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The elasticity of substitution and the sector bias of International Outsourcing: Solving the puzzle

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THE ELASTICITY OF SUBSTITUTION AND THE SECTOR BIAS OF INTERNATIONAL OUTSOURCING: SOLVING THE PUZZLE

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THE ELASTICITY OF SUBSTITUTION AND THE SECTOR BIAS OF INTERNATIONAL OUTSOURCING: SOLVING THE PUZZLE

DANIEL HORGOS

Zusammenfassung / Abstract

Considering the sector bias of International Outsourcing within a 2x2 framework, four different scenarios appear. Each industry can either relocate its high or its low skill intensive production fragment. Traditionally, depending on the superiority of a wage vs. an outsourcing-effect, general equilibrium effects of two scenarios are assumed to be ambiguous. Applying a formal duality approach and a calibration exercise for the German economy, this contribution shows that a focus on the elasticity of substitution can solve the puzzle. With the elasticity exceeding a critical value, unambiguous results in all four scenarios appear, supporting the sector bias of International Outsourcing.

JEL-Klassifikation / JEL-Classification: F16, F41, E25

Schlagworte / Keywords: International Outsourcing, Sector Bias, Elasticity of Substitution

1 Introduction

Since several years, effects of International Outsourcing are an important issue in economic research and political discussion as well. Grossman and Helpman (2005) recently mentioned that “we live in an age of outsourcing” (p. 135). In industrialized economies, concerns arise on possibly induced labor market disruptions, harming low skilled labor. These concerns base on the so-called factor bias of International Outsourcing, first stressed by Feenstra and Hanson (1996a,b). As Feenstra and Hanson show within a one-sector model, International Outsourcing in industrialized economies decreases relative demand of low skilled labor, if it is the relative low skill intensive production block that gets relocated. Thus, the relative wage of high skilled labor increases. As a consequence, International Outsourcing is seen as beneficial for the high skilled and harmful for low skilled labor, inducing welfare reducing effects in general equilibrium.

However, results differ when extending this one-sector model to more industries and thus, when moving the focus toward more disaggregated industry levels. As Arndt (1997, 1998a,b) shows, different effects occur depending on the relative skill intensity of the industry realizing outsourcing activities. Generally, International Outsourcing decreases production costs of the respective industry and thus, enables a wage premium if the economy faces given world prices. If International Outsourcing takes place in the relative high skill intensive industry, high skilled labor receives this wage markup. On the other hand, if International Outsourcing takes place in the relative low skill intensive industry, low skilled labor benefits in receiving the wage premium. In general equilibrium, the outsourcing industry increases output in tandem with employment. As these results show, low skilled labor can benefit from International Outsourcing even in industrialized economies, if it takes place in the relative low skill intensive industry. Thus, Arndt (1997) concludes that “concerns about the welfare-reducing implications of offshore sourcing appear to be greatly exaggerated” (p. 77).

More recently, a huge amount of theoretical contributions emerged extending these models in order to investigate different aspects of International Outsourcing effects. To mention just a view of them, Deardorff (2001a,b) illuminates the importance of the relative factor intensity of the relocated production blocks. Egger and Falkinger (2003) consider different modes of final goods production and examine several different equilibrium situations in order to determine the dominance of the factor or the sector bias of International Outsourcing. Kohler (2003) also examines distributional effects of International Outsourcing. Allowing for an arbitrary number of goods, factors, and fragments, he presents a “general principle which is at force” (p. 91) and provides the possibility of different parameter settings to achieve several well known outsourcing results, i.a. those of Feenstra and Hanson as well as Arndt. Burda and Dluhosch (2002)

investigate International Outsourcing within an increasing returns to scale framework to focus more on determinants arising with monopolistic competition.

Examining the sector bias of International Outsourcing as presented in Arndt (1997, 1998a,b) in greater detail, four different scenarios appear: International Outsourcing can occur in the relative low skill intensive industry by relocating either its low or its high skill intensive production fragment. The relative high skill intensive industry can also relocate either its low or its high skill intensive production block. In general equilibrium, each of these International Outsourcing scenarios induces effects on relative wages, relative labor unit requirements, output, as well as employment. As Arndt carefully figured out, with respect to the effects on relative wages, results of all four scenarios are unambiguous. However, concerning the effects on relative labor unit requirements, results become ambiguous in two of the four cases. Consequently, effects on output as well as employment are also not clear-cut in these two ambiguous cases. Table 1 summarizes the general equilibrium effects of the sector bias of International Outsourcing, highlighting the two ambiguous scenarios.

