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# 166

Daniel Horgos

**International Outsourcing and Wage Rigidity:  
A Formal Approach and First Empirical Evidence**

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# International Outsourcing and Wage Rigidity: A Formal Approach and First Empirical Evidence

Daniel Horgos\*

## Abstract

International Outsourcing effects on labor markets are mostly analyzed within flexible wage settings. Using a modern duality approach, this paper formally investigates differences occurring in industries with low skilled wage rigidity and, for the first time in literature, presents empirical evidence supporting the theoretical findings. Using a logit model to analyze microeconomic German panel data, results show that International Outsourcing significantly increases low skilled unemployment when taking place in industries characterized by low skilled wage rigidity. Thus, in terms of unemployment, not International Outsourcing but inflexible labor market institutions instead should be blamed for harming low skilled labor.

Keywords: International Outsourcing; wage rigidity; unemployment

JEL classification: F12, J64, F41

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# 1 Introduction

Within the last decade, a huge area of theoretical as well as empirical literature emerged investigating implications of International Outsourcing. Most of these contributions assume flexible wage economies. With respect to labor market rigidities, that typically characterize major European economies, only few theoretical contributions emerged recently. However, there is still a lack of empirical evidence. This manuscript tries to contribute to fill this gap. Therefore, it formally analyzes the implications of low skilled wage rigidity on general equilibrium effects of International Outsourcing and provides this field's first empirical evidence: When industries are characterized by sticky wages for low skilled labor, International Outsourcing increases the wage gap between low and high skilled labor less extensively. This, however, has to be bought dearly with an increase in low skilled unemployment.

Concerning labor market effects of International Outsourcing in a flexible wage economy, Feenstra and Hanson (1996a,b) very early show that International Outsourcing increases the relative wage of high skilled labor on a more aggregated industry level in both, the insourcing (developing) as well as the outsourcing (developed) economy. Within a series of papers, Arndt (1997, 1998a,b) investigates general equilibrium effects of International Outsourcing at more disaggregated industry levels. Since producers shed their less competitive production blocks to become more efficient competitors on world markets, International Outsourcing has different effects depending on the relative skill intensity of the outsourcing industry. When taking place in the relative low skill intensive industry, International Outsourcing increases relative wages of the low skilled, and decreases them when taking place in the relative high skill intensive industry. Since the outsourcing industry gets more competitive on world markets, it increases output while the other industry, the one remaining integrated, contracts. Focusing on the implications on innovation, Glass and Saggi (2001) show that International Outsourcing decreases relative wages but increases the pace of innovation and therefore, accelerates the progression of the technology frontier. Deardorff (2001a,b) shows within a combination of a Ricardian and a Heckscher-Ohlin model, that adjustment effects of International Outsourcing depend on the factor intensities of the relocated production blocks. Egger and Falkinger (2003) focus on distributional effects of International Outsourcing. Considering different modes of final goods production, they investigate factor price consequences of International Outsourcing in several equilibrium situations. More recently, Grossman and Rossi-Hansberg (2008) present a simple paradigm investigating consequences of what they call "task-trade" on prices, resource allocation, and welfare. Arguing in terms of factor augmenting technical changes, a decline in the costs of task trade directly boosts the productivity of the respective factor. Kohler (2008) presents a unified framework in order to explain

the differences of the factor vs. the sector bias of International Outsourcing. His results show that the implications depend strongly on the shock that induces offshore sourcing (a reduction in factor costs of delocalization on the one hand or a change in prices for the tradable final good on the other hand). Thus, Kohler illuminates the huge importance of being explicit in this respect in order to avoid joint endogeneity of International Outsourcing with employment or wage effects.

In more recent recent years, economic literature started to consider labor market imperfections as well, not at least in an attempt to better fit the theoretical results to empirical findings as observed e.g. in the major European economies. There, due to powerful unions and high social standards, labor markets are characterized by rigid wages for low skilled labor. Violating the typically posed flexible wage assumption and introducing different forms of wage rigidity, results of the impact of International Outsourcing on labor are likely to change. As Krugman (1995) illuminates, trade implications differ fundamentally between a European case (assuming wage rigidity) and an American one (assuming flexible wages): With wage rigidity, a decrease in the production of the low skill intensive good leads to an increase of low skilled unemployment. Even if the effects of wage rigidities are well known since the discussion in Brecher (1974a,b),<sup>1</sup> theoretical investigations analyzing the effects with respect to International Outsourcing activities are still rare.

Skaksen (2004) e.g. examines the effects of International Outsourcing occurring in unionized labor markets. Since his general equilibrium model considers only one-sector and one kind of labor, it is not applicable to discuss the important factor or sector bias of International Outsourcing and thus, to fit into the main part of the International Outsourcing literature. Nevertheless, results are quite interesting: When firms relocate production fragments abroad, the wage rate increases in tandem with unemployment. Kohler (2007) investigates effects of International Outsourcing and embeds the results into the German discussion on the Bazaar Economy. Even though his main analysis occurs within a flexible wage economy, Kohler mentions the importance of wage rigidity and distills few points that may be of formal interest, like e.g. the skill intensity of the relocated production fragments. Considering one industry facing a heterogeneous labor market, Koskela and Stenbacka (2007) investigate the effects of International Outsourcing and a solidaristically wage setting monopolistic labor union on the wage differential as well as unemployment for both skill groups. Following an increase of the wage differential due to outsourcing activities, unemployment of the high skilled increases while unemployment of the low skilled decreases. With unem-

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<sup>1</sup>For recent examinations of different subsidization schemes within a traditional HOS framework considering skill biased technical progress in hand with labor market rigidities, see e.g. Dluhosch and Horgos (2008). Dluhosch (2008) enriches a traditional HO model with labor market rigidities and investigates the implications of globalization and skill biased technical change as well.

ployment arising not in hand, but as a consequence of wage settings, this result conflicts with traditionally assumed implications of International Outsourcing discriminating low skilled labor. Modeling International Outsourcing similar as in Jones (2000) and Jones and Kierzkowski (2001) and introducing a fair-wage approach (see Solow, 1979; Akerlof, 1982; Akerlof and Yellen, 1988, 1990) to focus on a special form of labor market imperfection, Egger and Kreickemeier (2008) present a model where wage inequality is able to coexist with unemployment. Thus, using a novel diagrammatic tool (based on the Lerner-Pearce diagram), they are able to address major public concerns of International Outsourcing: With high skill intensive home production, International Outsourcing mitigates the unemployment problem and reduces the high skill wage premium. Additionally, they explore how preferences with respect to fair wages and the size of employment benefits govern employment effects.

When leaving the theoretical world and studying the empirical literature, there is no contribution examining the differences in labor market implications occurring when International Outsourcing takes place in industries characterized by a rigid wage floor. Since there is a lack of macro-variables indicating the degree of an industry's labor market inflexibility, the necessary information needs to be generated. This statistical problem, however, may be the reason for the lack of empirical evidence testing the few theoretical results which recently emerged in this field of research. This paper tries to contribute to fill this gap.

