments F_{11} and F_{21} in sector 1 and the same function as above in sector 2:

$$\begin{aligned} X_1 &= [F_{11}(L_{11}, H_{11}), F_{11}(L_{21}, H_{21})] \\ X_2 &= F_2(L_2, H_2) \end{aligned} \tag{15}$$

It is assumed that both fragments in sector 1 are combined by a Leontief technology of fixed input coefficients in order to produce output of commodity 1 (assembling). Therefore substitution does not take place between fragments, but within each fragment and full employment conditions are written as:

$$h_{11}X_1 + h_{21}X_1 = \bar{H}_1 \quad (16)$$

$$h_2X_2 = \bar{H}_2 \quad (17)$$

$$l_{11}X_1 + l_{21}X_1 + l_2X_2 = \bar{L} \quad (18)$$

The definitions of the elasticity of substitution are the same as before and we have σ_{11} , σ_{21} and σ_2 . The next step is to define the concept of OS used in this study. In the literature we find different approaches. On the one hand 'continuous' OS without any indivisibility as in (Kohler, 2004) is analysed, on the other hand we find the concept of outsourcing as a discrete shift from one technology to another and not as a marginal change in technology (Jones and Kierzkowski, 2001, Egger and Falkinger, 2003). In this study the second approach is chosen to represent OS and to differentiate between vertically integrated production and production with OS. For vertically integrated production in sector 1 the unit price equation is: $p_1 = (l_{11} + l_{21})w_U + (h_{11} + h_{21})w_1$.

Kohler (2003) has clearly laid down the necessary conditions for shifting from integrated production equilibrium to equilibrium 'cum outsourcing' thereby deriving a margin of fragmentation and the 'Stolper-Samuelson disturbances' brought about by OS. These results are the starting point of further analysis in this model framework. The dynamic price equation in sector 1 (the OS sector) can be written by taking into account all changes caused by a shift from integrated equilibrium to OS equilibrium. The factor shares in sector 1 are now given with $\vartheta_{L1} = \sum_i \vartheta_{Li}$ and $\vartheta_{H1} = \sum_i \vartheta_{Hi}$ where $i=1,2$ is the index of fragments. The factor shares

of the fragments in the case of integrated production are defined with $\vartheta_{F1} = \sum_k \vartheta_{k,11}$ and

$\vartheta_{F2} = \sum_k \vartheta_{k,21}$ with $k= L,H$ as the index of factors . If the fragments are sourced out abroad

they shall be labelled as ϑ_{F1}^f and ϑ_{F2}^f respectively and defined as:

$$\vartheta_{Fi}^f = l_{i1} \frac{w_U^f}{p_1} + h_{i1} \frac{w_1^f}{p_1} \quad (19)$$

with $i= 1,2$ is the index of fragments. Here ϑ_{F1}^f is the factor share of fragment 1 if produced abroad with foreign factor prices w_U^f and w_1^f . These factor shares of fragments are used here instead of the 'effective fragment prices' in Kohler (2003). Production of outsourced fragments therefore uses the same technology as integrated home production concerning the factor intensities, but there is a cost advantage due to lower factor prices. The foreign factor prices w_U^f and w_1^f are defined in a way to include all trade and communication costs linked to arms'-length transactions and there is no further fixed cost element of OS assumed. In this analysis 'home' is the region, where OS can take place, if foreign factor prices are below domestic factor prices: $w_U^f \leq w_U$; $w_1^f \leq w_1$. In that case one of the two fragments is sourced out abroad, but no OS takes place if $w_U^f = w_U$ and $w_1^f = w_1$. The foreign economy, where one of these fragments is produced, might be imagined in a position where due to scarcity of sector specific human capital no full composite unit of total output of commodity 1 can be produced. In the FGT case above the foreign economy is able to produce commodity 1 in a vertically integrated process thereby threatening the home sector, when trade liberalization takes place. In the OS case availability of sector specific human capital in 'foreign' is limited due to less experience in the production of these products. Therefore 'foreign' must specialize on one fragment and the threat for the home economy is that production of one fragment will be moved abroad entirely, if there is any factor price difference. The proportions of the mobile factor are defined as before and we now have $\lambda_{L,11}$, $\lambda_{L,21}$ and λ_{L2} .

