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**Outsourcing and Skill-Specific Employment
in a Small Economy:
Austria and the Fall of the Iron Curtain**

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Abstract

We present a model, in which a small industrialised economy outsources part of its production into a small foreign country which is well endowed with low-skilled labour. We analyse under which conditions sinking trade costs stimulate outsourcing activities, thereby increasing the wage dispersion and, if labour markets are unionised, also the employment of high-skilled relative to low-skilled labour. For a panel of Austrian industries, we find first that decreasing trade barriers, which can be associated with the fall of the Iron Curtain, indeed stimulate outsourcing to Eastern Europe and the former Soviet Union, and second, that outsourcing to these countries significantly shifts relative employment in favour of high-skilled labour.

JEL classification: C33; F14; F15; F16

Keywords: Fragmentation; Skill-specific employment; Simultaneous equations

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1 Introduction

Skill-biased technological change and globalisation are widely seen as possible explanations for the increase in wage inequality in the USA and growing unemployment rates of low-skilled labour in the EU. More recently, some authors have focussed on the role of outsourcing (fragmentation, slicing-up the value added chain) and underpinned the importance of trade in intermediates and their skill-specific consequences in terms of relative wages and employment (Krugman, 1995; Feenstra & Hanson, 1996, 1997 and 1999; Slaughter, 2000; amongst others). The decrease in trade costs is thereby widely seen as a key determinant for increased fragmentation, where the importance of both lower transportation costs and political factors (e.g. liberalising barriers to trade and investment in labour-rich Newly Industrialised Economies) has been stressed (Krugman, 1995; Feenstra, 1998).

From a theoretical point of view, outsourcing seems to provide a plausible means for explaining the factor market changes in industrialised countries (see Deardorff, 1998 and 2000; Arndt, 1999; Jones & Kierzkowski, 2000 for a theoretical analysis). However, most of the theoretical analysis has been done for large countries and empirical investigations have primarily envisaged the U.S. case.¹

Contrary to the USA, where wage effects are the main focus of analysis, in the EU, the impact on unemployment rates is of greater interest; differences in labour market developments (with respect to the USA and the EU) have traditionally been explained by institutional factors and most importantly by union power. Moreover, small open economies are more affected by changes in trade barriers than large ones are. Since most EU members may be considered as being small open economies, the labour market effects implied by the opening up of Eastern Europe and the former Soviet Union and the related increase in outsourcing activities may be more pronounced than the labour market effects in the USA implied by the integration of Mexico and the USA.

Our paper analyses whether and to which extent recent labour market developments can be attributed to the decline in trade barriers following the fall of the Iron Curtain and the related stimulation of outsourcing by

¹Feenstra & Hanson (1996, 1997 and 1999) estimate a significant and large effect of fragmentation (across countries) on factor markets, if a wide measure of outsourcing is used. In contrast, Slaughter (2000) does not find any large impact of outsourcing in his examination of only multinational enterprises headquartered in the USA.

domestic firms (purchases of intermediate inputs from the same industry) to Eastern Europe and the former Soviet Union. We provide a theoretical model in which a small country (Home) may produce a homogeneous good either internally (using low-skilled and high-skilled labour at Home) or by fragmenting production across borders (using low-skilled labour abroad and only high-skilled at home). We investigate under which conditions a decrease in trade barriers (as was the case after the fall of the Iron Curtain) increases outsourcing by Home into a foreign economy (Foreign) and show that a stimulation of outsourcing activities raises the employment of high-skilled relative to low-skilled labour, if the market for low-skilled labour in the Home is unionised.

For the econometric analysis, we examine the case of Austria, which seems to be a natural candidate² (regarding the geographical proximity and historic ties, compare Kohler, 2000B), investigating both the impact the opening-up of Eastern economies had on outsourcing activities and the related employment effects. Focussing on the Austrian manufacturing sector, we establish the following stylised facts for the country's openness in terms of gross production. Outsourcing to Eastern countries rose dramatically during the period 1990-1998. With an average annual rate of 10.71 percent, it grew much faster than overall outsourcing (1.67 percent p.a.)³, exports (3.9 percent p.a.) or imports (2.8 percent p.a.).

Considering the Austrian labour market, the employment of high-skilled relative to low-skilled workers rose markedly, with an average annual growth rate of 4.43 percent. In contrast, the wage rate of high-skilled relative to low-skilled labour was nearly constant over the same period with an average annual growth rate of 0.02 percent. This asymmetry in relative employment and relative wage dynamics may be explained by the fact that strong unions are at work in Austria, with the highest bargaining coverage rate of all EU members.

We find our theoretical story to be widely in accordance with the empirical results for a panel of 20 manufacturing industries at the NACE 2-digit level. First, outsourcing to Eastern countries reflects the search for low-wage labour and is driven by shrinking trade barriers. Secondly, an increase in outsourcing to the Eastern countries of one percent in terms of gross pro-

²In 1997, Austria's imports of manufactures from Eastern Europe and the former Soviet Union measured in terms of gross production were 2.5 times higher than the EU average. (Calculations are based on OECD Statistics on Foreign Trade.)

³Noteworthy outsourcing to OECD countries increased only by 0.6 percent p.a.

duction would generate a shift in relative employment of about 0.1 percent in favour of high-skilled labour. We provide two econometric approaches, instrumental variables (two-stage least squares, 2SLS; i.e. the covariance 2SLS estimator, see Krishnakumar, 1996) and system estimation (three-stage least squares, 3SLS) techniques using a fixed (industry and time) effects estimator. Treating outsourcing as an exogenous variable leads to a downward bias of the effects on relative employment.

The paper is organised as follows: Section 2 introduces the theoretical model; Section 3 describes the data base and presents the empirical results; Section 4 provides a conclusion of our findings.

2 The Model

We provide a model with three countries: "Home", which may be associated with Austria, "Foreign", which represents Eastern Europe and the former Soviet Union; and the rest of the world (ROW). We assume that Home and Foreign are both small relative to the ROW. In addition, Home's demand for low-skilled labour is small relative to Foreign's supply of low-skilled labour. Trade between Home and the ROW is free, whereas trade between Home and the ROW on the one side and Foreign on the other is to a certain extent inhibited by barriers. Home is an open industrialised economy, in which firms are competitive and produce a homogeneous final good, X , through the implementation of two factors, namely high-skilled (H) and low-skilled (L) labour, which both are supplied inelastically (\bar{H} , \bar{L}). Since Home is small, the price for X is determined on the world market and is given for Home.