Therefore, it first provides a formal model investigating how general equilibrium effects of International Outsourcing change if flexible wages are displaced by rigid wages for low skilled labor. In order to fit into the recently emerged discussion of the importance of the sector vs. the factor bias of International Outsourcing, the model assumes two sectors with two primary inputs of labor. Section 2 introduces the basic framework. Using Shephard's Lemma (cf. Shephard, 1953, 1970) and following the line of Uzawa (1964), Diewert (1971, 1974), Woodland (1977), and Mussa (1979), the model builds on the modern duality approach in international trade theory. In order to achieve the flexible wage benchmark model, Section 3 introduces International Outsourcing similar to skill biased technical change as defined in Jones (1965) and analyzes the occurring implications for general equilibrium. In Section 4, the flexible wage assumption is violated by introducing wage rigidity for low skilled labor as in Brecher (1974a,b). As it turns out, results differ fundamentally from the flexible wage approach. When International Outsourcing takes place in the relative high skill intensive industry, relative wages of the high skilled still increase, however, not as strong as in the flexible wage scenario. In order to keep production positive, and to maintain the minimum cost level, the relative low skill intensive industry has to reduce output. This additional reduction in output forces the industry to set low skilled labor free. Since not all of these workers can be absorbed by the expanding relative high

skill intensive industry, International Outsourcing increases unemployment of the low skilled as we move down the Rybczynski line towards the new equilibrium situation. Section 5 presents empirical results supporting the theoretical findings. Applying a logit model to analyze a German microeconomic panel data, results show that the probability for low skilled labor to get unemployed increases dramatically in extend and significance, if International Outsourcing takes place in industries characterized by low skilled wage rigidity. Section 6 concludes by summarizing the major findings and addressing some questions of high political relevance.

## 2 Theoretical Framework

In order to formally investigate equilibrium effects of International Outsourcing, this section uses the modern duality approach in international trade theory. Based upon an algebraic simplicity known as Shephard's Lemma, equilibrium conditions in the production sector are formulated in terms of unit cost functions rather than production functions. Following the line of Uzawa (1964), Diewert (1971, 1974), Woodland (1977), and Mussa (1979), this leads to a cost minimization problem in a factor-price space. The advantage of minimizing unit costs rather than maximizing output can be derived from Shephard (1953, 1970): With unit cost functions differentiable at the factor price  $w^*$ , the cost minimizing input-output-coefficients can simply be obtained with the partial derivative of the unit cost functions with respect to wages.

Consider an economy facing given world prices  $p$  with two industries, a relative high skill intensive ( $X$ ) and a relative low skill intensive one ( $Y$ ). Both industries use two primary inputs, low skilled labor  $L$  and high skilled labor  $H$  to produce goods of quantity  $q_i$  (with  $i = X, Y$ ). The production function is of a typical Cobb Douglas kind with constant returns to scale. Goods as well as factor markets are perfectly competitive with factors mobile between industries, but immobile between countries. The home country faces an inelastic supply of labor ( $\bar{L}, \bar{H}$ ) and remains incompletely specialized ( $q_i > 0$ ). In order to keep the model traceable, we focus on the supply side of the economy in setting the elasticity of demand unity ( $\sigma^D = 1$ ). Thus, the world market is assumed to absorb changes in demand and, since  $\hat{p} = 0$ , possible effects from price changes. Thus, with free entry in both industries, we achieve the unit cost functions equaling the price

$$c_X = a_{XL}w_L + a_{XH}w_H = p \quad (1)$$

$$c_Y = a_{YL}w_L + a_{YH}w_H = 1 \quad (2)$$

with  $c_i$  as unit costs,  $a_{ij}$  as unit factor requirements ( $j = L, H$ ),  $w_j$  as factor prices, the price of the relative low skill intensive good  $Y$  as numeraire, and the relative price of

good  $X$  as  $p \equiv p_X/p_Y$ . When partially differentiating the unit cost functions with respect to the wages (Shepard's Lemma), we achieve

$$a_{XL} = \frac{\partial c_X(w_L, w_H)}{\partial w_L} \quad (3)$$

$$a_{XH} = \frac{\partial c_X(w_L, w_H)}{\partial w_H} \quad (4)$$

$$a_{YL} = \frac{\partial c_Y(w_L, w_H)}{\partial w_L} \quad (5)$$

$$a_{YH} = \frac{\partial c_Y(w_L, w_H)}{\partial w_H} \quad (6)$$

as cost minimizing labor unit requirements. Additionally, we have to consider

$$a_{XL}q_X + a_{YL}q_Y = \bar{L} \quad (7)$$

$$a_{XH}q_X + a_{YH}q_Y = \bar{H} \quad (8)$$

as labor market equilibrium conditions. Thus, we have a system of eight endogenous variables ( $w_H$ ,  $w_L$ ,  $a_{XL}$ ,  $a_{XH}$ ,  $a_{YL}$ ,  $a_{YH}$ ,  $q_X$ , and  $q_Y$ ) in eight equations (1) - (8) that exactly determine the model.

### 3 General Equilibrium Effects of International Outsourcing: The Benchmark Model

In order to enable the industries relocating their production fragments abroad, we define  $\varphi_{ij}$  as an International Outsourcing parameter, similar to skill biased technical change as defined in Jones (1965). Since International Outsourcing is assumed to reduce labor unit requirements, the percentage change  $\hat{\varphi}_{ij} \equiv -\frac{1}{a_{ij} \cdot (\partial a_{ij} / \partial IO)}$  is a measure showing the alteration in  $a_{ij}$  due to International Outsourcing activities ( $IO$ ) that would take place at constant wages.<sup>2</sup> Thus, we have to rewrite the unit cost functions (1) and (2) into

$$c_X(\vec{w}_L, \vec{w}_H) = \vec{a}_{XL}\vec{w}_L + \vec{a}_{XH}\vec{w}_H \quad (9)$$

$$c_Y(\vec{w}_L, \vec{w}_H) = \vec{a}_{YL}\vec{w}_L + \vec{a}_{YH}\vec{w}_H \quad (10)$$

<sup>2</sup>In this contribution, International Outsourcing is defined in a broad sense, without considering organizational firm characteristics. Thus, International Outsourcing activities indicate a reduction in domestic labor unit requirements of the respective skill group, without distinguishing whether the production fragment relocated abroad is produced in-house or at arm's length. In order to keep the model traceable, determinants of International Outsourcing are also excluded. Thus, International Outsourcing here is modeled as illustrated in Arndt (1997, 1998a,b).

with  $\vec{w}_j \equiv \frac{w_j}{\varphi_{ij}}$  and  $\vec{a}_{ij} \equiv \varphi_{ij}a_{ij}$  as wages and labor unit requirements considering International Outsourcing activities. To minimize unit costs, (9) and (10) are totally differentiated in order to obtain

$$\theta_{XL}\hat{w}_L + \theta_{XH}\hat{w}_H = \theta_{XL}\hat{\varphi}_{XL} + \theta_{XH}\hat{\varphi}_{XH} \quad (11)$$

$$\theta_{YL}\hat{w}_L + \theta_{YH}\hat{w}_H = \theta_{YL}\hat{\varphi}_{YL} + \theta_{YH}\hat{\varphi}_{YH} \quad (12)$$

as equilibrium production in both industries with factor income shares  $\theta_{ij} \equiv \frac{a_{ij}w_j}{p_i}$  and “hats” over variables denoting percentage changes. As (11) and (12) show, in principle, there are four International Outsourcing situations: Both industries can either outsource their low skill intensive or their high skill intensive production block.