If fragment 1 is sourced out, it is entirely shifted from domestic integrated production to production abroad, so that in the price equation for sector 1 we have \hat{l}_{11} and $\hat{h}_{11} = -1$ and we get the additional cost element of production abroad, namely ϑ_{Fi}^f .

The general price equation for commodity 1 can therefore be represented by:

$$\hat{p}_1 = (\vartheta_{L,11} + \vartheta_{L,21})\hat{w}_U + (\vartheta_{H,11} + \vartheta_{H,21})\hat{w}_1 + (\vartheta_{F1}^f - \vartheta_{L,11} - \vartheta_{H,11}) \quad (20)$$

Equation (20) is formulated in a way to describe the case of integrated production as well as the OS equilibrium. That can be seen by expressing the additional net cost term in (20) by differences in factor prices:

$$\vartheta_{F1}^f - \vartheta_{L,11} - \vartheta_{H,11} = \frac{\lambda_{L,11}}{\pi_1}(w_U^f - w_U) + \frac{h_{11}}{p_1}(w_1^f - w_1) \quad (21)$$

with π_1 as the unskilled labour productivity share of sector 1 ($\pi_1 = p_1 X_1 / \bar{L}$) and π as total unskilled productivity: $\pi = \pi_1 + \pi_2$. The additional net cost term shall be also referred to in a condensed form as $(C^f - C)$.

In the case of integrated production factor prices are given by $w_U^f = w_U$, $w_1^f = w_1$ and therefore the additional net cost term $(C^f - C)$ becomes zero. Dynamics in factor prices are in that case determined as in equation (6). In the case of OS factor prices are given by $w_U^f < w_U$ and $w_1^f < w_1$, therefore fragment 1 disappears, so that $\vartheta_{L,11}\hat{w}_U = 0$ and $\vartheta_{H,11}\hat{w}_1 = 0$. Only the factor shares of fragment 2 play a role in price equation (20) in that case and the additional net cost term $(C^f - C)$ becomes relevant. The price equations in the case of OS of fragment 1 are therefore given with:

$$\hat{p}_1 = \vartheta_{L,21}\hat{w}_U + \vartheta_{H,21}\hat{w}_1 + \frac{\lambda_{L,11}}{\pi_1}(w_U^f - w_U) + \frac{h_{11}}{p_1}(w_1^f - w_1) \quad (22)$$

$$\hat{p}_2 = \vartheta_{L2}\hat{w}_U + \vartheta_{H2}\hat{w}_2 \quad (7)$$

Equation (22) takes into account the 'Stolper-Samuelson disturbances' of OS (Kohler, 2003) and reveals how they depend on factor price differences between 'home' and 'foreign'.

The model is complemented by output equations and full employment conditions for given endowments in the case of outsourcing of fragment 1:

$$\hat{X}_1 = -\hat{h}_{21} \quad ; \quad \hat{X}_2 = -\hat{h}_2 \quad (23)$$

Equation (23) is the specific form of equation (9) due to $\hat{h}_{11} = 0$, once fragment 1 has moved abroad. The full employment condition for unskilled labour ($\hat{L} = 0$) is given by:

$$\hat{L} = 0 = \hat{l}_{11}\lambda_{L,11} + \hat{l}_{21}\lambda_{L,21} + \hat{X}_1(\lambda_{L,11} + \lambda_{L,21}) + \hat{l}_2\lambda_{L2} + \hat{X}_2\lambda_{L2} \quad ; \quad (24)$$

As fragment 1 moves cross the border, $\hat{l}_{11} = -1$ and $\hat{l}_{11}\lambda_{L,11} = -\lambda_{L,11}$ for a given unskilled labour proportion $\lambda_{L,11}$ before OS. This is the factor savings effect of OS, which has to be compensated by a wage decrease for unskilled labour. Again we could assume wage rigidity in all labour markets ($\hat{w}_U = 0$, $\hat{w}_1 = 0$, $\hat{w}_2 = 0$) and solve the model for unemployment instead of factor prices. After cross-border OS has taken place, further output changes in sector 1 can lead to positive employment effects of unskilled labour, but only in fragment 2. Therefore $\hat{X}_1\lambda_{L,11} = 0$ after OS. Applying that to equation (24) we end up with the following condition:

$$\lambda_{L,21}\sigma_{21}(\hat{w}_1 - \hat{w}_U) + \lambda_{L2}\sigma_2(\hat{w}_2 - \hat{w}_U) - \lambda_{L,11} = 0 \quad (25)$$