We model the markets for the two factors as segmented and assume that H is supplied in a perfectly competitive labour market in Home. The labour market for L may be either competitive or distorted by trade union activities. We account for unions in the following way. If trade unions are at work in the small Home country, the wage setting is not fully flexible. Since we are examining a segmented labour market, in our model, trade unions set wages for low-skilled labour, depending on the wages of high-skilled labour. Hence, trade unions are looking at the wage-spread between high-skilled and low-skilled labour.⁴ We assume that unions accept higher wage dispersion

⁴According to empirical evidence, relative wages (w^H/w^L) are not fully flexible in a unionised economy. Compare for example Belman & Heywood, 1990; Meng, 1990; and

if low-skilled employment declines⁵ and moreover, that firms choose employment unilaterally. The latter implies that low-skilled workers are paid their marginal product.⁶

2.1 Production Technology, Profit Maximisation and the Equilibrium Structure of Production Modes

We allow for fragmentation in the production of X , where we assume that the key determinant comprises the differences between countries regarding the wages of low-skilled labour. Thus, we concentrate solely on vertical fragmentation and on cross-border outsourcing (Deardorff, 1998) and derive solutions for the shift in outsourcing activities and the related employment effects which would result when Foreign opens up its markets.

For the sake of simplicity, we assume that differences in wage rates are too small to pay for outsourcing activities between Home and the ROW, so that outsourcing (for both Home and the ROW) is only possible into Foreign. Thus, Home exports X and imports intermediate goods from Foreign.⁷

There are two modes according to which Home can produce X : An *integrated* mode (i) and a *fragmented* mode (f). Whereas integrated production (which is assumed to be organised within a single firm) is entirely located in Home and uses both low-skilled and high-skilled workers supplied by the Home country, a fragmented firm only produces a down-stream fragment in Home, while it imports an up-stream component from Foreign. The imported intermediate is assumed to be produced by a foreign affiliate of a multinational based in Home.⁸ In particular, the down-stream process uses only high-skilled labour together with the imported fragment. For the up-stream process, Foreign supplies low-skilled labour. Moreover, some additional high-skilled labour (supplied by Home) is necessary to make Foreign's low-skill-

Dell' Aringa & Lucifora, 1994; etc.

⁵This can be argued by assuming that the weight of employment in union objectives rises relative to the weight of wage equality, if the unemployment of low-skilled workers increases.

⁶This is in accordance with right-to-manage and monopoly union models.

⁷Remember, trade between Home and Foreign is assumed to be impeded to some extent.

⁸From a macroeconomic point of view, it is only important that process i is organised internally (i.e. within borders), while f is organised across borders, whereas it is not important whether first, process i is organised within a single firm, and second, the up-stream fragment is produced by a foreign affiliate of multinational based in Home or at arm's length.

intensive intermediate useable for Home. Thus, fragmented production (f) does not use Home-supplied low-skilled labour.

We set the mass of the continuum of firms active in Home at unity and assume that all firms under a particular production regime (i or f) are identical. All firms face a fully competitive goods market. Then, the two production technologies are given by

$$X_k^i = F^i(l_k, h_k^i) \quad (1)$$

$$X_j^f = F^f(o_j, h_j^d) \quad (2)$$

where superscript i (f) indicates that the production of firm k (j) is integrated (fragmented). X_k^i (X_j^f) is the output of the small integrated (fragmented) firm k (j). d refers to the down-stream process. $F^i(\cdot)$ and $F^f(\cdot)$ are both linear homogeneous, strictly concave production functions. o_j is the intermediate input of firm j , produced in Foreign by an affiliate of the multinational j under a *Leontief* technology⁹

$$o_j = \min\{\widehat{l}_j, \kappa h_j^u\}, \quad (3)$$

where \widehat{l}_j denotes foreign low-skilled labour used for producing o_j . u indicates the up-stream process. We consider that o_j , when it is imported by Home, already contains h_j^u , which is part of Home's endowment of high-skilled labour. Thus, o_j in fact denotes the imported fragment. $\kappa > 1$ is a shift parameter. According to (1), (2) and (3), Home's high-skilled labour can be employed either in an integrated firm (h^i), in the down-stream process of a fragmented firm (h^d) or in the production of the imported intermediate (h^u).

Total costs arising for firm j , due to its use of fragments produced in

⁹The reason for using a Leontief technology is the following. First, remember, that h_j^u , which may be associated with high-skilled coordination or organisation requirements, has been assumed to be necessary for making Foreign's low-skill-intensive intermediate useable for the downstream process of a fragmented firm in Home. Thus, it seems to be plausible that (Home-supplied) high-skilled labour employed in the production of the up-stream fragment h_j^u is not substitutable with Foreign-supplied low-skilled labour \widehat{l}_j . Secondly, we want to make use of a linear-homogeneous production function, since "economies of scale are widely believed to be important in understanding both the causes and effects of trade within the OECD, but probably play a smaller role in NIE trade". (Krugman, 1995, p. 345).

Foreign, including both production and trade costs, are given by

$$\tilde{C}(o_j) = [c(w_{\hat{L}}, w_H^u) + t + \tau(O)] o_j, \text{ with } \frac{\partial c}{\partial w_{\hat{L}}} > 0 \text{ and } \frac{\partial c}{\partial w_H^u} > 0, \quad (4)$$

where $c(w_{\hat{L}}, w_H^u)$ represents unit costs of production, which are independent of the output level due to the linear homogeneity of o_j . $w_{\hat{L}}$ indicates Foreign's wage rate for low-skilled labour and w_H^u denotes the wage rate for (Home-supplied) high-skilled labour used in the up-stream process of a fragmented firm. t represents trade costs (tariff or non-tariff barriers to trade). Note that $\tau(0) = 0$, $\tau'(O) \geq 0$ and that O is the aggregated amount of Home's outsourcing, i.e. $O = \sum_{j=1}^J o_j$, given for the individual firm. According to this, $\tau(O)$ indicates external diseconomies of scale of outsourcing, which may arise due to a limited capacity for outsourcing¹⁰, where $\tau'(O) = 0$ implies that there are no diseconomies of scale.

The decision problem of firm k , the production of which is integrated, is given by

$$\max_{l_k \geq 0, h_k^i \geq 0} F^i(l_k, h_k^i) - w_L l_k - w_H^i h_k^i \quad (5)$$

and the decision problem of multinational j is represented by

$$\max_{o_j, h_j^d \geq 0} F^f(o_j, h_j^d) - [c(w_{\hat{L}}, w_H^u) + t + \tau(O)] o_j - w_H^d h_j^d, \quad (6)$$

where w_L denotes the wage rate for (Home-supplied) low-skilled labour and w_H^i and w_H^d are wages for high-skilled labour used in integrated firms and in the down-stream process of fragmented firms, respectively. Due to perfect competition, wages are given for the individual firm.