In order to keep the focus on analyzing the changes of International Outsourcing implications occurring in rigid wage industries, it is sufficient to consider only the International Outsourcing situation, in which the high skill intensive industry relocates its low skill intensive production fragments.<sup>3</sup> Thus, with  $\hat{\varphi}_{XL} > 0$  and  $\hat{\varphi}_{XH} = \hat{\varphi}_{YL} = \hat{\varphi}_{YH} = 0$ , (11) and (12) change to

$$\theta_{XL}\hat{w}_L + \theta_{XH}\hat{w}_H = \theta_{XL}\hat{\varphi}_{XL} \quad (13)$$

$$\theta_{YL}\hat{w}_L + \theta_{YH}\hat{w}_H = 0 \quad (14)$$

## Wages and Labor Unit Requirements

To examine the effects of International Outsourcing on wages, we can solve (13) and (14) for the change in low and high skilled wages and obtain

$$\hat{w}_L = -\frac{\theta_{XL}\theta_{YH}}{\Delta_{\Theta}}\hat{\varphi}_{XL} \quad (15)$$

$$\hat{w}_H = \frac{\theta_{XL}\theta_{YL}}{\Delta_{\Theta}}\hat{\varphi}_{XL} \quad (16)$$

with  $\Delta_{\Theta}$  as the determinant of the matrix of factor income shares  $\Theta \equiv \begin{pmatrix} \theta_{XH} & \theta_{XL} \\ \theta_{YH} & \theta_{YL} \end{pmatrix}$  and

$$\hat{w}_H - \hat{w}_L = \frac{\theta_{XL}}{\Delta_{\Theta}}\hat{\varphi}_{XL} \quad (17)$$

<sup>3</sup>As known from the sector bias of International Outsourcing (cf. Arndt, 1997, 1998a,b), low skilled wages increase if International Outsourcing takes place in the relative low skill intensive industry. Thus, a possible downward wage rigidity for low skilled labor would not be binding.

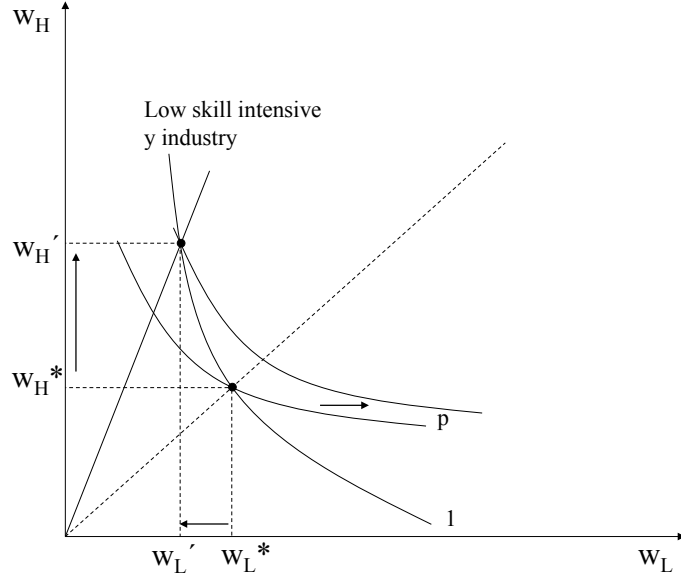


Figure 1: Effects of International Outsourcing on wages (low skill parts of relative high skill intensive industry)

as the percentage change in relative high skilled wages. Since  $\Delta_{\Theta} > 0$ , International Outsourcing of the low skill intensive production block in the relative high skill intensive industry increases the relative wage of the high skilled  $\hat{w}_H - \hat{w}_L > 0$ , as depicted in the Mussa-Woodland-Figure 1.

Since the relative high skill intensive industry relocates its low skill intensive production block, it needs less low skilled labor to produce one unit of commodity X. As the economy faces given world prices, this induces a reduction of unit costs. Thus, the respective unit cost curve shifts horizontally outward. Since relative wages of the high skilled increase in both industries, high skilled labor gains from this International Outsourcing activity in receiving a wage premium.

As we know from Shephard's Lemma (3) - (6), equilibrium labor unit requirements can be obtained by differentiating the unit cost functions partially with respect to the wages. Considering International Outsourcing ( $\vec{a}_{ij} = a_{ij}\varphi_{ij} = \frac{\partial c_i}{\partial \vec{w}_j}$  and thus,  $a_{ij} = \frac{\partial c_i}{\partial \vec{w}_j \varphi_{ij}}$ ) we obtain

$$\hat{a}_{XL} = \theta_{XH}(\hat{w}_H - \hat{w}_L + \hat{\varphi}_{XL} - \hat{\varphi}_{XH}) - \hat{\varphi}_{XL} \quad (18)$$

$$\hat{a}_{XH} = -\theta_{XL}(\hat{w}_H - \hat{w}_L + \hat{\varphi}_{XL} - \hat{\varphi}_{XH}) - \hat{\varphi}_{XH} \quad (19)$$

$$\hat{a}_{YL} = \theta_{YH}(\hat{w}_H - \hat{w}_L + \hat{\varphi}_{YL} - \hat{\varphi}_{YH}) - \hat{\varphi}_{YL} \quad (20)$$

$$\hat{a}_{YH} = -\theta_{YL}(\hat{w}_H - \hat{w}_L + \hat{\varphi}_{YL} - \hat{\varphi}_{YH}) - \hat{\varphi}_{YH} \quad (21)$$

as the percentage change of the cost minimizing labor unit requirements. Now consider that only  $\hat{\varphi}_{XL} > 0$  and substitute for the change in relative wages (17) we obtain

$$\hat{a}_H - \hat{a}_L = -\frac{\theta_{XL}}{\Delta_{\Theta}} \hat{\phi}_{XL} \quad (22)$$

as the percentage change of relative labor unit requirements. Since International Outsourcing increases relative wages of the high skilled, relative labor unit requirements of the high skilled decrease in both industries. Thus, both industries shift skill requirements toward more low skilled labor.<sup>4</sup>

## Output and Employment

To investigate the effects of International Outsourcing on output, take the total differential of the full employment conditions (7) and (8). In equilibrium, we obtain

$$\hat{q}_X \lambda_{XL} + \hat{q}_Y \lambda_{YL} = -(\hat{a}_{XL} \lambda_{XL} + \hat{a}_{YL} \lambda_{YL}) \quad (23)$$

$$\hat{q}_X \lambda_{XH} + \hat{q}_Y \lambda_{YH} = -(\hat{a}_{XH} \lambda_{XH} + \hat{a}_{YH} \lambda_{YH}) \quad (24)$$

with labor shares  $\lambda_{iL} \equiv \frac{L_i}{L}$  and  $\lambda_{iH} \equiv \frac{H_i}{H}$ . Substituting for the changes of labor unit requirements and relative wages we can solve these equations for the percentage change in output of both industries, subject to the change in International Outsourcing activities

$$\hat{q}_X = \frac{\delta_H \lambda_{YL} + \delta_L \lambda_{YH}}{\Delta_{\Theta} \Delta_{\Lambda}} \theta_{XL} \hat{\phi}_{XL} + \theta_{XL} \hat{\phi}_{XL} \quad (25)$$

$$\hat{q}_Y = -\frac{\delta_H \lambda_{XL} + \delta_L \lambda_{XH}}{\Delta_{\Theta} \Delta_{\Lambda}} \theta_{XL} \hat{\phi}_{XL} \quad (26)$$

with  $\delta_L \equiv \lambda_{XL} \theta_{XH} + \lambda_{YL} \theta_{YH}$ ,  $\delta_H \equiv \lambda_{XH} \theta_{XL} + \lambda_{YH} \theta_{YL}$ , and the determinant of the matrix of labor shares  $\Delta_{\Lambda} > 0$  with  $\Lambda \equiv \begin{pmatrix} \lambda_{XH} & \lambda_{YH} \\ \lambda_{XL} & \lambda_{YL} \end{pmatrix}$ . Since International Outsourcing makes the respective industry more competitive on world markets, output increases in the relative high skill intensive industry ( $\hat{q}_X > 0$ ), whereas output of the industry remaining integrated decreases ( $\hat{q}_Y < 0$ ).