The model can be solved for explicit expressions of factor prices in the case of OS, where no change in terms of trade takes place (i.e. $\hat{p}_1 = 0$ and $\hat{p}_2 = 0$). The solution derived for the unskilled wage rate is:

$$\hat{w}_U = \frac{1}{\Delta^*} [\lambda_{L,21}\sigma_{21}(C - C^f) - \lambda_{L,11}] \quad (26)$$

where Δ^* is the sum $\lambda_{L,21} \frac{\sigma_{21}}{\vartheta_{H,21}} \vartheta_{F2} + \lambda_{L2} \frac{\sigma_2}{\vartheta_{H2}}$ and $(C - C^f) = \frac{\lambda_{L,11}}{\pi_1}(w_U - w_U^f) + \frac{h_{11}}{p_1}(w_1 - w_1^f)$.

For large cost advantages ($C - C^f$) the impact of OS on the unskilled wage rate might even be positive. The most important parameter in (26) is the proportion of fragment 1 unskilled labour input $\lambda_{L,11}$. The larger this proportion, the higher the necessary decrease in the unskilled wage rate after OS in order to restore full employment equilibrium. This is the

consequence of the factor saving effect and can be thought of measuring the ‘macroeconomic significance’ of the phenomenon OS. If any difference in factor prices between ‘home’ and ‘foreign’ leads to total OS of one fragment, it is clearly the magnitude of this fragment in terms of the domestic labour market that matters. On the other hand we observe the ‘pure’ cost saving effects in (26) determined by factor price differences. Actually equation (26) allows to decompose the total unskilled wage impact into the (negative) factor savings impact ($-\frac{1}{\Delta^*}\lambda_{L,11}$) and the (positive) ‘pure’ cost saving effect ($\frac{1}{\Delta^*}[\lambda_{L,21}\sigma_{21}(C-C^f)]$). The necessary decrease in the unskilled wage rate becomes smaller, when the cost savings effect becomes larger. This result is in line with Kohler’s conclusion: ‘the higher the gain, the lower the pain’ (Kohler, 2004).

The impact on the skilled wage rates can be derived from the price equations by inserting (26):

$$\hat{w}_1 = (C - C^f) \left[1 - \frac{\vartheta_{L,21}}{\vartheta_{H,21}} \frac{1}{\Delta^*} \lambda_{L,21} \sigma_{21} \right] + \frac{\vartheta_{L,21}}{\vartheta_{H,21}} \frac{\lambda_{L,11}}{\Delta^*} \quad (27)$$

$$\hat{w}_2 = \frac{\vartheta_{L2}}{\vartheta_{H2}} \frac{1}{\Delta^*} [\lambda_{L,21} \sigma_{21} (C^f - C) + \lambda_{L,11}] \quad (28)$$

In (27) we observe that the cost advantage ($C-C^f$) exerts a direct positive impact on the skilled wage rate in the OS sector and a negative impact as far as it raises the unskilled wage rate. As far as OS depresses the unskilled wage rate in order to restore full employment equilibrium (depending on $\lambda_{L,11}$) it also raises the skilled wage rate in the OS sector. The impact on the skilled wage rate in the other sector (equation (28)) only captures the repercussions from the change in the unskilled wage rate: the cost advantage ($C-C^f$) depresses the skilled wage rate in sector 2 (as it raises the unskilled wage rate), whereas the factor savings effect (depending on $\lambda_{L,11}$) raises it like in sector 1. The skilled wage rate in sector 2 is in (28) expressed in terms of the variables of the ‘OS version’ of the specific factors model. This representation hides the aspect that changes in w_2 are only determined by changes in w_U and could be directly derived

from equation (7) as: $\hat{w}_2 = -\frac{\vartheta_{L2}}{\vartheta_{H2}} \hat{w}_U$. Therefore the impact of a given change in the unskilled wage rate on the skilled wage rate in sector 2 is the same for the OS and the FGT case.