2.1.1 The First Order Conditions

Solving the maximisation problem for Home's firm k , which produces under mode (i) results in the following first order conditions

$$F_{l_k}^i \leq w_L, \quad (7)$$

$$F_{h_k^i}^i \leq w_H^i, \quad (8)$$

¹⁰Diseconomies of scale may arise due to congestion at the border, rising prices for renting buildings and offices in Foreign, other variable infrastructure costs, etc.

where $F_{l_k}^i = \partial F^i / \partial l_k$ and $F_{h_k^i}^i = \partial F^i / \partial h_k^i$. Equivalently, for multinationals we find

$$F_{o_j}^f \leq [c(w_{\hat{L}}, w_H^u) + t + \tau(O)], \quad (9)$$

$$F_{h_j^d}^f \leq w_H^d, \quad (10)$$

where $F_{o_j}^f = \partial F^f / \partial o_j$ and $F_{h_j^d}^f = \partial F^f / \partial h_j^d$. We concentrate on interior solutions only (i.e. $l_k > 0$, $h_k^i > 0$, $o_j > 0$ and $h_j^d > 0$). This means that trade barriers t allow for some outsourcing from Home into Foreign but not for full specialisation in the fragmented production mode in Home before *and* after the opening up of Foreign. Thus, trade barriers t and low-skilled wages in Foreign $w_{\hat{L}}$ are such, that (7)-(10) hold with equality. If we assume that all firms using a particular production process are identical, then, in a symmetric equilibrium, we obtain

$$l_k = L, h_k^i = H^i, h_j^d = H^d, o_j = O. \quad (11)$$

Note that $o_j = O$ implies $\hat{l}_j = \hat{L}$, $h_j^u = H^u$ and that capital letters denote both average and aggregate levels, due to the unit mass of all firms. Total employment of high-skilled labour is therefore given by $H = H^i + H^d + H^u$. Moreover, with a competitive high-skilled labour market, we have full employment of high-skilled labour, i.e. $H = \bar{H}$, and

$$w_H^i = w_H^d = w_H^u \equiv w_H. \quad (12)$$

According to (7), (8), (11) and (12) equilibrium relative wages are given by

$$\frac{F_{H^i}^i}{F_L^i} = \frac{w_H}{w_L} = \omega. \quad (13)$$

Finally, if both labour markets are competitive, low-skilled labour is always fully employed, i.e. $L = \bar{L}$ and $d\bar{L}/dH^i = 0$. In contrast, if trade unions are at work, ω is neither fully flexible nor totally constant, implying that L becomes a function of H^i , i.e. $L(H^i)$, with $L(\bar{H}) < \bar{L}$ and $0 < dL/dH^i < 1$. Being more precise, we assume that

$$\frac{d^2 F^i(\bar{L}, H^i)}{d(H^i)^2} < \frac{d^2 F^i(L(H^i), H^i)}{d(H^i)^2} < 0, \quad (14)$$

according to (8), (11), (12).

2.1.2 Equilibrium Structure of Production Modes

Since production is diversified, i.e. $l_k > 0$, $h_k^i > 0$, $o_j > 0$ and $h_j^d > 0$, each firm has the option of choosing either an integrated or a fragmented production mode without entry costs¹¹, and we find the following two conditions. First, profits must be equal in equilibrium, i.e.

$$\underbrace{F^i(l_k, h_k^i) - w_L l_k - w_H h_k^i}_{\pi_k^i} = \underbrace{F^f(o_j, h_j^d) - [c(w_{\hat{L}}, w_H) + (t + \tau(O))] o_j - w_H h_j^d}_{\pi_j^f}, \quad (15)$$

according to (5), (6) and (12). Secondly, profits must be zero in equilibrium, i.e.

$$\pi = 0, \quad (16)$$

where $\pi_k^i = \pi_j^f \equiv \pi$. Note that (15) and (16) determine the equilibrium structure of the two production modes as a function of trade barriers t and low-skilled wages paid in Foreign $w_{\hat{L}}$.

2.2 The Opening-up of Foreign and Its Impact on the Production Structure and Relative Employment in Home

Now we discuss how a decrease in trade barriers t , as was the case following the fall of the Iron Curtain, alters the equilibrium production structure and the relative labour demand in Home. We assume that world market prices are unaffected by the opening-up of Foreign, whereas the wages of low-skilled workers in Foreign may be affected by a change in t . This is due to the fact that Foreign is small compared to the ROW. Since Home's demand for low-skilled labour is assumed to be small with respect to the low-skilled labour supply in Foreign, $w_{\hat{L}}$ is exogenous from Home's point of view and the decline

¹¹Consider that our free entry assumption also includes zero costs of switching between the two production technologies.

of t has an impact on $w_{\hat{L}}$ only if Foreign also opens up to the ROW. Formally, we have

$$\frac{dw_{\hat{L}}(t)}{dt} \leq 0. \quad (17)$$

Proposition 1 *A decline in trade costs t increases the outsourcing activities of Home into Foreign, implying a shift from integrated to fragmented production if and only if¹²*

$$-\frac{1}{\partial c(\cdot)/\partial w_{\hat{L}}} < \frac{dw_{\hat{L}}(t)}{dt}. \quad (18)$$

Proof. See appendix A.1. ■

Note that if (17) holds with equality, (18) is always fulfilled, since the left hand side of (18) is smaller than zero. From now on, we assume that (18) is fulfilled and therefore, that outsourcing (by Home) decreases with t , which is broadly accepted among economists (see Krugman, 1995, and Feenstra, 1998, among others). Below, we will test whether or not this assumption is consistent with our empirical findings.

The source for an increase in outsourcing activities by Home into Foreign (if Foreign opens up) is the following. If trade costs t decline and low-skilled wages in Foreign $w_{\hat{L}}$ do not increase too much (i.e. if (18) is fulfilled), the costs of supplying X^f decrease, so that the profits of fragmented firms become positive. This yields an incentive to raise outsourcing and therefore leads to an increased demand for high-skilled workers in Home. Thus, wages w_H rise, implying a decline in the output of integrated production (due to the lower employment of high-skilled workers in integrated production), as well as an increase in the outsourcing activities of Home and therefore also in the aggregate output of fragmented firms (X^f).

We already know that the shift from integrated to fragmented production will affect Home's labour markets. But the impact on the employment of high-skilled labour relative to low-skilled labour H/L remains to be determined.

¹²Remember that we have assumed (7)-(10) to hold with equality, also after Foreign has been opened.

Proposition 2 *If both labour markets are competitive, i.e. if ω is fully flexible, then a decline in trade costs (i) increases the relative wage rate ω and (ii) has no impact on relative employment H/L .¹³*

Proof. See appendix A.2. ■

The background for Proposition 2 is the following. If trade costs t decline, outsourcing activities in Home are stimulated, according to Proposition 1, implying an increase in the wage rate of high-skilled labour w_H . However, this means that less high-skilled labour is used in integrated production. Now, if both labour markets are fully competitive, w_L declines until (Home-supplied) low-skilled labour L is again fully employed. Since w_H increases and w_L declines if t decreases, the relative wage unambiguously rises with the opening up of Foreign. This is a standard outcome in models of the new endowment-based trade theory.