As we know, assuming wage flexibility, high and low skilled labor remain fully employed. However, provided that labor can freely move between the industries, within industry employment effects arise. Taking the total differential of the full employment conditions and substituting for the change in relative wages, labor unit requirements as well as output, we obtain

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<sup>4</sup>The unambiguity of this result depends strongly on the assumption of a Cobb Douglas production process and the flexible wage set-up. Since the shift toward more low skill intensive production does not hold empirically, this may be a first hint pointing to labor market rigidities. Then, firms would reduce low skill employment which adds to unemployment (cf. Dluhosch, 2008).

$$\hat{L}_X = \frac{\theta_{XH}\Delta_\Lambda + (\delta_H\lambda_{YL} + \delta_L\lambda_{YH})}{\Delta_\Theta\Delta_\Lambda} \theta_{XL}\hat{\phi}_{XL} \quad (27)$$

$$\hat{L}_Y = \frac{\theta_{YH}\Delta_\Lambda - (\delta_H\lambda_{XL} + \delta_L\lambda_{XH})}{\Delta_\Theta\Delta_\Lambda} \theta_{XL}\hat{\phi}_{XL} \quad (28)$$

$$\hat{H}_X = \frac{(\delta_H\lambda_{YL} + \delta_L\lambda_{YH}) - \theta_{XL}\Delta_\Lambda}{\Delta_\Theta\Delta_\Lambda} \theta_{XL}\hat{\phi}_{XL} \quad (29)$$

$$\hat{H}_Y = -\frac{\theta_{YL}\Delta_\Lambda + (\delta_H\lambda_{XL} + \delta_L\lambda_{XH})}{\Delta_\Theta\Delta_\Lambda} \theta_{XL}\hat{\phi}_{XL} \quad (30)$$

as the percentage change in within industry employment of low and high skilled labor. Since International Outsourcing increases employment of the low skilled in the relative high skill intensive industry ( $\hat{L}_X > 0$ ), employment of the low skilled in the relative low skill intensive industry has to decrease ( $\hat{L}_Y < 0$ ). The same pattern occurs for high skilled labor. With employment of the high skilled decreasing in the relative low skill intensive industry ( $\hat{H}_Y < 0$ ) employment of the high skilled in the relative high skill intensive industry has to increase ( $\hat{H}_X > 0$ ). Thus, since International Outsourcing increases output in the relative high skill intensive industry, low as well as high skilled labor quit employment in the low skill intensive industry and move to the high skill intensive one.

## Summarizing the Main Findings

Since the relative high skill intensive industry relocates its low skill intensive production block, it needs less low skilled labor and thus, faces a reduction in unit costs. Assuming an economy facing given world prices, the additional return is used to pay a wage premium for high skilled labor. Thus, with labor assumed to be mobile between the industries, relative wages of the high skilled increase in both industries. Consequently, labor unit requirements of high skilled labor decrease. This implies a skill shift toward more low skilled labor. Since the industry facing International Outsourcing activities gets more competitive on world markets, output increases while output of the other industry (the one keeping its integrated production structure) decreases. All these results have to be considered for the effects on within industries' employment: Since labor moves from the contracting relative low skill intensive to the expanding relative high skill intensive industry, low skill as well as high skill employment increases in the industry with International Outsourcing activities, while it decreases in the industry remaining integrated.

## 4 General Equilibrium Effects with Wage Rigidity

After examining general equilibrium effects of International Outsourcing with flexible wages, this section considers an empirically more realistic scenario for major European

economies. There, powerful unions as well as high social standards induce some kind of wage rigidity for low skilled labor. As employees would not accept wages beneath the margin set by social standards, wages are prevented from adjusting to shocks. Thus, results are likely to differ fundamentally from the flexible wage benchmark model. In order to consider these differences we violate the flexible wage assumption and subject the entire labor market of the economy to a wage floor for low skilled labor. Following Brecher (1974a,b), labor market inflexibility is modeled with real wages for the low skilled rigid with respect to the numeraire.

The rigid wage, exogenously given in real terms, is specified at a fixed level denoted by  $\bar{w}_L$ , the real wage before the respective industry decides to relocate production fragments abroad. Thus, at  $\bar{w}_L$  low skilled labor is fully employed but with downward inflexibility of the real wage

$$w_L \geq \bar{w}_L \text{ or } \hat{w}_L \geq 0 \quad (31)$$

To investigate the implications of International Outsourcing with wage rigidity assume again the case that the relative high skill intensive industry relocates its low skill intensive production fragment ( $\hat{\phi}_{XL} > 0$  whereas  $\hat{\phi}_{XH} = \hat{\phi}_{YL} = \hat{\phi}_{YH} = 0$ ). As we know from (15) and (17) real wages of the low skilled decrease in absolute as well as in relative terms. Thus, the above defined minimum wage (31) is binding, preventing low skilled wages from downward adjustment ( $\hat{w}_L = 0$ ).

With wage rigidity we have to rewrite (13) and (14) and obtain

$$\theta_{XH}\hat{w}_H = \theta_{XL}\hat{\phi}_{XL} \quad (32)$$

$$\theta_{YH}\hat{w}_H = 0 \quad (33)$$

as equilibrium conditions. Solving for the percentage change in high skill wages, different results *ceteris paribus* emerge for the two industries

As Figure 2 shows, International Outsourcing of the low skill intensive production fragment in the relative high skill intensive industry shifts the respective unit cost function horizontally outside. Due to the wage rigidity for the low skilled, wages of the high skilled increase in the same industry but, in a first step, remain unchanged in the relative low skill intensive industry. As we assumed labor to be completely mobile between industries, the high skilled employed in the relative low skill intensive industry would immediately move to the relative high skill intensive industry in order to achieve the wage premium. Thus, the low skill intensive industry would stop production. However, holding to the assumption of incomplete specialization, this is not an equilibrium anymore. Thus, in order to keep production positive, the relative low skill intensive industry is forced to accept the high skill wage premium paid in

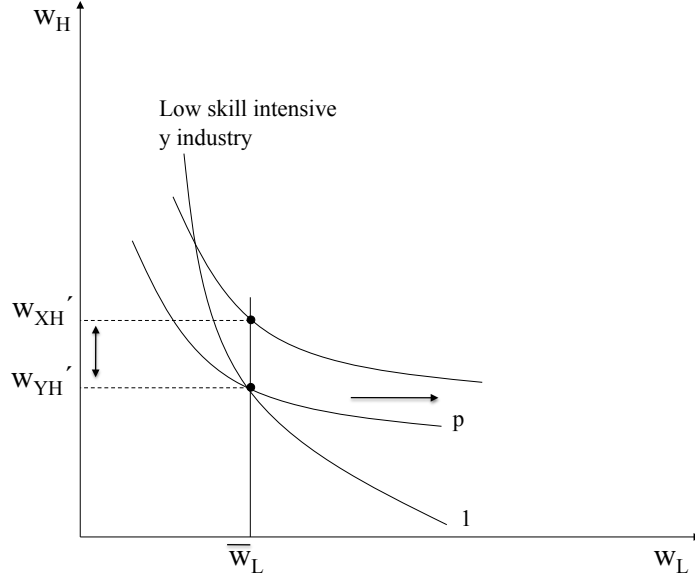


Figure 2: Effects of International Outsourcing on wages (with wage rigidity)

the relative high skill intensive industry ( $\hat{w}_{YH} = \hat{w}_{XH} = \hat{w}_H = \frac{\theta_{XL}}{\theta_{XH}} \hat{\phi}_{XL}$ ). Then, however, the relative low skill intensive industry is no longer producing at minimum costs. The only way for the relative low skill intensive industry to remain at the minimum cost level is to reduce output.