Table 1: Sector Bias of International Outsourcing (overview)

scenario	low skill int. industry		high skill int. industry	
	low skill part	high skill part	low skill part	high skill part
relative wages of the high skilled	↓	↓	↑	↑
relative labor unit requirements of the high skilled	↑	?	?	↓
output	high skill int. industry ↓	?	?	high skill int. industry ↑
	low skill int. industry ↑			low skill int. industry ↓
employment	high skill int. industry ↓	?	?	high skill int. industry ↑
	low skill int. industry ↑			low skill int. industry ↓

As the table shows, relative wages of the high skilled increase if International Outsourcing takes place in the relative high skill intensive industry. This effect occurs either if the industry relocates its high or its low skill intensive production fragment. By contrast, International Outsourcing decreases the relative wage of the high skilled if it takes place in the relative low skill intensive industry. As in the relative high skill intensive industry, this effect occurs either if the industry relocates its high or its low

skill intensive production block. The effects on relative wages induce skill shifts in both industries and thus, affect relative labor unit requirements. Thereby, however, two of the four International Outsourcing scenarios yield only ambiguous results (International Outsourcing of the high skill intensive production block in the relative low skill intensive industry and International Outsourcing taking place in the relative high skill intensive industry by relocating its low skill intensive fragment). In general equilibrium, these ambiguity seeps through to the effects on output as well as employment. Thus, general equilibrium effects of the sector bias of International Outsourcing are only determined exhaustively in two of the four possible scenarios, the relative low skill intensive industry relocating its low skill intensive production part and the relative high skill intensive industry its high skill intensive one.

In order to investigate the empirical importance of the four different scenarios, the magnitude and development of International Outsourcing are calculated for Germany. The results are presented in Table 2.¹

Table 2: Magnitude and development of International Outsourcing in Germany

scenario	low skill int. industries		high skill int. industries	
	low skill parts	high skill parts	low skill parts	high skill parts
1991	6%	3%	2%	8%
1995	6%	3%	2%	9%
2000	6%	4%	2%	12%
1991 – 2000	7%	38%	0%	59%

As the numbers show, International Outsourcing activities in the two ambiguous cases are by no means less important than in the other ones. Considering the relative low skill intensive industries, International Outsourcing of the high skill intensive parts is in average about one half (1991 and 1995) or two third (2000) of the average of relocating the low skill intensive production blocks. Considering the development of International Outsourcing, this scenario is even more important with an increasing rate of around 38 percent. Thus, the two ambiguous scenarios seem to be of high empirical relevance for an overall examination of International Outsourcing activities. Since there is a lack in theoretical research investigating general equilibrium effects of these two important International Outsourcing scenarios in an exhaustive manner this contribution tries to fill the gap.

¹The results base on input-output tables provided by the Federal Statistical Office in Germany and are calculated using the Vertical Specialization index, an index often used to proxy International Outsourcing activities. The index relates imported intermediates (estimated) to the output of an industry. For a detailed investigation of the VS index, compared to several other International Outsourcing indices, see Horgos (2009).

Applying a formal model of general equilibrium effects of International Outsourcing and a calibration exercise for the German economy, the paper shows that results depend strongly on the elasticity of substitution between low and high skilled labor. As it turns out, if the elasticities exceed a critical value, effects are no longer ambiguous and support the sector bias of International Outsourcing: An increase of International Outsourcing in the relative low skill intensive industry unambiguously reduces the relative wage of the high skilled and increases their relative labor unit requirements. As the outsourcing industry gets more productive on world markets, output as well as employment of this industry increase. These effects occur either if the industry relocates its low or its high skill intensive production fragment. Results are similar with the opposite direction when International Outsourcing takes place in the relative high skill intensive industry.

The remainder of the paper is structured as follows. Section 2 discusses the model set up. The framework builds on the modern duality approach to general equilibrium and follows the line of international trade contributions like Uzawa (1964), Diewert (1971, 1974), Woodland (1977), and Mussa (1979). International Outsourcing is introduced similar to skill biased technical progress as in Jones (1965). Section 3 examines general equilibrium effects of the four International Outsourcing scenarios, moving the focus especially on the importance of the elasticity of substitution. As the elasticities exceed a critical value, effects on relative labor unit requirements are no longer ambiguous and mainly driven by the relative skill intensity of the industry fragmenting production. However, since effects on output and employment are only clear-cut with the assumption of Cobb Douglas elasticities, Section 4 calibrates the model for a wider range of elasticities using data for the German economy in 2005. Section 5 concludes by summarizing the major findings.

2 Model Set Up

In order to investigate general equilibrium effects of International Outsourcing, the paper uses the modern duality approach, based on Shephard's Lemma, and follows the line of international trade contributions as Uzawa (1964), Diewert (1971, 1974), Woodland (1977), or Mussa (1979). The duality approach in international trade formulates equilibrium conditions in terms of unit cost functions rather than production functions and minimizes these unit costs in a factor price space.²

²Traditional trade theory, by contrast, analyzes equilibrium conditions within a quantity space as introduced by Lerner (1932) and made popular by Chipman (1966). The reason for choosing the duality approach in this paper belongs to several advantages with respect to Shephard's Lemma that will be explained below.