If both specific factor prices increase and the unskilled wage rate decreases, the input coefficients of skilled labour will decline due to substitution effects and allow both sectors to expand their production. As in the case of FGT we can solve the model for output changes and get:

$$\hat{X}_1 = \frac{\vartheta_{L1}}{\vartheta_{F2}} \sigma_{21} \left[(C - C^f) - \frac{\vartheta_{F2}}{\vartheta_{H,21}} \hat{w}_U \right] \quad ; \quad \hat{X}_1 = -\frac{\vartheta_{L2}}{\vartheta_{H2}} \sigma_2 \hat{w}_U \quad (29)$$

For the outsourcing sector the potential of expansion depends both on the cost advantage and on the decrease in the unskilled wage rate. For the other sector it is just a negative function of the unskilled wage rate. Comparing equation (29) with the corresponding equation (14) of the FGT case, we observe that changes in the output of sector 2 induced by changes in the unskilled wage rate are the same. Therefore we arrive at the conclusion that FGT with a price decrease in commodity 1 and OS in sector 1 exhibit the same impact on sector 2 (in terms of wages and output) *if they have the same impact* on the unskilled wage rate. This impact depends on the 'macroeconomic dimension' of the respective shocks (terms of trade and OS)

The potential of expansion for both sectors generates an increase in real income (although unskilled wage incomes have decreased) and is equivalent to the result of the 'welfare surplus' of outsourcing emphasized by Arndt (1997, 1999) and Kohler (2004). Production patterns therefore change as both sectors expand by different rates, but no decrease of production takes place. Downward rigid wages for skilled labour would not lead to an increase in skilled unemployment in this case and no increased labour reallocation is required for a new equilibrium, what means less adjustment costs. Anyway we would incur unskilled unemployment like in the FGT case, if the unskilled segment of the labour market were not fully competitive. Therefore we can consider OS as an attractive alternative to FGT from a labour market-perspective, if downward wage rigidity for sector specific labour is an important factor for unemployment. It must be emphasized however that according to the

assumption in this analysis OS is only feasible, if the foreign economy lacks sector specific human capital and cannot produce an entire unit of the final good. In the opposite case final goods can be produced in the foreign economy and compete with domestic production (the FGT case).

3. A Numerical Example

A more precise comparison between the two cases depends on empirical values of variables and parameters. For this purpose a numerical example is chosen here using the stylized facts of Austrian OS to Eastern Europe after the fall of the Iron Curtain. The stylized facts of Austrian OS to Eastern Europe are well described and compiled in Egger, Pfaffermayr and Wolfmayr-Schnitzer (2001) and shall be taken here as a starting point. They describe the pronounced rise of OS from Austria to Eastern Europe during the nineties leading to a share of aggregate imported inputs in aggregate gross output of about 10 percent in 1998. Obviously the share of aggregate imported inputs from Eastern Europe is much smaller only amounting to 1.2 percent in 1998. At the level of industries Egger, Pfaffermayr and Wolfmayr-Schnitzer (2001) find considerable differences of OS (defined as imported inputs) to Eastern Europe and also a large increase concentrated on a few sectors. They conclude with a positive (though insignificant) correlation between the relative skill intensity (H_i / L_i in terms of the model applied here) and the change in OS during the nineties. The data for relative skill intensity by industry for the numerical example are taken from Egger, Pfaffermayr and Wolfmayr-Schnitzer (2001) and their calculations about OS (relying on the Austrian input output tables for 1990 and 1995) are complemented here with data from the Austrian input output tables for 2000. In the literature we find a discussion about the correct measure of OS, more specifically on the necessary 'narrowness' of the OS concept. Total imported inputs might be seen as a too broad concept as they also include complementary imports (e.g. energy) that could never have been produced by the sector. An alternative therefore is to rely on the main diagonal of the import use matrix, i.e. taking only the imports of the same products as the sector produces. Applying both concepts to recent Austrian data (Table 1) we find three 'clusters', where OS

seems important for the Austrian economy. One is the textile&clothing sector, where both total imported inputs as well as own imported inputs are important. The industry 'wearing apparel' shows a much smaller amount of own imported inputs, but (not shown here) a large fraction of textile imports. As a sharp distinction and borderline between these two industries might be difficult, we think that wearing apparel also fits well in the scheme of high total as well as high own imported inputs.