## Wages and Labor Unit Requirements

Provided that the relative low skill intensive industry has to accept the high skill wage premium, implied by International Outsourcing occurring in the relative high skill intensive industry, and since the wage floor for low skilled labor is binding ( $\hat{w}_L = 0$ ), the change in relative wages of the high skilled equals the respective absolute change with

$$\hat{w}_H - \hat{w}_L = \frac{\theta_{XL}}{\theta_{XH}} \hat{\phi}_{XL} \quad (34)$$

Thus, also with a wage floor for low skilled labor, International Outsourcing in the relative high skill intensive industry increases relative wages of the high skilled, however, not as strong as in the flexible wage scenario

$$(\hat{w}_H - \hat{w}_L)|_{\text{flex}} - (\hat{w}_H - \hat{w}_L)|_{\text{rigid}} = \frac{\theta_{XL}}{\Delta_{\Theta}} \hat{\phi}_{XL} - \frac{\theta_{XL}}{\theta_{XH}} \hat{\phi}_{XL} > 0 \quad (35)$$

since  $\Delta_{\Theta} \equiv \theta_{XH} - \theta_{YH} < \theta_{XH}$ . Thus, the minimum wage for low skill labor mildens the widening of the wage gap.

For the effects of International Outsourcing on relative labor unit requirements remember (18) - (21) and substitute for the change of relative wages assuming the binding

minimum wage (34). Solving for the change in relative labor unit requirements, we obtain

$$\hat{a}_H - \hat{a}_L = -\frac{\theta_{XL}}{\theta_{XH}} \hat{\phi}_{XL} \quad (36)$$

Since relative wages of the high skilled increase also with a minimum wage for low skilled labor, International Outsourcing again induces a skill shift towards more low skilled labor in both industries. However, the skill shift is, as the effects on relative wages, not as strong with wage rigidity as with flexible wages.

## Output and Employment

In order to achieve the equilibrium pattern of output and employment, call the endowment of the economy with fixed overall factor supplies ( $\bar{L}$  and  $\bar{H}$ ) constraining the employment conditions. With the assumption of wage rigidity, we have to rewrite (7) and obtain

$$L \equiv a_{XL}q_X + a_{YL}q_Y \leq \bar{L} \quad (37)$$

considering that unemployment of the low skilled may occur ( $\hat{L} \leq 0$ ). Thus, there is the possibility of low skilled labor being not employed in the X or in the Y industry. Since high skill wages remain flexible, high skilled labor stays fully utilized

$$H \equiv a_{XH}q_X + a_{YH}q_Y = \bar{H} \quad (38)$$

Taking the total differential of the employment conditions (37 and 38), we obtain

$$\hat{q}_X \lambda_{XL} + \hat{q}_Y \lambda_{YL} = \hat{L} - (\hat{a}_{XL} \lambda_{XL} + \hat{a}_{YL} \lambda_{YL}) \quad (39)$$

$$\hat{q}_X \lambda_{XH} + \hat{q}_Y \lambda_{YH} = -(\hat{a}_{XH} \lambda_{XH} + \hat{a}_{YH} \lambda_{YH}) \quad (40)$$

as equilibrium condition. Considering the changes in labor unit requirements as well as relative wages, we can solve (39) and (40) for  $\hat{q}_X$  and  $\hat{q}_Y$  and achieve

$$\hat{q}_X = \frac{\lambda_{YL}(\lambda_{XH} + \theta_{YL}\lambda_{YH}) + \lambda_{YH}(\theta_{YH}\lambda_{YL})}{\Delta_\Lambda} \cdot \frac{\theta_{XL}}{\theta_{XH}} \hat{\phi}_{XL} - \frac{\lambda_{YH}\hat{L}}{\Delta_\Lambda} \quad (41)$$

$$\hat{q}_Y = -\frac{\lambda_{XL}(\lambda_{XH} + \theta_{YL}\lambda_{YH}) + \lambda_{XH}(\theta_{YH}\lambda_{YL})}{\Delta_\Lambda} \cdot \frac{\theta_{XL}}{\theta_{XH}} \hat{\phi}_{XL} + \frac{\lambda_{XH}\hat{L}}{\Delta_\Lambda} \quad (42)$$

as equilibrium output patterns for both industries. Since low skilled labor was fully employed before slicing up the value chain, employment of the low skilled can either

remain unchanged or decrease ( $\hat{L} \leq 0$ ). Thus, International Outsourcing increases output in the relative high skill intensive industry and leads to a contraction of the relative low skill intensive one. By contrast to the benchmark-case of flexible wages, the change in output occurring with rigid wages is due to two different forces, one “normal” effect of the International Outsourcing activity as well as an “additional” effect as the low skill intensive industry sets low skilled labor free ( $\hat{L}_Y \leq 0$ ), in order to maintain the minimum cost level. Since  $\lambda_{XH} > \lambda_{YH}$ , the change of low skilled employment decreases the output in the relative low skill intensive industry ( $Y$ ) by more than it expands output in the relative high skill intensive industry ( $X$ ) (i.e.  $\frac{\lambda_{YH}}{\Delta_\Lambda} \hat{L} < \frac{\lambda_{XH}}{\Delta_\Lambda} \hat{L}$ ).

To examine the effects on employment, consider again the change within the industries. Substituting for the change in relative wages, the change in labor unit requirements as well as the change in output, we obtain

$$\hat{H}_X = -\frac{\theta_{XL}}{\theta_{XH}} \hat{\varphi}_{XL} + \frac{\lambda_{YL}(\lambda_{XH} + \theta_{YL}\lambda_{YH}) + \lambda_{YH}(\theta_{YH}\lambda_{YL})}{\Delta_\Lambda} \frac{\theta_{XL}}{\theta_{XH}} \hat{\varphi}_{XL} - \hat{L} \frac{\lambda_{YH}}{\Delta_\Lambda} \quad (43)$$

$$\hat{H}_Y = -\frac{\theta_{YL}\theta_{XL}}{\theta_{XH}} \hat{\varphi}_{XL} - \frac{\lambda_{XL}(\lambda_{XH} + \theta_{YL}\lambda_{YH}) + \lambda_{XH}(\theta_{YH}\lambda_{YL})}{\Delta_\Lambda} \frac{\theta_{XL}}{\theta_{XH}} \hat{\varphi}_{XL} + \hat{L} \frac{\lambda_{XH}}{\Delta_\Lambda} \quad (44)$$

as the effects of International Outsourcing on within industries’ high skill employment. Provided that high skilled wages stay flexible, the relative low skill intensive industry ( $Y$ ) again decreases employment of the high skilled ( $\hat{H}_Y \leq 0$ ), whereas the relative high skill intensive industry increases high skilled employment. For the within industries’ change in low skill employment we achieve

$$\hat{L}_X = \frac{\theta_{XL}}{\theta_{XH}} \hat{\varphi}_{XL} - \frac{\lambda_{YH}}{\lambda_{YL}} \hat{L}_Y \quad (45)$$

as the long run equilibrium. Thus, after some painful adjustment processes in the short run, some of the low skilled labor set free in the relative low skill intensive industry ( $Y$ ) is absorbed by the relative high skill intensive industry ( $X$ ). However, since not all of the unemployed low skilled can be absorbed at given wages by the relative high skill intensive industry ( $X$ ), International Outsourcing of the low skill intensive parts in the relative high skill intensive industry increases unemployment of the low skilled as long as we move down the Rybczynski line to find the new equilibrium situation.