Assume an economy that faces given world prices p with two industries, a relative high skill intensive (X) and a relative low skill intensive one (Y).³ Both industries use two primary inputs, low skilled labor (L) and high skilled labor (H) to produce goods of quantity q_i (with $i = X, Y$). Factors are mobile between industries, but internationally immobile. The home economy faces an inelastic supply of factors (\bar{L}, \bar{H}) and remains incompletely specialized ($q_i > 0$) throughout the process. Thus, with goods as well as factor markets perfectly competitive, we achieve

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

$$c_X = a_{XL}w_L + a_{XH}w_H = p \quad (2)$$

with c_i as unit costs per industry equaling the price, a_{ij} as unit factor requirements ($j = L, H$), w_j as factor prices and the price of the low skill intensive good (Y) as numeraire. The unit cost functions are positive and linearly homogeneous. According to Shephard's Lemma we can partially differentiate the unit cost functions to solve for the cost minimizing labor unit requirements

$$a_{YL} = \frac{\partial c_Y(w_L, w_H)}{\partial w_L} \quad (3)$$

$$a_{YH} = \frac{\partial c_Y(w_L, w_H)}{\partial w_H} \quad (4)$$

$$a_{XL} = \frac{\partial c_X(w_L, w_H)}{\partial w_L} \quad (5)$$

$$a_{XH} = \frac{\partial c_X(w_L, w_H)}{\partial w_H} \quad (6)$$

Considering flexible wages, each factor is either employed in the X or in the Y industry. Thus, we achieve

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

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

as the labor market clearing conditions and 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.

To introduce International Outsourcing, we define φ_{ij} as the International Outsourcing parameter, similar to skill biased technical change as in Jones (1965). Since International Outsourcing is assumed to reduce labor unit requirements, the percentage

³While assuming that the economy's trade flows do not affect the price ($\dot{p} = 0$) and the price elasticity of demand being unity ($\sigma^D = 1$), we assure that the world market is able to absorb changes in demand. Thus, while setting the focus on the supply side, we are able to abstract from price changes and their effects on the production structure of the two industries.

change $\hat{\varphi}_{ij} \equiv -\frac{1}{a_{ij}(\partial a_{ij}/\partial IO)}$ shows the alteration in a_{ij} due to International Outsourcing (IO) that would take place at constant wages. Thus, we have to rewrite the unit cost functions (1) and (2) into

$$c_Y(\vec{w}_L, \vec{w}_H) = \vec{a}_{YL}\vec{w}_L + \vec{a}_{YH}\vec{w}_H \quad (9)$$

$$c_X(\vec{w}_L, \vec{w}_H) = \vec{a}_{XL}\vec{w}_L + \vec{a}_{XH}\vec{w}_H \quad (10)$$

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.⁴

3 General Equilibrium Effects of International Outsourcing

To investigate general equilibrium effects of International Outsourcing, this section first examines the change in relative wages. Afterward, the effects on relative labor unit requirements, output as well as employment are considered.

Relative Wages

In order to minimize costs, we totally differentiate the unit cost functions (9) and (10) and achieve

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

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

as equilibrium production costs in both industries with factor income shares $\theta_{ij} \equiv \frac{a_{ij}w_j}{p_i}$ and “hat” denoting percentage changes. Equation (11) and (12) directly distinguish between the four different International Outsourcing scenarios already mentioned in the introduction:

- (i) International Outsourcing of the low skill intensive production part in the relative low skill intensive industry ($\hat{\varphi}_{YL} > 0$ whereas $\hat{\varphi}_{YH} = \hat{\varphi}_{XL} = \hat{\varphi}_{XH} = 0$)
- (ii) International Outsourcing of the high skill intensive production part in the relative low skill intensive industry ($\hat{\varphi}_{YH} > 0$ whereas $\hat{\varphi}_{YL} = \hat{\varphi}_{XL} = \hat{\varphi}_{XH} = 0$)

⁴In order to focus on the effects of International Outsourcing, and to keep the model traceable, determinants of International Outsourcing are not considered explicitly. In this form, International Outsourcing is an exogenous process reducing labor unit requirements. Since the focus is on the ambiguous scenarios as presented in Arndt (1997, 1998a,b), the way of formally modeling International Outsourcing here is the same way as Arndt illustrates the sector bias graphically.

- (iii) International Outsourcing of the low skill intensive production part in the relative high skill intensive industry ($\hat{\phi}_{XL} > 0$ whereas $\hat{\phi}_{YL} = \hat{\phi}_{YH} = \hat{\phi}_{XH} = 0$)
- (iv) International Outsourcing of the high skill intensive production part in the relative high skill intensive industry ($\hat{\phi}_{XH} > 0$ whereas $\hat{\phi}_{YL} = \hat{\phi}_{YH} = \hat{\phi}_{XL} = 0$)