>Table 1: Outsourcing by Industries in percent of Output (Austrian Input-Output Table 2000)

A second 'cluster' of high total as well as own imported inputs consists of raw material intensive sectors (basic metals and chemicals), where OS might be accompanied by foreign direct investment and location of production in different subsidiaries of multinational companies. A further 'cluster' can be identified, where assembling plays an important role (electrical machinery, radio/television and communication equipment, mother vehicles and other transport equipment). These industries might best represent the case assumed for the theoretical analysis in this study, where the foreign economy due to scarcity of sector specific human capital cannot produce one entire unit of the final good, but can produce certain fragments at much lower wage costs.

All these data are combined in order to design the numerical example, where the Austrian economy is split up into two sectors. The factor proportions λ_{Li} are 0.33 for $i = 1$ and 0.67 for $i = 2$. The factor shares θ_{ji} are: given as: $\theta_{Li} = 0.25$ for $i = 1$ and 0.2 for $i = 2$ (the corresponding values for θ_{Hi} are: $\theta_{Hi} = 0.75$ for $i = 1$ and 0.8 for $i = 2$). All substitution elasticities σ_{ij} are in a first step set equal to unity corresponding to the Cobb-Douglas case. In a second step some sensitivity analysis has been undertaken for the case of considerably lower elasticities. Prices and the wage rate are normalized, from which the skilled wage rates in both sectors follow ($w_1 = 2.04$; $w_2 = 2.16$). Both sectors exhibit the same input coefficients for skilled labour, namely $h_1 = h_2 = 0.375$ and are only slightly different in terms of unskilled factor intensities: $l_1 = 0.25$ and $l_2 = 0.2$. This assumption reflects the stylized facts on the one

hand, but also mostly reduces the influence of the sector, where outsourcing takes place. Foreign factor prices have been assumed at the level of 40 percent of domestic factor prices corresponding to actual data about the average per capita income of Eastern European neighbours of Austria: $w_U^f = 0.4$; $w_1^f = 0.82$. This is directly relevant for the OS case, as it determines the cost advantage (note that input coefficients for the fragment sourced out are the same abroad). For the case of FGT shocks in the price of commodity 1 are introduced and gradually increased. The magnitude of this price decrease depends on the product of lower factor prices and lower productivity in 'foreign'. If – as lined out above - factor prices are at 40 percent of the domestic economy and (as data show) average productivity of Eastern European neighbours of Austria is about two thirds of Austrian productivity, then in our numerical example the maximum price shock for commodity 1 would be about 40 percent.

For the case of OS different shocks in terms of the distribution of total sector 1 employment between both fragments are introduced, starting with $\lambda_{L,11} = 0.05$ up to $\lambda_{L,11} = 0.32$. The higher $\lambda_{L,11}$ becomes, the more pronounced is the shock of OS for the domestic unskilled labour market.

>>Table 2: *Macroeconomic Impacts of Trade Liberalization (different shocks in terms of price decreases, $(-\hat{p}_1)$)*

>>Table 3: *Macroeconomic Impacts of Outsourcing (different shocks in terms of the unskilled labour proportion of fragment 1, $(\lambda_{L,11})$)*

All calculations have been carried out according to the corresponding formulae of the theoretical analysis, i.e. applying constant share variables θ_{ji} and λ_{ji} . Obviously this is only fully correct for marginal changes in variables. The results in Table 2 assert the main results from the theoretical analysis. Especially the *magnification effect* can be observed leading to large losses for skilled labour in the import competing sector. The adjustment costs of such a

shock are apparent from these changes in the income distribution as well as from changes in production patterns.