## Summarizing the Main Findings

Subjecting the labor market of the economy to a rigid wage floor for low skilled labor, International Outsourcing of the low skill intensive part in the relative high skill intensive industry enables the industry to pay a high skill wage premium. However, due to the wage rigidity, high skill wages do not increase in the relative low skill intensive industry in the first step. Thus, since the high skilled in the relative low skill intensive

industry would move to the relative high skill intensive one, in order to benefit from the wage premium, the low skill intensive industry would stop production. This is no equilibrium situation holding to the assumption of incomplete specialization. Thus, the relative low skill intensive industry has to accept the high skill wage premium. In order to remain at the minimum level of unit costs, the industry has to reduce output. Thus, absolute as well as relative wages of the high skilled increase in both industries, however, not as strong as in the flexible wage scenario. Assuming Cobb Douglas production structures, this induces a skill shift in both industries towards more low skilled labor. With wage rigidity, the output pattern depends on two different forces. Since International Outsourcing increases the competitiveness in the relative high skill intensive industry, the industry expands while the low skill intensive contracts. However, since the relative low skill intensive industry is forced to accept the high skill wage premium paid in the relative high skill intensive industry, there is an additional force constraining the low skill intensive industry. Since the low skilled labor set free by the relative low skill intensive industry can not be completely absorbed by the relative high skill intensive one, we move the Rybczynski line downward, with low skill unemployment increasing until we reach the new equilibrium situation.

## **5 Empirical Evidence for Germany**

In order to empirically test the theoretical findings stated above, this section provides a micro-econometric panel data analysis investigating the different implications of International Outsourcing that occur when being adopted in a flexible wage industry, or in an industry characterized by a rigid wage floor for low skilled labor instead. Due to small but important differences between the empirical situation and the theoretical assumptions made above, empirical results are expected to differ slightly from the theoretical findings. Thus, the expected empirical outcomes are stressed first, before the section describes the data and the econometric tests in detail.

In order to focus on a long run perspective and to keep the theoretical equilibrium traceable, one crucial assumption imposed was labor being completely mobile between the industries. This, however, is not reflected in the data. Due to personal characteristics like e.g. education or family status, labor is not completely mobile empirically. Thus, painful short run adjustment effects need to be accepted. Given these facts, International Outsourcing is expected to increase unemployment of the low skilled when taking place in high skill intensive industries, even when wages can adjust. However, when outsourcing takes place in industries with wage rigidity, the increase in unemployment is expected to be more extensive. When Outsourcing takes place in the relative low skill intensive industries, unemployment of the low skilled should not increase since the wage floor is assumed not to be binding. At more aggregated industry levels, like

the whole economy or the service industry, we are not able to make any presumptions.

## Data and Econometric Methodology

In order to provide empirical evidence for the way wage rigidity affects International Outsourcing implications, the analysis bases on microeconomic panel data for the German economy between 1991 and 2000. Within a multiple logit model, individual unemployment is regressed on the International Outsourcing activity of the industry the individual's employed in, as well as several variables controlling for observable individual-specific as well as industry-specific characteristics.

$$U_{ijt} = \beta_0 + \beta_1 VS_{jt} + \beta_2 Y_{jt} + \beta_3 age_{it} + \beta_4 deast_{it} + \beta_5 dmale_{it} + \tau_j + \delta_t + \mu_i + \epsilon_{it} \quad (46)$$

$U$  is a binary variable indicating if individual  $i$  is unemployed at time  $t$ ,  $VS$  is an index proxying International Outsourcing activities in industry  $j$  at time  $t$ ,<sup>5</sup>  $Y$  is the output of industry  $j$ ,  $age$  the age of individual  $i$ . The dummy variable  $deast$  indicates if the individual's residence is in East Germany, and the dummy variable  $dmale$  the gender of the individual. Additionally, we control for time specific effects ( $\delta$ ), industry specific effects ( $\tau$ ), as well as unobservable individual heterogeneity ( $\mu$ ). Thus, with the error term  $\epsilon$  allowing for unspecified correlation of errors within industries, the regression cares for contemporaneous correlation even though maximum likelihood estimation is used instead of OLS.<sup>6</sup> In order to focus on the implications of wage rigidity, we run this regression for all industries and compare the results with results when considering only rigid wage industries.

The data is taken from the German Socio Economic Panel GSOEP and from input-output tables provided by the German Federal Statistical Office. The input-output tables are used to calculate the VS-index and the output of each two-digit NACE industry for the period 1991 to 2000. The endogenous variable  $U$ , indicating the employment status of an individual, is taken from the GSOEP (waves H/8, 1991 to Q/17, 2000). The GSOEP additionally provides information on the age of an individual,

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<sup>5</sup>On a more aggregated industry level it is necessary to proxy International Outsourcing activities. Therefore, several indices are developed and some of them are very common in use. One of these indices, called the VS-index, is a proxy of imported inputs in production and can be calculated using  $VS_t = \sum_{j=1}^n \sum_{w=1}^z \frac{(m_{wt}/s_{wt}) \cdot q_{wjt}}{p_{jt}}$  with  $q$  as total inputs from industry  $w$  used in industry  $j$ ,  $p$  as production value in industry  $j$ ,  $m$  as total imports and  $s$  as the domestic use of goods  $w$ . For a descriptive overview of International Outsourcing activities in Germany, measured by the VS-index, and an empirical investigation of often used International Outsourcing indices, see Horgos (2009).