Proposition 3 *If the market for low-skilled labour is unionised, then a decline in trade barriers t increases both the relative wage rate ω and the employment of high-skilled relative to low-skilled labour H/L .*

Proof. Follows directly from $0 < dL(H)/dH < 1$, (14) and the proof of Proposition 2. ■

Again, a decline in trade barriers t makes outsourcing more attractive, implying an increase in the wage rate of high-skilled labour w_H . Since trade unions restrict the flexibility of relative wages, the employment of high-skilled relative to low-skilled labour increases. Regarding the relative wage ω , there are two possible results, which depend on whether or not there are external diseconomies of scale from outsourcing.

Remark 1 *If outsourcing does not exhibit external diseconomies of scale, i.e. if $\tau'(O) = 0$, unions cannot influence relative wages.*

¹³Note that this result is also true under a more general specification which allows for home-supplied low-skilled employment in the downstream process of the fragmented production mode. In contrast to the analysis of Sven Arndt (1997), we find that an increase in outsourcing (if it stimulates downstream activities) makes both integrated production and the downstream process of fragmented production more low-skilled intensive, since the downstream process is more high-skilled intensive than integrated production. In terms of figure 2 in Arndt (1997) p. 74 this means that the ray of the factor intensity (H/L) of the downstream process is steeper than the respective ray of integrated production.

Proof. Follows directly from the proofs of Proposition 1 and 2. ■

If there are no diseconomies of scale (i.e. if there are no capacity restrictions) in our simple, linear homogeneous model for given trade barriers, not only prices, but also wages are determined on world markets and cannot be influenced by Home. Thus, Home is small in every respect. In this case, a decline in trade costs yields an upward shift in relative wages, which is independent of union activities and, since unions try to restrict the flexibility of relative wages, an increase in the employment of high-skilled relative to low-skilled labour.

Remark 2 *If outsourcing exhibits external diseconomies of scale, i.e. if $\tau'(O) > 0$, unions have some impact on wage dispersion.*

Proof. Follows directly from the proofs of Proposition 1 and 2. ■

If unions try to restrict wage dispersion, they further increase the outsourcing activities of Home, as compared to the case of competitive labour markets. But, since outsourcing exhibits diseconomies of scale, i.e. since $\tau'(O) > 0$, an increase in the aggregate amount of Home's outsourcing makes outsourcing less attractive. These external diseconomies of scale allow for some impact of the unions on wage dispersion ω , although Home's labour demand is small with respect to the low-skilled labour supply in Foreign, and production functions are linear homogeneous. Thus, if $\tau'(O) > 0$, and the market for low-skilled labour in Home is unionised, a decline in trade barriers t means an increase in the employment of high-skilled relative to low-skilled labour and a depressed increase in relative wages.

3 Data Description

In our empirical analysis, we want to test whether outsourcing by Austria into Eastern Europe and the former Soviet Union has increased since the fall of the Iron Curtain and, if this is the case, whether and to which extent the increase in outsourcing may account for the dramatic changes in relative employment in manufacturing observed in Austria's unionised labour market.

3.1 Trade Data

We use a small panel of 20 Austrian NACE 2-digit industries over the period 1990-1998. Exports and imports are reported by Statistics Austria. Since

there is no direct measure of outsourcing available, we use the consumption of intermediates and the consumption of imported intermediates, reported as a cross-table (industry by industry) at the requested classification level. Contrary to Feenstra & Hanson, who used a wide measure of outsourcing including "all imported intermediate or final goods that are used of, or sold under the brandname of, an American firm" (Feenstra & Hanson, 1996, p. 107), we apply a narrow measure of outsourcing, including only *intermediates imported from Eastern countries, which are produced and used by industry i*. Due to this choice of definition, we probably underestimate (although to a small extent) the impact which the opening up of the Eastern countries had on the Austrian labour market as a whole, since we do not consider imported intermediates produced and used by different industries. Moreover, we underestimate the labour market effects of overall outsourcing, since we focus only on outsourcing to Eastern countries. In contrast to Slaughter (2000), we do not restrict our measure of outsourcing to multinational enterprises headquartered in the Home country under consideration (i.e. Austria). We construct our narrow measure of outsourcing to Eastern countries in the following way¹⁴

$$O_{it} = \underbrace{(\text{intermediates}_{it})}_A \underbrace{\left(\frac{\text{imports}_{it}^{\text{world}}}{\text{gross production}_{it}}\right)}_B \underbrace{\left(\frac{\text{imports}_{it}^{\text{Eastern countries}}}{\text{imports}_{it}^{\text{world}}}\right)}_C, \quad (19)$$

where the first term (A) indicates intermediates which are produced and used by industry i , an information which is provided by input-output (IO) tables. The second term (B) represents the import openness of industry i , and the last term (C) indicates the share of imports from Eastern countries with respect to overall imports. ($A \cdot B$) is reported in Austrian IO statistics, whereas for 1995 only (A) is available. We therefore collect the remaining information from trade statistics and interpolate the series.

Trade barriers (applied most-favoured-nation tariff rate, TB , and the frequency ratios for non-tariff barriers, NTB) are from OECD and UNESCO statistics. Data again were interpolated and transposed to the NACE 2-digit

¹⁴Note that this measures outsourcing in absolute terms. In the empirical analysis we use this measure either in percent of gross production or of total consumption of intermediates by industry.

level. *NTB* tables report zero frequency for a couple of industries (years); however, this does not allow us to simply take the logs. Hence, we construct a dummy variable (*NTBD*), indicating whether NTBs are applied at all. Moreover, we take the logs of *NTB* and multiply the resulting variable with *NTBD*. This results in an interaction term (*NTBI*), which can only be interpreted together with *NTBD*.

3.2 Skill and Union Data

We collect information regarding skills (employment and wages) from the Austrian "Lohn – und Gehaltsstatistik" provided by the Austrian Chamber of Commerce, which is available for industry categories similar to NACE. Noteworthy and in contrast to other measures, these statistics classify employees according to their utilisation rather than according to their education or training. We derive a measure for defining high-skilled and low-skilled by aggregating the corresponding subgroups of employees. As high-skilled blue-collar workers, we define the sum of qualified and highly qualified workers. High-skilled white-collar workers are persons who have jobs which demand special qualifications (included in group IV, V, or VI of the respective statistics). The remaining employees are classified as low-skilled.

Data on union membership was provided by various sections of the Austrian Trade Union Confederation, which is a centrally managed organisation. These sections cover either one or more industries and bargain over wages for the respective groups of workers. According to the organisation of unions and wage setting practices, the degree of organisation (*ORG*) varies only over 11 groups of industries. *ORG* is defined as follows

$$ORG_{it} = \left(\frac{\text{unionisation rate}_{it}}{\text{unionisation rate}_t} \right), \quad (20)$$

which measures the degree of unionisation of industry i , relative to the average industry, in each year t .