From Table 3 we observe that OS might become a significant problem for the unskilled labour market, if the activities of a large part of the total unskilled labour force can be sourced out cross the border. Starting with low proportions of the unskilled labour force that are sourced out we confirm the result of a possible positive impact on unskilled labour from the theoretical analysis. This result simply reflects the consequence of a large cost effect of OS (given by the factor price differences between 'home' and 'foreign') in relation to the factor savings effect. As the positive impact on sector 2 wages and output only materializes, if unskilled wages decrease, for these cases with a low factor savings effect we find adjustment costs for skilled labour and changes in production patterns also for OS. The numbers in Table 1 show, that outsourcing might amount up to a maximum of 50 percent of output in a sector. Obviously no direct values for the share of OS activities in employment of a sector are available, as we cannot directly observe the factor intensity of the single fragments. If outsourcing also amounts 50 percent of unskilled employment in sector 1, this would yield $L_{11} = 10$ and $\lambda_{L,11} = 0.167$. One sixth of the total unskilled labour force could be lost in that case by cross border OS. From Table 3 we get for that case a decrease in the unskilled wage rate of 6.3 percent, whereas the skilled wage rate would increase in the outsourcing sector by 16.2 percent and in the other sector by 1.6 percent. Output would increase in both sectors indicating a net welfare gain and higher aggregate income. Searching for a similar impact on the unskilled wage rate in Table 2 ($\hat{w}_U = -6.1$ percent), yields the case of a 17.5 percent price decrease in sector 1 with a loss for the skilled wage rate in sector 1 of more than 20 percent. From the theoretical analysis we know that for cases of FGT and OS with the same impact on the unskilled wage rate the results for sector 2 skilled wages and output are also the same. This is reasserted here for both cases with $\hat{w}_2 = 1.5$ (1.6) percent and $\hat{X}_2 = 1.5$ (1.6) percent for $\hat{w}_U = -6.1$ (-6.3) percent.

For the same (negative) impact on unskilled labour FGT and OS have the same influence on the other sector, but final goods trade harms the sector where it occurs whereas the OS sector

benefits. Although this analysis does not directly treat with welfare implications, this aspect can be seen as a 'Pareto advantage' of outsourcing. The mid-term consequences expected of this difference are higher adjustment costs of final goods trade.

Although the underlying variables for this numerical example have been derived from stylized facts for OS in Austria, this is not the case for the substitution elasticities. One could argue that due to the segmentation of the labour market in skilled (in our case: sector-specific) and unskilled labour the substitution elasticity in the production process is also much lower than unity. For this reason a sensitivity analysis was carried out, where all σ_{ij} are set equal to 0.5. For both cases (FGT and OS) we found compensating impacts of these changes in the different formulae as well as compensating impacts of the change in the elasticities in both sectors, i.e. we would get larger changes if the substitution elasticities differ in both sectors. The results for FGT in the case of $\sigma_{ij} = 0.5$ only change concerning the output effects, which are on average five times smaller than in the case with $\sigma_{ij} = 1$. The results for OS in the case of $\sigma_{ij} = 0.5$ only change concerning the impact on the unskilled wage rate, which turns out to be on average double of the case with $\sigma_{ij} = 1$. All other impacts on income distribution are the same for FGT and OS as in the case with $\sigma_{ij} = 1$.

4. Summary

In this paper a specific factors model is set up in order to compare the impacts of final goods trade (FGT) and outsourcing (OS) on the labour market and on production patterns. One motivation of the specific factors model is the idea of countries' specialization leading to the accumulation of sector specific skills. If a foreign low-wage economy is able to produce a full composite unit of one commodity (in terms of the home economy), final goods are traded and foreign imports compete with domestic production. If this is not the case due to scarcity of sector specific human capital in 'foreign', OS will take place.

The impacts on income distribution and on production patterns of the two cases are significantly different. In the FGT case the unskilled wage rate declines and the skilled wage

rate declines in the import competing sector and rises in the other sector. Production in the import competing sector declines and rises in the other sector indicating a necessary transfer of resources between sectors. If due to labour market institutions skilled wages establish at a level too high for full employment, FGT would lead to an increase in equilibrium unemployment. In the case of OS the impacts depend on the interplay of the factor saving and the cost saving effect. If factor price differences between 'home' and 'foreign' are not very large, the unskilled wage rate declines and skilled wage rates in both sectors rise, indicating that in the case of rigid skilled wages no increase in unemployment would occur. Also production in both sectors rises indicating a net welfare gain of OS. For cases of FGT and OS with the same impact on the unskilled wage rate the impact on the other sector is the same as well, but only with OS the directly affected sector also benefits indicating an additional 'Pareto advantage' of outsourcing. Simulations with a numerical example capturing the stylized facts of Austrian OS to Eastern Europe clearly reassert the results from the theoretical model.