<sup>6</sup>See Moulton (1990) for the necessity to include industry controls in order to account for correlation of errors within groups and thus, to provide spurious regression when estimating the effects of macro-variables on micro-units.

the individual's residence, gender, as well as the education of each individual with respect to the international comparable ISCED from UNESCO (1997).<sup>7</sup>

In order to perform the required estimations, additional information on the existence of wage rigidity at the industry level is needed. However, since wage rigidity is typically not observable on a more aggregated sectoral bases, there is a need to proxy wage rigidity at the industry level. This, however, is an empirical challenge and thus, may be the reason why there is no empirical evidence for wage rigidities affecting the implication of economic phenomena, like e.g. International Outsourcing activities. In order to generate an indicator denoting if an industry is characterized by a rigid wage structure or not, the analysis follows a similar procedure as in Holden (2004), Goette et al. (2007), Knoppik and Beissinger (2005), and Bauer et al. (2007).<sup>8</sup>

In order to obtain the information whether an industry is characterized by rigid wages for the low skilled or not, the percentage change of the mean wage  $\hat{w}_{it}$  of the low skilled is calculated for each year in each two-digit NACE industry as a first step. Based on the percentage changes, a normalized distribution of the corresponding wage changes per industry-year is generated by adjusting the empirically observed wage changes with the industry specific median and standard deviation  $\hat{w}_{it}^n \equiv \frac{\hat{w}_{it} - \mu(\hat{w})_i}{sd(\hat{w})_i}$ . Afterward, the industry-year specific samples of the empirical distribution need to be calculated. As the empirical samples and their moments are stochastic and thus burdened with unknown uncertainty, a bootstrap method is used. Thus, we create a distribution of the low skilled wage changes in bootstrapping the empirically observed percentage changes for each industry-year sample. Based on the generated empirical distribution, the number of wage cuts per industry is calculated and, in this regard, the respective probability of a wage cut occurring in this industry is computed. The empirically observed probability of wage cuts needs to be related to a normalized probability of wage cuts (assuming no wage rigidity). Therefore, a notional distribution of the normalized wage cuts is created by adjusting the normalized wage changes with the bootstrapped mean and standard deviation  $\tilde{w}_{it} \equiv \hat{w}_{it}^n sd^B + \mu^B$ . Based on this notional normalized distribution, the number of wage cuts and the respective probability of these wage cuts occurring per industry are calculated. The notional normalized probability of wage cuts per industry can then be related to the empirically observed probability of wage cuts per industry. If the empirically observed probability of wage cuts per industry is smaller than the notional normalized one, it is assumed that the respective

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<sup>7</sup>In line with the ISCED, low skill educated workers are defined as individuals with primary, lower secondary or second stage of basic education, whereas high skilled workers are individuals with some form of post secondary education.

<sup>8</sup>For more papers on the measurement of wage rigidities see the special edition of the Economic Journal, Vol. 117, Iss. 524, Nov. 2007.

Table 1: Effects on low skilled unemployment in Germany (1)

in considering	Whole Economy		Service Industry	
	all industries	rigid wage industries	all industries	rigid wage industries
VS	12.7423 (1.60)	25.8744*** (2.46)	27.7687 (1.56)	41.3825* (1.83)
Y	4.75e-06 (1.50)	-2.66e-06 (-.42)	-5.55e-06 (-.91)	-1.37e-05 (-1.39)
age	-.0551*** (-10.79)	-.0546*** (-9.27)	-.0583*** (-9.18)	-.0610*** (-7.59)
d East Ger.	.2544* (1.64)	-.2107 (1.15)	.2281 (1.31)	.1278 (.59)
d Male	-.3102** (2.33)	-.3272** (-2.21)	-.0518 (-.32)	-.0272 (-.14)
cons	-3.0526*** (-3.59)	-5.2270*** (-3.66)	-1.5433 (-1.13)	-3.3119*** (-2.45)
Observations	16,194	13,195	9,921	7,218
Groups	5,039	4,173	3,563	2,664
Prob > chi2	0.0000	0.0000	0.0000	0.0000
Industry Controls	YES	YES	YES	YES
Year Controls	YES	YES	YES	YES
Region Controls	YES	YES	YES	YES

(z-Statistics in parantheses)

\* / \*\* / \*\*\* significant at 10 / 5 / 1 percent

industry is characterized by rigid wages for low skilled labor.<sup>9</sup>

## Results

In order to empirically test the effects of wage rigidity on the implications of International Outsourcing activities, (46) is first regressed for the whole economy, differing between all industries and industries with rigid wages for low skilled labor.<sup>10</sup> The results are presented in the first two columns of Table 1.

<sup>9</sup>Table 3 in the Appendix provides an overview of the two-digit NACE industries in Germany characterized as rigid-wage industries due to this classification (considering the period 1991-2000).

<sup>10</sup>Since it can not be assumed that the individuals exhibit a systematic intercept, but instead, that they are randomly drawn from a binomial distribution, all the models below are tested using a random-effects logit estimator. Additionally, since the data consists of a huge amount of observations and a comparably small amount of years, the random effects logit model can be assumed to be much more efficient than its fixed effects variant. When regressing the unemployment status on the contemporaneous industries' output, a possible endogeneity problem could be assumed. Therefore, Durbin-Wu-Hausman tests are applied to assure that possible endogeneity does not significantly affect the consistency of the estimated coefficients.

As the results show, International Outsourcing (proxied by the VS index) increases the probability of low skilled labor to get unemployed, however, with a z-value of 1.60, not at a statistically significant level. By contrast, when considering that International Outsourcing takes place in industries with wage rigidity for low skilled labor, the probability of getting unemployed due to International Outsourcing activities is twice as high, and in addition, highly statistically significant at a level of 1 percent. The included control variables also yield a variety of very interesting results. While the output of an industry has only insignificant effects, the individual control variables strongly influence the possibility of an individual getting unemployed on a statistically significant level. The age of an individual, e.g., decreases the probability of getting unemployed slightly, but statistically significant at the 1 percent level. Living in the eastern part of Germany or being female, by contrast, significantly increases the likelihood of getting unemployed. These highly statistically significant effects ensure that the overall model is fitted well with highly significant chi<sup>2</sup>-values. The model is based on approx. 15,000 individual observations, includes industry, year, and region controls to avoid contemporaneous correlation, and thus, is necessarily representative to derive generalizable results.

When International Outsourcing takes place in the service sector, results also confirm the increasing effect of wage rigidity on unemployment of the low skilled. Considering all service industries, International Outsourcing indeed increases the probability for the low skilled to get unemployed, however, as for the whole economy, not at a statistically significant level. When focusing solely on the service industries characterized by a rigid wage floor for low skilled labor, the effect is nearly twice as intensive and statistically significant at the 10 percent level. The results of the other control variables confirm the above stated findings, as well as the robustness of the model.

After providing empirical evidence for more aggregated industry levels, the results presented in Table 2 move the focus on more disaggregated industry levels, the high as well as low skill intensive industries of the manufacturing sector. Considering the above mentioned differences between the theoretical model (adopting a long run perspective) and the empirical methodology (accounting for short run adjustment) the empirical results strongly support the theoretical picture of section 4. If International Outsourcing takes place in high skill intensive industries, the probability for low skilled individuals to get unemployed increases, statistically significant at the 10 percent level. However, when International Outsourcing takes place in high skill intensive industries characterized by wage rigidity for low skilled labor, the probability of getting unemployed nearly doubles and becomes statistically even more significant with the z-value increasing up to 2.16. The results of the additional control variables do not change compared to the whole economy, however, the gender and the east German dummy variable are outside the statistically significant range.