3.3 Remaining variables

Median firm size and price-cost margins are variables which additionally may account for the power of employees in wage bargaining. Median firm size is a variable, included in the data collected in the monthly WIFO investment

survey of Austrian manufacturing firms (NACE 2-digit). We define the price-cost margin variable as the share of value added minus wage costs in gross production. Information on gross production, value added, nominal capital stocks and capital deflators (all NACE 2-digit) is provided by Statistics Austria. The percentage of hours of capital stock in use is also reported in the WIFO investment survey.

Finally, the unit labour costs of the Eastern economies are derived by using employment, wage, and gross production data (including production indices) obtained from industry data on 7 central and Eastern European countries, which were kindly provided by the Vienna Institute of Comparative Economic Studies (WIIW). These data are reported in ISIC classification and in own currency. We calculated unit labour costs for each country and industry, using 1993 as the base year. We converted the series according to the fixed exchange rate (1993) and weighted them with respect to industry-specific real gross production of the respective Eastern country (base year 1993), to obtain the required variable. Because of the lack of data on member countries of the former Soviet Union and (partly) of former Yugoslavia, this should be seen as an upper-bound approximation of unit labour costs in the Eastern countries as a whole.

4 Empirical Analysis

Following our theoretical model, the empirical analysis proceeds in two steps. First, we shall provide insights on the determinants of Austrian outsourcing to Eastern countries which basically means looking for empirical evidence of Proposition 1. Secondly, controlling for other channels of influence (exports, imports, non-neutral technical change, etc.), we are interested in isolating the effect of outsourcing on the employment of high-skilled relative to low-skilled labour. This means we should search for empirical evidence of Proposition 3.

4.1 Determinants of Outsourcing

Table 1 reports results of fixed effects panel regressions of outsourcing (OUT) on the weighted average of Eastern unit labour costs ($ULCE$), trade barriers (TB), and the two variables for non-tariff barriers to trade ($NTBD$, $NTBI$) mentioned above.

> Table 1 <

We report two different estimations, where the difference is only in the measure of outsourcing. In Specification I, outsourcing is measured in terms of gross production (OY), and in Specification II in terms of intermediate consumption (OI). The former measure comprises two effects: the (possible) general increase in the fragmentation (purchases of industry i intermediates by industry i within *and* across borders) of the average industry and the development of the share of Eastern countries in outsourcing activities. The latter measure only comprises the increase in the share of Eastern countries in overall fragmentation (intermediate consumption of industry i goods by industry i). The results broadly confirm our view that outsourcing to Eastern countries is low-cost seeking, reflected by a negative coefficient for $ULCE$. A reduction in trade barriers should be associated with greater activity in outsourcing. The positive sign for $NTBD$ should probably not be interpreted causally. This variable has almost no variation in the time dimension and demonstrates that non-tariff barriers occur in industries where outsourcing is high. However, $NTBI$ shows a negative sign which is insignificant. From a theoretical point of view, we would have expected a significantly negative impact of $NTBI$ on outsourcing. Nevertheless, we may conclude that our story seems to shed some useful light on the determinants of Austrian outsourcing into Eastern countries.

4.2 Employment Effects of Outsourcing

The second step of our analysis is concerned with the employment effects of outsourcing. We propose the following specification in the estimation setup

$$RS_{it} = \beta_0 + \beta_1 RW_{it} + \beta_2 XY_{it} + \beta_3 MY_{it} + \beta_4 KY_{it} + \beta_5 OUT_{it} \quad (21) \\ + \mu_i + \lambda_t + \varepsilon_{it}$$

where RS is the employment of high-skilled labour relative to low-skilled labour (H/L), RW is the relative wage rate (w_H/w_L), XY is export openness in terms of gross production, MY is imports minus outsourcing to Eastern countries in terms of gross production, KY is the capital-output ratio (real stock of capital in terms of gross production), OUT is outsourcing again (reflected in the estimations as the two possible definitions, OY and OI),

and μ_i (λ_t) represents industry (time) specific fixed effects. However, this specification invokes an econometric problem of endogeneity between relative employment (RS) and relative wages (RW). Additionally, we might face a problem of the endogeneity of relative employment (RS) and outsourcing (OUT). Endogeneity leads to biased and inconsistent estimates of the least squares estimation. Fortunately, one can overcome this problem by the use of instrumental variables (IV), which again enables us to obtain consistent estimates. Table 2 reports the results of applying IV for relative wages (RW) and outsourcing (OUT) in Specifications 1 and 2, and for relative wages only (treating outsourcing as exogenous) in Specifications 3 and 4. Note that we again distinguish between outsourcing in terms of gross production (OY , Specifications 1 and 3) and in terms of intermediate consumption (OI , Specifications 2 and 4). Overall non-neutral technical change is controlled for by the introduction of fixed time effects. Industry specific effects are wiped out by fixed industry effects. According to the normality tests, the database exhibits sound properties for the hypothesis tests. The reported Ramsey RESET tests confirm that there might be additional unexhausted information which e.g. could be due to underlying non-linearities. We therefore should interpret the estimation results with care.

> Table 2 <

Outsourcing to Eastern countries exerts a significantly positive impact on the employment of high-skilled workers relative to the low-skilled workers. This is a robust result, which does not depend on whether we treat outsourcing as exogenous (Specifications 3 and 4) or not (Specifications 1 and 2). Relative employment negatively (but not significantly) depends on relative wages. All other explanatory variables exhibit a significant impact. Export openness and import openness are included to control for trade effects which increase the efficiency of production (Greenaway et al., 1999). We find that an increase in Austrian industry exports has an employment effect in favour of high-skilled workers. The opposite holds true for imports. The latter is due to a simple displacement effect, as it is well-known that Austria is an importer of high-skill-intensive goods, thereby reducing the relative demand for high-skilled employees at Home. A higher capital intensity is associated with a lower ratio of high-skilled relative to low-skilled employment. At the Austrian industry level, we do not observe a high positive correlation between capital and high-skilled labour employment, as in the U.S. (see e.g.

Berman et al., 1994) and other countries. In contrast, a majority of the capital intensive industries comprise large former state-owned enterprises which are specialised in the production of low-skill-intensive goods. According to the F-tests, both fixed industry effects and outlier dummies contribute relevant information. Interestingly, this is not the case for overall exogenous, non-neutral technical change (fixed time effects).