In terms of the labour market OS might be characterized as an adjustment strategy to globalization for economies with unemployment due to skilled wage rigidity and restricted mobility of skilled labour. As the impact on the unskilled wage rate is the same in both cases, these results are only valid with downward flexible wages for unskilled labour. If this condition is not fulfilled and unemployment in an economy is mainly due to unskilled wage rigidity the results might differ from this analysis. This issue should be further investigated in a specific factors-model with wage rigidity and unemployment.

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Tables

Table 1: Outsourcing by Industries in percent of Output (Austrian Input-Output Table 2000)

	Imported Inputs (total)	Imported Inputs (own)
Mining and quarrying products	8,7	0,6
Food products and beverages	12,4	3,1
Tobacco products	25,9	2,5
Textiles	34,3	18,2
Wearing apparel; furs	32,4	6,0
Leather and leather products	41,2	23,4
Wood and wood products	17,8	6,0
Pulp, paper and paper products	25,7	16,2
Printed matter and recorded media	26,9	1,3
Coke, refined petroleum products	55,2	1,4
Chemicals, chemical products	32,9	23,8
Rubber and plastic products	31,9	4,6
Other non-metallic mineral products	15,0	4,8
Basic metals	38,0	26,6
Fabricated metal products	22,4	6,3
Machinery and equipment	27,4	13,2
Office machinery and computers	36,3	8,4
Electrical machinery and apparatus	30,6	13,3
Radio, television, communication equipment	37,0	22,2
Medical, precision and optical instruments	20,4	6,5
Motor vehicles	55,8	38,3
Other transport equipment	33,3	9,4
Furniture; other manufactured goods	20,1	3,4

Table 2: Macroeconomic Impacts of Trade Liberalization (different shocks in terms of price decreases, $(-\hat{p}_1)$)

\hat{p}_1	\hat{w}_U	\hat{w}_1	\hat{w}_2	\hat{X}_1	\hat{X}_2
-2,5	-0,9	-3,0	0,2	-0,5	0,2
-5,0	-1,7	-6,1	0,4	-1,1	0,4
-7,5	-2,6	-9,1	0,6	-1,6	0,6
-10,0	-3,5	-12,1	0,9	-2,1	0,9
-12,5	-4,3	-15,2	1,1	-2,7	1,1
-15,0	-5,2	-18,2	1,3	-3,2	1,3
-17,5	-6,1	-21,2	1,5	-3,7	1,5
-20,0	-6,9	-24,3	1,7	-4,3	1,7
-22,5	-7,8	-27,3	1,9	-4,8	1,9
-25,0	-8,7	-30,3	2,1	-5,3	2,1
-27,5	-9,5	-33,4	2,4	-5,9	2,4
-30,0	-10,4	-36,4	2,6	-6,4	2,6
-32,5	-11,3	-39,4	2,8	-6,9	2,8
-35,0	-12,2	-42,5	3,0	-7,5	3,0

Table 3: Macroeconomic Impacts of Outsourcing (different shocks in terms of the unskilled labour proportion of fragment 1, $(\lambda_{L,11})$)

$\lambda_{L,11}$	\hat{w}_U	\hat{w}_1	\hat{w}_2	\hat{X}_1	\hat{X}_2
5,0	3,2	8,7	-0,8	1,6	-0,8
6,7	2,2	9,8	-0,5	2,3	-0,5
8,3	1,0	10,9	-0,3	3,0	-0,3
10,0	-0,2	12,0	0,1	3,8	0,1
11,7	-1,6	13,1	0,4	4,6	0,4
13,3	-3,0	14,2	0,7	5,5	0,7
15,0	-4,6	15,2	1,1	6,4	1,1
16,7	-6,3	16,2	1,6	7,4	1,6
18,3	-8,1	17,1	2,0	8,4	2,0
20,0	-10,1	18,0	2,5	9,5	2,5
21,7	-12,2	18,8	3,0	10,7	3,0
23,3	-14,4	19,6	3,6	11,9	3,6
25,0	-16,8	20,3	4,1	13,2	4,1
26,7	-19,3	20,9	4,8	14,6	4,8
28,3	-22,0	21,4	5,4	16,1	5,4
30,0	-24,8	21,8	6,1	17,6	6,1
31,7	-27,9	22,1	6,9	19,2	6,9

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