Table 2: Effects on low skilled unemployment in Germany (2)

in	High Skill Industries		Low Skill Industries	
	all industries	rigid wage industries	all industries	rigid wage industries
VS	36.8284*	61.0233**	-4.5951	-6.0987
	(1.68)	(2.16)	(-.21)	(-.29)
Y	9.78e-07	-4.25e-06	1.14e-04*	7.77e-05
	(.08)	(-.32)	(1.69)	(1.05)
age	-.0702***	-.0676***	-.0616***	-.0569***
	(-4.18)	(-4.03)	(-4.64)	(-4.29)
d East Ger.	.3054	.3714	.3779	.4915
	(.56)	(.69)	(.80)	(1.04)
d Male	-.1085	-.0234	-.6600**	-.6916**
	(-.28)	(.06)	(-2.16)	(-2.22)
cons	-9.2156**	-12.7672**	-17.2181*	-12.8314
	(-1.95)	(-2.18)	(-1.72)	(-1.16)
Observations	2,768	2,738	3,042	2,802
Groups	1,018	1,003	1,085	1,006
Prob > chi2	0.0120	0.0043	0.0330	0.0238
Industry Controls	YES	YES	YES	YES
Year Controls	YES	YES	YES	YES
Region Controls	YES	YES	YES	YES

(z-Statistics in parantheses)

\* / \*\* / \*\*\* significant at 10 / 5 / 1 percent

When International Outsourcing takes place in the relative low skill intensive industries, the probability for the low skilled to get unemployed decreases, however, not at a statistically significant level. This result, occurring even in industries with wage rigidity, supports the expected results known from the sector bias of International Outsourcing (cf. Arndt, 1997): Since low skilled labor gains when International Outsourcing occurs in relative low skill intensive industries, the demand for low skilled labor increases as does employment and wages. Thus, a possible wage floor would not be binding and unemployment would be expected to decrease. The results of the included control variables again confirm the findings. One interesting point to note additionally is that the increasing effect of being a female on the probability of the low skilled to get unemployed is statistically significant, and even much higher, in relative low skill intensive industries compared to the relative high skill intensive ones.

## 6 Conclusion

In order to examine general equilibrium effects of International Outsourcing, research mostly assumes a flexible wage set-up. However, in major European economies, labor

markets are characterized by powerful unions and high social standards, inducing an implicit wage rigidity for low skilled labor. While only few contributions theoretically examining International Outsourcing effects within a rigid-wage economy emerged recently, there is still no empirical evidence which support these findings. This paper contributes to fill this gap.

Therefore, general equilibrium effects of International Outsourcing are formally examined by employing a modern duality approach. Assuming a binding wage floor for low skilled labor, results differ fundamentally from the flexible wage scenario: With International Outsourcing of the low skill intensive production block in the relative high skill intensive industry, real wages of the high skilled increase in the outsourcing industry while *ceteris paribus* not changing in the relative low skill intensive industry. However, with labor completely mobile between industries, the relative low skill intensive industry had to quit production since all high skilled would move to the skill intensive industry. Thus, for staying afloat, the relative low skill intensive industry is forced to accept the high skill wage premium and thus, to decrease output. Therefore, International Outsourcing increases relative wages of the high skilled, however, not as strong as in the flexible wage scenario. This induces a skill shift in both industries toward more low skilled labor. Since the outsourcing industry gets more competitive on world markets, it expands while output in the industry remaining integrated decreases. However, since wage rigidity forces the low skill intensive industry to set low skilled labor free, the contraction of the industry gets additionally amplified. Since not all of the low skilled can be absorbed by the high skill intensive industry, unemployment of the low skilled occurs as we move down the Rybczynski line toward the new equilibrium. Thus, the smaller increase of the wage gap occurring with International Outsourcing in a rigid wage economy has to be bought dearly with unemployment of low skilled labor.

The link between International Outsourcing and the increase of low skilled unemployment when low skilled wages are assumed to be rigid is tested within a microeconomic panel data analysis. Therefore, a variable indicating if wages are rigid within an industry is created. The empirical results strongly support the theoretical findings: If International Outsourcing takes place in industries characterized by inflexible labor markets, the probability of an individual getting unemployed increases dramatically in extent and significance.

Since the link between International Outsourcing and labor market imperfections is rarely explored yet, plenty of room exists for future research. Empirical contributions could also investigate the remaining general equilibrium effects occurring if International Outsourcing takes place in rigid wage industries. It would e.g. be worth examining the difference of the implications on the wage gap between low and high skilled labor as well as on the output of the industries. However, not only the effects of

International Outsourcing are worth being examined: The change in determinants of International Outsourcing due to wage rigidity would additionally being worth to get investigated. Maybe there is a force of minimum wages toward more or less International Outsourcing activities, leading an economy to even more intensively participate or to retire from the international division of labor.

This contribution tries not to explain the main causes for unemployment in major European economies. Instead, the paper highlights the importance of labor market institutions to gain or lose from a non-stoppable economic process, International Outsourcing. Policy makers can either stand for more flexibility, and accept a larger wage gap, or for more rigid labor markets, and buying a decrease in the wage gap dearly with low skilled unemployment. Thus, in terms of unemployment, not International Outsourcing but inflexible labor market institutions should instead be blamed for harming low skilled labor.

## Appendix: Wage Rigidity at the 2-digit NACE Industry Level

Table 3: 2-digit NACE industries with a rigid wage structure

NACE	Industry	Wage Rigidity	NACE	Industry	Wage Rigidity
1	Agriculture	1	41	Water collection, treatment and supply	0
2	Forestry	0	45	Construction of buildings	1
5	Fishing	0	50	Wholesale and retail trade and repair of motor vehicles	0
10	Mining of coal and lignite	1	51	Wholesale trade	1
11	Extraction of crude petroleum and natural gas	0	52	Retail trade	1
12	Mining of iron ores	0	55	Accommodation	1
13	Mining of non-ferrous metal ores	0	60	Land transport and transport via pipelines	1
14	Quarrying of stone, sand and clay	0	61	Water transport	0
15	Manufacture of food products and beverages	1	62	Air transport	0
16	Manufacture of tobacco products	0	63	Warehousing and support activities for transportation	1
17	Manufacture of textiles	1	64	Postal and courier activities	1
18	Manufacture of wearing apparel	1	65	Financial service activities, except insurance	1
19	Manufacture of leather and related products	1	66	Insurance, reinsurance and pension funding	1
20	Manufacture of wood except furniture	0	67	Activities auxiliary to financial services	0
21	Manufacture of paper and paper products	1	70	Real estate activities	1
22	Printing and reproduction of recorded media	1	71	Rental and leasing activities	0
23	Manufacture of coke and refined petroleum products	0	72	Data processing and data warehouse	0
24	Manufacture of chemicals and chemical products	1	73	Scientific research and development	0
25	Manufacture of rubber and plastic products	1	74	Office administrative and other business support activities	0
26	Manufacture of other non-metallic mineral products	0	75	Public administration and defence; compulsory social security	1
27	Manufacture of basic metals	1	80	Education	0
28	Manufacture of fabricated metal products, except machinery	1	85	Human health activities	0
29	Machinery	1	90	Activities of households as employers of domestic personnel	0
30	Manufacture of computer, electronic and optical products	1	91	Activities of membership organisations	1
31	Manufacture of electrical equipment	1	92	Culture, sports, and entertainment	1
32	Radio, TV, and telecommunications	1	93	Other services	1
33	Manufacture of machinery and equipment	1	95	Sewerage	0
34	Manufacture of motor vehicles, trailers and semi-trailers	1	96	Industry - not assigned	1
35	Manufacture of other transport equipment	0	97	Handcraft - not assigned	0
36	Manufacture of furniture	1	98	Services - not assigned	1
37	Repair and installation of machinery and equipment	1	99	Activities of extraterritorial organisations and bodies	0
40	Electricity, gas, steam and air conditioning supply	1	100	Undifferentiated goods and services producing activities	0

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