Buse (1992) and Shea (1997) remark that the inclusion of irrelevant and overidentifying instruments increases the finite sample bias of the IV estimator. Therefore, in the instrumental variable 2SLS regressions, only those instruments are used which have a significant impact in the first stage regressions. These are the degree of union organisation (*ORG*), the price-cost margin (*PCM*), median industry firm size (*MSIZE*), and the most favoured nation tariff rate (*TB*) in all specifications. Of course, in Specifications 1 and 2, relative wages (*RW*) and outsourcing (*OY*, *OI*) are instrumented with the same variables. Additionally, we apply Shea's (1997) partial R_p^2 test in order to check for instrumental relevance.¹⁵ We find that instruments do have a relevant impact, although we observe that the instrumentation of outsourcing is of even greater relevance than that of relative wages. Additionally we apply the Davidson & MacKinnon (1993) test on instrument validity. This is a specification test for the correlation of the instruments with the error term in the second stage regression. In our case, the test statistics do not reject the hypothesis of proper specification and instrumentation in any of the specifications of Table 2. We may therefore conclude from our analysis that outsourcing should be treated as endogenous in the empirical setup. Ignoring the possible endogeneity would result in a downward bias of the estimated effect of outsourcing on relative employment.

As is well known, the two-stage least squares (2SLS) instrumental variables (IV) estimator is consistent, although it neglects information contained in other equations, being only a limited information method. Therefore, this technique is less efficient. In order to overcome this problem, one has to consider full information or system methods of estimation (e.g. three-stage least squares, 3SLS, or full information maximum likelihood estimation, FIML). From an econometric point of view, systems estimation also enables us to overcome another problem. In the presence of two or more endogenous variables (which is the case in our example), 2SLS only allows for a single set

¹⁵Partial R_p^2 measures the additional contribution of the instrument set for the explanation of each endogenous variable.

of instruments for the whole set of endogenous variables. This might provide less theoretical support than a distinct identification and it artificially causes problems of irrelevance in the presence of multicollinearity between parts of the sets of instruments, especially when the instruments are not exactly exogenous (Shea, 1997)¹⁶. The latter results in the above mentioned finite sample bias of the estimator. We therefore estimate four specifications according to 3SLS (see Table 3): Two of them use the same set of identifying variables for both relative wages and outsourcing (Specifications A and B) and are explicitly in accordance with Specifications 1 and 2 in Table 2. The remaining two specifications (C and D), distinguish between the set of identifying assumptions for relative wages (degree of organisation of trade unions, *ORG*; medium industry firm size, *MSIZE*; and price-cost margin, *PCM*) and for outsourcing (tariff barriers, *TB*; non-tariff barriers, *NTBD* and *NTBI*; and unit labour costs in Eastern economies, *ULCE*).

> Table 3 <

As can easily be seen, there is only a minor difference between Specification A (B) and Specification 1 (2), which is primarily evident in lower standard errors and is due to the efficiency gain of 3SLS. Applying different sets of identifying assumptions for relative wages and outsourcing underpins the robustness of our results. The impact of outsourcing on relative employment is always significantly positive. Moreover, the effects are very close and between 0.08 and 0.12 percent.¹⁷ Over the last decade, we observed an increase in outsourcing to the Eastern economies of about 11 percent and an

¹⁶Shea (1997, p. 348) notes for 2SLS that "low relevance increases the inconsistency of IV estimates whenever instruments are not perfectly exogenous. Even when instruments are perfectly exogenous, low relevance increases asymptotic standard errors and therefore reduces the power of hypothesis tests. Moreover, low relevance can cause the finite-sample distribution of IV estimates to depart considerably from the asymptotic normal distribution...". The same, of course, holds true for 3SLS.

¹⁷Remember that outsourcing in terms of gross production (*OY*) is a composite of two effects, namely of a change in the share of Eastern countries in intermediate imports and a change in the share of intermediates in gross production (a general change in the fragmentation of the value added chain). This measure might be superior for our purpose, particularly as compared to outsourcing (across borders) in terms of the consumption of industry intermediates (*OI*), which only reflects the change in the role of the Eastern countries in fragmentation relative to others (exhibited by a lower coefficient of outsourcing in Specifications B and D as compared to A and C).

increase in relative employment of about 4.5 percent p.a. Thus, our econometric results would lead us to the conclusion that outsourcing to the Eastern countries accounts for about a quarter of the change in relative employment, in favour of high-skilled labour.

5 Concluding Remarks

The opening up of Eastern Europe and the former Soviet Union, following the fall of the Iron Curtain induced a political and economic (re)orientation of these countries with respect to the EU (mainly in terms of trade and foreign direct investment, FDI) at rather rapid pace. Parallel to this development, the Eastern countries also modernised and expanded their infrastructure facilities, while maintaining relatively low levels of unit labour costs. However, so far analyses have mostly been concentrated on the change in terms of overall trade and FDI and - in a few examples - on their impact on the labour markets in the Western economies. In contrast, the analysis of trade in intermediates (i.e. outsourcing) and its impact on the labour market has been scarce. According to the stylised facts, many of the smaller Western European countries are relatively open to imports (especially of intermediates) from the Eastern countries. Additionally, in many of these smaller economies, wages (mostly of the lower skilled) are bargained by trade unions. This brings the question of the causes of increased outsourcing to the low-wage Eastern countries and its consequences on employment in small Western European economies into the limelight of interest.

We present a model in which the trade of Home (a small economy) with Foreign (in our context to be associated with the Eastern economies) is impeded, while Home trades freely with the rest of the world (ROW). We focus on a homogeneous industrialised good, the production of which may be either internal (using low-skilled and high-skilled labour at Home) or fragmented across borders (using low-skilled abroad and only high-skilled labour at Home). In contrast to other models of fragmentation, ours sheds some light on the driving forces of outsourcing and identifies a condition under which outsourcing by a small country increases with a fall in trade barriers. Moreover, we show that if Home's labour markets are competitive, an increase in outsourcing raises relative wages in favour of high-skilled labour, but has no impact on the employment of high-skilled relative to low-skilled labour. If the market for low-skilled labour is unionised, we find that a stimulation

of outsourcing raises both relative wages and relative employment in Home. Regarding relative wages, there are two possible outcomes. First, if there are no external diseconomies of scale, unions lose control over wages. Secondly, if outsourcing exhibits external diseconomies of scale, unions depress the shift of relative wages.

We apply our theoretical model to the case of Austria which, regarding its level and growth of openness to imports (especially outsourcing) vis-à-vis the Eastern economies, is a very pronounced example of a small Western European economy. We find that our theoretical story is widely in accordance with the empirical results. Outsourcing to Eastern countries is low-wage seeking. Moreover, shrinking trade barriers are an important stimulus of outsourcing to the Eastern European countries and the former Soviet Union.

Regarding the labour market, we estimate the impact of outsourcing on relative employment, controlling for other non-neutral influences. We find that a one percent increase in outsourcing to the Eastern countries (in terms of gross production) would generate a shift in relative employment of about 0.1 percent in favour of high-skilled labour segment. Regarding the dynamics over the last decade, outsourcing to the East would account for about one quarter of the change in relative employment in favour of the high-skilled.