Assuming first scenario (i), equation (11) and (12) can be solved for the effects of International Outsourcing on the percentage change in real wages

$$\hat{w}_L|_{\hat{\phi}_{YL}>0} = \frac{\theta_{XH}\theta_{YL}}{\Delta_{\Theta}}\hat{\phi}_{YL} \quad (13)$$

$$\hat{w}_H|_{\hat{\phi}_{YL}>0} = -\frac{\theta_{XL}\theta_{YL}}{\Delta_{\Theta}}\hat{\phi}_{YL} \quad (14)$$

with the determinant $\Delta_{\Theta} \equiv \begin{vmatrix} \theta_{XH} & \theta_{XL} \\ \theta_{YH} & \theta_{YL} \end{vmatrix} > 0$. Since the factor income shares are positive per definition ($\theta_{ij} > 0$), low skilled real wages increase (13 > 0), whereas wages of the high skilled decrease (14 < 0). As we know from the sector bias, International Outsourcing reduces the production costs of the respective industry and thus, since we assume an economy facing given world prices, enables a wage premium for either high or low skilled labor. Since International Outsourcing takes place in the relative low skill intensive industry in this scenario, low skilled labor receives the wage premium, while wages of the high skilled decrease. Equations (13) and (14) can be rearranged in order to achieve

$$\hat{w}_H - \hat{w}_L|_{\hat{\phi}_{YL}>0} = -\frac{\theta_{YL}}{\Delta_{\Theta}}\hat{\phi}_{YL} \quad (15)$$

as the percentage change of the relative wage of high skilled labor. Figure 1 illustrates this process within a factor-price space in shifting the unit cost curve of the relative low skill intensive industry (Y) horizontally outward.

Assuming scenario (ii), wage effects are of the same tendency since International Outsourcing occurs in the same industry. Real wages of the high skilled decrease, while low skilled labor again receives the wage premium. Thus, relative wages of the high skilled decrease with

$$\hat{w}_H - \hat{w}_L|_{\hat{\phi}_{YH}>0} = -\frac{\theta_{YH}}{\Delta_{\Theta}}\hat{\phi}_{YH} \quad (16)$$

Since, in the relative low skill intensive industry, the factor income shares of the low skilled are bigger than the factor income shares of the high skilled ($\theta_{YL} > \theta_{YH}$), the

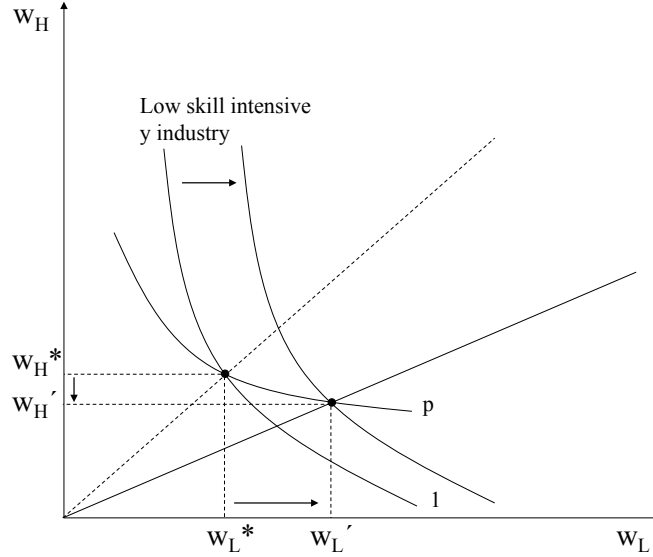


Figure 1: Effects of International Outsourcing on wages

decrease in relative wages of the high skilled is more intensive if the industry relocates its low skill intensive production patterns ($\hat{w}_H - \hat{w}_L|_{\hat{\phi}_{YL}>0} < \hat{w}_H - \hat{w}_L|_{\hat{\phi}_{YH}>0}$).

Considering International Outsourcing to take place in the relative high skill intensive industry, scenarios (iii) and (iv), results are of opposite direction. For the percentage change in relative high skilled wages we achieve

$$\hat{w}_H - \hat{w}_L|_{\hat{\phi}_{XL}>0} = \frac{\theta_{XL}}{\Delta_{\Theta}} \hat{\phi}_{XL} \quad (17)$$

$$\hat{w}_H - \hat{w}_L|_{\hat{\phi}_{XH}>0} = \frac{\theta_{XH}}{\Delta_{\Theta}} \hat{\phi}_{XH} \quad (18)$$

with both effects being positive and $\hat{w}_H - \hat{w}_L|_{\hat{\phi}_{XH}>0} > \hat{w}_H - \hat{w}_L|_{\hat{\phi}_{XL}>0}$. Proposition 1 summarizes the effects of International Outsourcing on relative wages, considering the four different International Outsourcing scenarios.

Proposition 1 *The relative wage of high skilled labor decreases if International Outsourcing takes place in the relative low skill intensive industry. If International Outsourcing takes place in the relative high skill intensive industry, relative high skilled wages increase. This pattern occurs regardless of which production block of the respective industry gets relocated.*

Relative Labor Unit Requirements

As we know from Shephard's Lemma, equilibrium labor unit requirements can be achieved by partial differentiating the unit cost functions (see equations 3 - 6). With log differentiation, we obtain

$$\hat{a}_{YL} = \theta_{YH}\sigma^Y(\hat{w}_H - \hat{w}_L + \hat{\phi}_{YL} - \hat{\phi}_{YH}) - \hat{\phi}_{YL} \quad (19)$$

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

$$\hat{a}_{XL} = \theta_{XH}\sigma^X(\hat{w}_H - \hat{w}_L + \hat{\phi}_{XL} - \hat{\phi}_{XH}) - \hat{\phi}_{XL} \quad (21)$$

$$\hat{a}_{XH} = -\theta_{XL}\sigma^X(\hat{w}_H - \hat{w}_L + \hat{\phi}_{XL} - \hat{\phi}_{XH}) - \hat{\phi}_{XH} \quad (22)$$

as the percentage change of labor unit requirements with σ^i as elasticity of substitution between low and high skilled labor in industry i ($i = X, Y$). Now, assume again scenario (i: $\hat{\phi}_{YL} > 0$) and substitute for the percentage change of low and high skilled real wages, we achieve

$$\hat{a}_{YH} - \hat{a}_{YL}|_{\hat{\phi}_{YL}>0} = \sigma^Y \frac{\theta_{YL}}{\Delta_{\Theta}} \hat{\phi}_{YL} + (1 - \sigma^Y) \hat{\phi}_{YL} \quad (23)$$

$$\hat{a}_{XH} - \hat{a}_{XL}|_{\hat{\phi}_{YL}>0} = \sigma^X \frac{\theta_{YL}}{\Delta_{\Theta}} \hat{\phi}_{YL} \quad (24)$$

as the percentage change of relative labor unit requirements of the high skilled in the two industries. In the relative high skill intensive industry (X), the industry that holds to its integrated production process in this scenario, relative labor unit requirements increase solely due to the wage-effect: Since relative wages of the high skilled decrease in both industries (see equation 15), the industries substitute high for low skilled labor. By contrast, in the relative low skill intensive industry (Y), the industry performing International Outsourcing activities, the wage-effect gets enriched by an outsourcing-effect: Since the industry relocates its low skill intensive production fragment, additional effects occur for relative labor unit requirements. Depending on the elasticity of substitution between low and high skilled labor, the outsourcing-effect can either increase (if $0 < \sigma^Y < 1$) or reduce relative labor unit requirements of the high skilled (if $\sigma^Y > 1$). With Cobb Douglas elasticities ($\sigma^i = 1$) the outsourcing-effect equally decreases low and high skilled labor unit requirements. However, in the ongoing scenario (i) the wage-effect outperforms the outsourcing-effect anyway, since $\frac{\theta_{YL}}{\Delta_{\Theta}} > 1$. Thus, as illustrated in Arndt (1997), relative labor unit requirements of the high skilled unambiguously increase in both industries, inducing a skill shift toward more high skilled labor.

Considering the first ambiguous case (scenario ii: $\hat{\phi}_{YH} > 0$), we achieve

$$\hat{a}_{YH} - \hat{a}_{YL}|_{\hat{\phi}_{YH}>0} = \sigma^Y \frac{\theta_{YH}}{\Delta_{\Theta}} \hat{\phi}_{YH} - (1 - \sigma^Y) \hat{\phi}_{YH} \quad (25)$$

$$\hat{a}_{XH} - \hat{a}_{XL}|_{\hat{\phi}_{YH}>0} = \sigma^X \frac{\theta_{YH}}{\Delta_{\Theta}} \hat{\phi}_{YH} \quad (26)$$

as the effects of International Outsourcing on relative labor unit requirements of the high skilled. In the relative high skill intensive industry (X), where the production

process still remains integrated, relative labor unit requirements of the high skilled increase again solely due to the wage-effect. In the relative low skill intensive industry (Y), the wage-effect gets again accompanied by an outsourcing-effect. In this scenario, when relocating the high skill intensive fragment, the wage-effect is not as strong as in scenario (i), providing the possibility for the outsourcing-effect to outperform the wage-effect. However, with the elasticity of substitution being big enough, the wage-effect is still dominant, leading to an increase of relative labor unit requirements of the high skilled ($\hat{a}_{YH} - \hat{a}_{YL}|_{\hat{\phi}_{YH}>0} > 0$ if $\sigma^Y > \frac{\Delta_{\Theta}}{\theta_{XH}}$). By contrast, if the elasticity of substitution is beneath this critical value, the wage-effect still increases relative labor unit requirements of the high skilled, but the outsourcing-effect is stronger and turns the change of relative high skilled labor unit requirements negative. Considering the critical value of the elasticity in detail, we can note that $0 < \frac{\Delta_{\Theta}}{\theta_{XH}} < 1$ if $\Delta_{\Theta} < \theta_{XH}$ per definition. Thus, assuming Cobb Douglas elasticities, the wage-effect is anyway stronger than the outsourcing-effect with International Outsourcing increasing relative labor unit requirements of the high skilled, as in the opposite scenario (i).