This phenomenon could prove to be similar for some of the other small Western European countries, and it is likely to grow even more pronounced when (at least some of) the Eastern economies join the European Union (see Kohler, 2000A). According to the extent of their openness to import from the East and the degree to which their trade unions are organised, the Scandinavian and the BENELUX countries could be influenced in a similar way.

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A Theoretical Appendix

A.1 Proof of Proposition 1

Remember that we focus on interior solutions only (i.e. we assume $L > 0$, $H^i > 0$, $H^d > 0$, $O > 0$ and thus $\hat{L} > 0$, $H^u > 0$ before *and* after a change in t). Then, we find

$$F_{H^i}^i = w_H, \quad (22)$$

$$F_O^f = [c(w_{\hat{L}}, w_H) + (t + \tau(O))], \quad (23)$$

$$F_{H^d}^f = w_H, \quad (24)$$

according to (8)-(10), (11) and (12). It can easily be shown that $dO/dt \geq 0$, if (18) is violated. To better understand this assertion, assume that this would not be the case, i.e. assume $dO/dt < 0$. This implies $dH^u/dt < 0$, according to (3), and furthermore $d\tau/dt \leq 0$. Thus w_H increases, according to (23) and (24) and the strict concavity and linear homogeneity of $F^f(\cdot)$. Note that an increase w_H implies that H^d declines, since $F_{H^d}^f$ increases with O/H^d and O declines per assumption. Thus, we have $d(H^d + H^u)/dt < 0$ and therefore $d(H^i)/dt > 0$, due to the competitiveness of the labour market for high-skilled workers. But an increase in the number of high-skilled workers in integrated production means a decline in high-skilled wages, according to (14) and (22), which is a contradiction.

In the same way, it can be shown that $dO/dt < 0$, if (18) is fulfilled. To better understand this assertion, assume that this is not the case, i.e. assume $dO/dt \geq 0$. This implies $dH^u/dt \geq 0$, according to (3), and furthermore $d\tau/dt \geq 0$. Thus, w_H declines, according to (23) and (24) and the strict concavity and linear homogeneity of $F^f(\cdot)$. Note that a decline in w_H implies that H^d increases, since $F_{H^d}^f$ increases with O/H^d and O does not decline per assumption. Thus, we have $d(H^d + H^u)/dt > 0$ and therefore $d(H^i)/dt < 0$, due to the competitiveness of the labour market for high-skilled workers. But a decline in the number of high-skilled workers in integrated production means an increase in high-skilled wages w_H , according to (14) and (22), which is a contradiction. In the same way it can be shown that under condition (18) $dO/dt < 0$ is in accordance with an interior equilibrium, i.e. with $L > 0$, $H^i > 0$, $H^d > 0$, $O > 0$ and thus $\hat{L} > 0$, $H^u > 0$, before *and* after a change in t . This completes the proof of Proposition 1. ■

A.2 Proof of Proposition 2

Use $dO/dt < 0$ and the full employment of both H and L . It can then be shown that an interior solution after the change in t can only be reached if $dw_H/dt < 0$. To better understand this assertion, note that according to Proposition 1 $dw_H/dt \geq 0$ would imply $d(H^d + H^u)/dt < 0$ and therefore $dH^i/dt > 0$. But an increase in the number of high-skilled workers in integrated production means a decline in high-skilled wages w_H , according to (14) and (22), which is a contradiction. Now, if $dw_H/dt < 0$, then $dH^i/dt > 0$ and therefore $d(H^d + H^u)/dt < 0$, according to (14) and (22), which is in accordance with $dO/dt < 0$. Finally, according to (11), (12), (13) and (14), we find

$$\frac{d\omega^D}{dt} < 0, \quad (25)$$

due to the linear homogeneity of $F^i(\cdot)$. This completes the proof of Proposition 2. ■

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Table 1: The Determinants of Austrian Outsourcing into Eastern Economies 1990-1998

Dependent Variable ³⁾	Specification I ¹⁾		Specification II ²⁾	
	β	Std. error	β	Std. error
Unit Labor Costs in Eastern Countries (ULCE) ⁴⁾	-0.89	0.313 **)	-0.83	0.294 **)
Tariff Barriers (TB) ⁵⁾	-0.43	0.124 **)	-0.41	0.122 **)
Non-Tariff Barriers Dummy (NTBD) ⁶⁾	0.60	0.160 **)	0.56	0.158 **)
Non-Tariff Barriers Interaction (NTBI) ⁷⁾	-0.01	0.009	-0.01	0.009
Constant	-6.70	0.598 **)	-6.03	0.567 **)
Statistics (N=20; T=9) ⁸⁾		p-value		p-value
Observations	180		180	
Adj. R ²	0.89		0.89	
Time Effects: F (8, 148) ⁹⁾	2.96	0.004 **)	3.12	0.003 **)
Industry Effects: F (19, 148) ⁹⁾	66.92	0.000 **)	62.09	0.000 **)

1) Outsourcing to Eastern countries measured in percent of gross production. - 2) Outsourcing to Eastern countries measured in percent of intermediate inputs. - 3) All variables are in logs. Parameter estimates for fixed time and industry effects are not reported in order to save space. Only heteroskedasticity consistent standard errors are reported. - 4) ULCE are wages per unit of output, with 1993 as the base year.

5) Simple average applied most favored nation (MFN) tariff rate. - 6) Dummy variable which is 1, if non-tariff barriers are reported, 0 otherwise. - 7) Interaction term with NTBD, which takes the value of the simple frequency ratio of NTBs if NTBD is 1, and 0 otherwise. - 8) Degrees of freedom in parentheses.

9) F-tests for testing the restriction of joint zero parameters for the respective effects (fixed time and industry effects). - **) significant at 5 percent, *) significant at 10 percent.

Table 2: Skill-specific Relative Employment and Outsourcing in Austria 1990-1998

Two-stage Least Squares Estimation Results. Dependent Variable is Log of High-skilled Relative to Low-skilled Employment