A similar result occurs when considering the second ambiguous case (scenario iii: $\hat{\phi}_{XL} > 0$). Since the relative high skill intensive industry relocates its low skill intensive production block, the change in relative labor unit requirements of the high skilled can be described with

$$\hat{a}_{YH} - \hat{a}_{YL}|_{\hat{\phi}_{XL}>0} = -\sigma^Y \frac{\theta_{XL}}{\Delta_{\Theta}} \hat{\phi}_{XL} \quad (27)$$

$$\hat{a}_{XH} - \hat{a}_{XL}|_{\hat{\phi}_{XL}>0} = -\sigma^X \frac{\theta_{XL}}{\Delta_{\Theta}} \hat{\phi}_{XL} + (1 - \sigma^X) \hat{\phi}_{XL} \quad (28)$$

where, in the relative high skill intensive industry (X), it depends on the elasticity of substitution (σ^X) whether the wage-effect outperforms the outsourcing-effect, or vice versa. As can be shown, $\hat{a}_{XH} - \hat{a}_{XL}|_{\hat{\phi}_{XL}>0} < 0$ if $\sigma^X > \frac{\Delta_{\Theta}}{\theta_{YL}}$. Thus, with the elasticity of substitution being big enough, the wage-effect outperforms the outsourcing-effect again, leading to a reduction of relative labor unit requirements of the high skilled. Since $\theta_{YL} > \Delta_{\Theta}$ per definition, $0 < \frac{\Delta_{\Theta}}{\theta_{YL}} < 1$ indicating that, within a Cobb Douglas world, International Outsourcing decreases relative labor unit requirements of the high skilled anyway due to the dominance of the wage-effect.

One scenario, International Outsourcing of the high skill intensive production block in the relative high skill intensive industry (scenario iv: $\hat{\phi}_{XH} > 0$), is still missing. There, we achieve

$$\hat{a}_{YH} - \hat{a}_{YL}|_{\hat{\phi}_{XH}>0} = -\sigma^Y \frac{\theta_{XH}}{\Delta_{\Theta}} \hat{\phi}_{XH} \quad (29)$$

$$\hat{a}_{XH} - \hat{a}_{XL}|_{\hat{\phi}_{XH}>0} = -\sigma^X \frac{\theta_{XH}}{\Delta_{\Theta}} \hat{\phi}_{XH} - (1 - \sigma^X) \hat{\phi}_{XH} \quad (30)$$

as the percentage change in relative labor unit requirements of the high skilled. If $\frac{\theta_{XH}}{\Delta_\Theta} > 1$, results are unambiguous with the wage-effect outperforming the outsourcing-effect anyway, as in scenario (i). Thus, with the relative wage of the high skilled increasing (see equation 18), an unambiguous skill shift toward more low skilled labor occurs in both industries. Proposition 2 summarizes the results of this section.

Proposition 2 *The effects of International Outsourcing on relative labor unit requirements of the high skilled are driven by a wage and an outsourcing-effect. While results are unambiguous in two of the four possible scenarios, the outsourcing-effect can outperform the wage-effect in the remaining two scenarios, leading to ambiguous results. The elasticity of substitution between low and high skilled labor is the parameter solving this ambiguity. If the elasticity exceeds a critical value, the wage-effect is stronger than the outsourcing-effect, leading to unambiguous results that substantiate the sector bias of International Outsourcing: Relative labor unit requirements of the high skilled increase if International Outsourcing takes place in the relative low skill intensive industry and decrease if it takes place in the relative high skill intensive industry. Which production block gets relocated is only of minor importance.*

Output

In order to examine the effects of International Outsourcing on the output of the industries, remember the full employment conditions (7) and (8), take the total differential and substitute for the change in relative wages and relative labor unit requirements. For scenario (i: $\hat{\phi}_{YL} > 0$), we achieve

$$\hat{q}_Y|_{\hat{\phi}_{YL}>0} = \frac{(\delta_H\lambda_{XL} + \delta_L\lambda_{XH})}{\Delta_\Theta\Delta_\Lambda}\theta_{YL}\hat{\phi}_{YL} + \frac{(1 - \sigma^Y)\lambda_{XH}\lambda_{YL}}{\Delta_\Lambda}\hat{\phi}_{YL} + \sigma^Y\theta_{YL}\hat{\phi}_{YL} \quad (31)$$

$$\hat{q}_X|_{\hat{\phi}_{YL}>0} = -\frac{(\delta_H\lambda_{YL} + \delta_L\lambda_{YH})}{\Delta_\Theta\Delta_\Lambda}\theta_{YL}\hat{\phi}_{YL} - \frac{(1 - \sigma^Y)\lambda_{YH}\lambda_{YL}}{\Delta_\Lambda}\hat{\phi}_{YL} \quad (32)$$

as the percentage change of the industries' output with λ as labor shares ($\lambda_{ij} = \frac{L_i}{L}$, or $\frac{H_i}{H}$ respectively), $\delta_L \equiv \lambda_{XL}\theta_{XH}\sigma^X + \lambda_{YL}\theta_{YH}\sigma^Y$, and $\delta_H \equiv \lambda_{XH}\theta_{XL}\sigma^X + \lambda_{YH}\theta_{YL}\sigma^Y$. With respect to output, results depend on too many parameters for getting solved endogenously: The θ 's and λ 's are implicitly driven by low and high skilled wages, the four labor unit requirements, labor endowments in both industries, and the two elasticities of substitution. Thus, in order to achieve unambiguous results, we need to assume Cobb Douglas elasticities at first. With these assumptions, we are able to reduce equations (31) and (32) to

$$\hat{q}_Y|_{\hat{\phi}_{YL}>0} = \frac{(\delta_H\lambda_{XL} + \delta_L\lambda_{XH})}{\Delta_\Theta\Delta_\Lambda}\theta_{YL}\hat{\phi}_{YL} + \theta_{YL}\hat{\phi}_{YL} \quad (33)$$

$$\hat{q}_X|_{\hat{\phi}_{YL}>0} = -\frac{(\delta_H\lambda_{YL} + \delta_L\lambda_{YH})}{\Delta_\Theta\Delta_\Lambda}\theta_{YL}\hat{\phi}_{YL} \quad (34)$$

with the δ 's > 0 , the λ 's > 0 , as well as the two determinants $\Delta_{\Theta} > 0$ and $\Delta_{\Lambda} > 0$. As the result shows, the relative low skill intensive industry (Y), where International Outsourcing takes place in this scenario, expands, whereas the relative high skill intensive industry (X), where production remains integrated, reduces output.⁵

Holding to the Cobb Douglas assumption, even in the cases where the effects on output are traditionally assumed to be ambiguous, unambiguous results can be obtained. When the low skill intensive industry relocates its high skill intensive production fragment (scenario ii: $\hat{\phi}_{YH} > 0$), we achieve

$$\hat{q}_Y|_{\hat{\phi}_{YH}>0} = \frac{(\delta_H\lambda_{XL} + \delta_L\lambda_{XH})}{\Delta_{\Theta}\Delta_{\Lambda}}\theta_{YH}\hat{\phi}_{YH} + \theta_{YH}\hat{\phi}_{YH} \quad (35)$$

$$\hat{q}_X|_{\hat{\phi}_{YH}>0} = -\frac{(\delta_H\lambda_{YL} + \delta_L\lambda_{YH})}{\Delta_{\Theta}\Delta_{\Lambda}}\theta_{YH}\hat{\phi}_{YH} \quad (36)$$

and

$$\hat{q}_Y|_{\hat{\phi}_{XL}>0} = -\frac{(\delta_H\lambda_{XL} + \delta_L\lambda_{XH})}{\Delta_{\Theta}\Delta_{\Lambda}}\theta_{XL}\hat{\phi}_{XL} \quad (37)$$

$$\hat{q}_X|_{\hat{\phi}_{XL}>0} = \frac{(\delta_H\lambda_{YL} + \delta_L\lambda_{YH})}{\Delta_{\Theta}\Delta_{\Lambda}}\theta_{XL}\hat{\phi}_{XL} + \theta_{XL}\hat{\phi}_{XL} \quad (38)$$

if International Outsourcing takes place in the relative high skill intensive industry by relocating its low skill intensive production block (scenario iii: $\hat{\phi}_{XL} > 0$). As the results show, also in these two cases the industry relocating production unambiguously increases output.

Turning to scenario (iv), we achieve

$$\hat{q}_Y|_{\hat{\phi}_{XH}>0} = -\frac{(\delta_H\lambda_{XL} + \delta_L\lambda_{XH})}{\Delta_{\Theta}\Delta_{\Lambda}}\theta_{XH}\hat{\phi}_{XH} \quad (39)$$

$$\hat{q}_X|_{\hat{\phi}_{XH}>0} = \frac{(\delta_H\lambda_{YL} + \delta_L\lambda_{YH})}{\Delta_{\Theta}\Delta_{\Lambda}}\theta_{XH}\hat{\phi}_{XH} + \theta_{XH}\hat{\phi}_{XH} \quad (40)$$

Again, the relative high skill intensive industry (X), where International Outsourcing takes place, expands while the relative low skill intensive industry decreases output. Proposition 3 summarizes the effects of International Outsourcing on the output of the industries.

Proposition 3 *Considering the effects of International Outsourcing on the output of the industries, results again depend strongly on the elasticities of substitution. With Cobb Douglas elasticities, the effects are unambiguous for all four International Outsourcing scenarios. The industry where International Outsourcing takes place expands, while the industry remaining integrated reduces output. This result occurs no matter whether the industries relocate their high or their low skill intensive production fragment.*

⁵We relax the Cobb Douglas assumption of this paragraph in the calibration exercise in Section 4.