Dependent Variable ⁵⁾	Specification 1 ¹⁾³⁾		Specification 2 ^{2) 3)}		Specification 3 ¹⁾⁴⁾		Specification 4 ²⁾⁴⁾	
	β	Std. error	β	Std. error	β	Std. error	β	Std. error
Outsourcing (OY)	0.10	0.040 ^{**)}	-	-	0.04	0.018 ^{**)}	-	-
Outsourcing (OI)	-	-	0.08	0.031 ^{**)}	-	-	0.02	0.209
Relative Wage Rate (RW)	-0.93	1.056	-0.07	0.850	-0.79	0.990	-1.36	1.232
Export Openness (XY) ⁶⁾	0.23	0.074 ^{**)}	0.28	0.066 ^{**)}	0.17	0.060 ^{**)}	0.20	0.070 ^{**)}
Import Openness (MY) ⁶⁾	-0.25	0.014 ^{**)}	-0.36	0.069 ^{**)}	-0.22	0.073 ^{**)}	-0.25	0.086 ^{**)}
Capital Output Ratio (KY)	-0.24	0.119 ^{**)}	-0.22	0.096 ^{**)}	-0.15	0.097	-0.07	0.115
Constant	2.20	0.839 ^{**)}	1.49	0.717 ^{**)}	1.44	0.625 ^{**)}	1.34	0.755 ^{*)}
Statistics (N=20; T=9) ⁷⁾		p-value		p-value		p-value		p-value
Observations	179		179		179		179	
Adj. R ²	0.98		0.98		0.98		0.98	
Time Effects: F (8, 146) ⁸⁾	0.98	0.457	0.89	0.526	1.46	0.178	1.31	0.245
Industry Effects: F (19, 146) ⁸⁾	389.19	0.000 ^{**)}	464.45	0.000 ^{**)}	440.83	0.000 ^{**)}	311.49	0.000 ^{**)}
Outlier Effects: F(3, 143) ⁸⁾	5.98	0.001 ^{**)}	-	-	6.07	0.001 ^{**)}	-	-
Normal Distribution I: adj. χ^2 ⁹⁾	1.84	0.398	4.64	0.098 ^{*)}	1.84	0.398	4.64	0.098 ^{*)}
Normal Distribution II ¹⁰⁾	1.01	0.155	0.43	0.332	1.01	0.155	0.43	0.332
Endogeneity (OUT) ¹¹⁾	2.50	0.126	6.82	0.009 ^{**)}	-	-	-	-
Instrument Relevance: R ² _p (RWAGE) ¹²⁾	0.21		0.26		0.19		0.19	
Instrument Relevance: R ² _p (OUT) ¹²⁾	0.50		0.57		-	-	-	-
Overidentification χ^2 (m) ¹³⁾	2.31	0.315	1.60	0.450	5.74	0.125	1.60	0.450
RESET: F(3, 144) ¹⁴⁾	7.17	0.000 ^{**)}	6.69	0.000 ^{**)}	7.17	0.000 ^{**)}	6.69	0.000 ^{**)}

1) Outsourcing to Eastern countries measured as percent of gross production. - 2) Outsourcing to Eastern countries measured as percent of intermediate inputs. - 3) Relative wages and outsourcing are instrumented according to the degree of trade union organisation (ORG), price cost margin (PCM), median firm size (MSIZE), trade barriers (TB), non-tariff barrier dummy (NTBD), and non-tariff barrier interaction term (NTBI). - 4) Only relative wages are instrumented according to the degree of trade union organisation (ORG), price cost margin (PCM), median firm size (MSIZE), and tariff barriers to trade (TB). - 5) All variables are in logs. Parameter estimates for fixed time and industry effects as well as for outlier dummies are not reported in order to save space. - 6) Exports (imports) as percent of industry gross production. - 7) Degrees of freedom in parentheses. - 8) F-tests for testing the restriction of joint zero parameters for the respective effects (outlier dummies, fixed time and industry effects). - 9) Combined Skewness/Kurtosis test for normality, Royston (1991). 10) Shapiro-Wilk W test for normal data (Royston 1991); asymptotically following a normal distribution. - 11) Hausman test on the endogeneity of outsourcing, Hausman (1978), Greene (1997). - 12) Partial R² diagnostics testing for instrumental relevance, Shea (1997). 13) Testing the validity of instruments based on overidentifying restrictions, under the null being distributed as χ^2 (number of overidentifying restrictions, m), Davidson & MacKinnon (1993, p. 236). 14) Ramsey RESET test using powers of the fitted values of the dependent. - **) significant at 5 percent.

Table 3: Three-Stage Least Squares Systems Estimation Results

Dependent Variable is Log of High-skilled Relative to Low-skilled Employment in Heads

Dependent Variable ⁵⁾	Specification A ¹⁾³⁾		Specification B ²⁾³⁾		Specification C ¹⁾⁴⁾		Specification D ²⁾⁴⁾	
	β	Std. error	β	Std. error	β	Std. error	β	Std. error
Outsourcing (OY)	0.10	0.036 **)	-	-	0.12	0.026 **)	-	-
Outsourcing (OI)	-	-	0.08	0.025 **)	-	-	0.08	0.027 **)
Relative Wage Rate (RW)	-0.93	0.944	0.06	0.731	-0.61	0.520	-0.21	0.612
Export Openness (XY)	0.23	0.066 **)	0.28	0.058 **)	0.26	0.054 **)	0.29	0.058 **)
Import Openness (MY)	-0.25	0.073 **)	-0.37	0.062 **)	-0.33	0.057 **)	-0.36	0.060 **)
Capital Output Ratio (KY)	-0.24	0.106 **)	-0.22	0.086 **)	-0.35	0.081 **)	-0.22	0.084 **)
Constant	2.20	0.750 **)	1.47	0.614 **)	1.90	0.562 **)	1.59	0.605 **)
Statistics (N=20; T=9; 3 Equations) ⁶⁾		p-value		p-value		p-value		p-value
Observations	179		179		179		179	
R ² Relative Employment ⁷⁾	0.986		0.988		0.989		0.987	
R ² Relative Wages ⁷⁾	0.942		0.943		0.942		0.941	
R ² Outsourcing ⁷⁾	0.935		0.942		0.947		0.940	
Time effects: $\chi^2(24, 148)$ ⁸⁾	75.79	0.000 **)	80.99	0.000 **)	86.57	0.000 **)	74.22	0.000 **)
Industry effects: $\chi^2(57, 148)$ ⁸⁾	13721.83	0.000 **)	14041.82	0.000 **)	17723.39	0.000 **)	15300.01	0.000 **)
Outlier Effects: $\chi^2(9, 143)$ ⁸⁾	32.00	0.000 **)	-	-	48.04	0.000 **)	-	-

1) Outsourcing to Eastern countries measured as percent of gross production. - 2) Outsourcing to Eastern countries measured as percent of intermediate inputs. - 3) Relative wages and outsourcing in Specification A (Specification B) are instrumented as in Specification 1 (Specification 2), Table 2. - 4) Relative wages are instrumented according to the degree of trade union organisation (ORG), price cost margin (PCM), and medium industry firm size (MSIZE); outsourcing is instrumented by trade barriers (TB), non-tariff barrier dummy (NTBD), non-tariff barrier interaction term (NTBI), and unit labor costs in Eastern countries (ULCE). - 5) All variables are in logs. Parameter estimates for fixed time and industry effects, as well as for outlier dummies, are not reported in order to save space. - 6) Degrees of freedom in parentheses. - 7) R² for the respective equation. - 8) Likelihood ratio test, testing for joint zero parameters for fixed time effects, fixed industry effects, and outlier effects, respectively. - **) significant at 5 percent.