Employment

Since we assume a flexible wage economy, the effects of International Outsourcing on employment are straightforward. Low as well as high skilled labor are fully employed, either in the relative low, or in the relative high skill intensive industry. With overall fixed supply of labor, changes on employment are in line with the contraction and expansion of the two industries. In order to achieve percentage changes of the different employment constellations within industries, consider the full employment conditions (7) and (8) and log differentiate. Substituting for the change in relative wages, relative labor unit requirements and output, and holding to the Cobb Douglas assumption again, we achieve

$$\hat{L}_X|_{\hat{\phi}_{YL}>0} = -\frac{\theta_{XH}\theta_{YL}}{\Delta_{\Theta}}\hat{\phi}_{YL} - \frac{(\delta_H\lambda_{YL} + \delta_L\lambda_{YH})}{\Delta_{\Theta}\Delta_{\Lambda}}\theta_{YL}\hat{\phi}_{YL} \quad (41)$$

$$\hat{L}_Y|_{\hat{\phi}_{YL}>0} = -\frac{\theta_{YH}\theta_{YL}}{\Delta_{\Theta}}\hat{\phi}_{YL} + \frac{(\delta_H\lambda_{XL} + \delta_L\lambda_{XH})}{\Delta_{\Theta}\Delta_{\Lambda}}\theta_{YL}\hat{\phi}_{YL} \quad (42)$$

$$\hat{H}_X|_{\hat{\phi}_{YL}>0} = \frac{\theta_{XL}\theta_{YL}}{\Delta_{\Theta}}\hat{\phi}_{YL} - \frac{(\delta_H\lambda_{YL} + \delta_L\lambda_{YH})}{\Delta_{\Theta}\Delta_{\Lambda}}\theta_{YL}\hat{\phi}_{YL} \quad (43)$$

$$\hat{H}_Y|_{\hat{\phi}_{YL}>0} = \frac{\theta_{YL}\theta_{YL}}{\Delta_{\Theta}}\hat{\phi}_{YL} + \frac{(\delta_H\lambda_{XL} + \delta_L\lambda_{XH})}{\Delta_{\Theta}\Delta_{\Lambda}}\theta_{YL}\hat{\phi}_{YL} \quad (44)$$

as the percentage change of high and low skilled labor in the two industries since International Outsourcing occurs in the relative low skill intensive industry by relocating the low skill intensive production block (scenario i: $\hat{\phi}_{YL} > 0$). The first part of the equations belongs to the change in relative wages. As the relative wage of the low skilled increases in this scenario, employment of the low skilled is reduced. The second component belongs to the change in output of the industries (including the change in relative labor unit requirements and relative wages as well): Low and high skilled employment expand in the industry where International Outsourcing takes place (Y) since this industry increases output. As these results show, the relative high skill intensive industry decreases employment of the low skilled ($\hat{L}_X|_{\hat{\phi}_{YL}>0} < 0$). Thus, due to the flexible wage set up, the freed low skilled move to the low skill intensive industry (Y), the industry performing outsourcing activities and expanding output, to find employment. Thus, $\hat{L}_Y|_{\hat{\phi}_{YL}>0}$ needs to be positive. Simultaneously, the relative low skill intensive industry (Y) increases high skill intensive employment ($\hat{H}_Y|_{\hat{\phi}_{YL}>0} > 0$). As long as we assume an inelastic supply of labor, the high skilled are withdrawn from the relative high skill intensive industry. Thus, $\hat{H}_X|_{\hat{\phi}_{YL}>0}$ needs to be negative.

As in the previous section on output, effects on employment are unambiguous in all four scenarios since Cobb Douglas elasticities are assumed. Consider e.g. scenario (ii: $\hat{\phi}_{YH} > 0$), International Outsourcing taking place in the relative low skill intensive industry by relocating its high skill intensive production fragment, we obtain

$$\hat{L}_X|_{\hat{\phi}_{YH}>0} = -\frac{\theta_{XH}\theta_{YH}}{\Delta_{\Theta}}\hat{\phi}_{YH} - \frac{(\delta_H\lambda_{YL} + \delta_L\lambda_{YH})}{\Delta_{\Theta}\Delta_{\Lambda}}\theta_{YH}\hat{\phi}_{YH} \quad (45)$$

$$\hat{L}_Y|_{\hat{\phi}_{YH}>0} = -\frac{\theta_{YH}\theta_{YH}}{\Delta_{\Theta}}\hat{\phi}_{YH} + \frac{(\delta_H\lambda_{XL} + \delta_L\lambda_{XH})}{\Delta_{\Theta}\Delta_{\Lambda}}\theta_{YH}\hat{\phi}_{YH} \quad (46)$$

$$\hat{H}_X|_{\hat{\phi}_{YH}>0} = \frac{\theta_{XL}\theta_{YH}}{\Delta_{\Theta}}\hat{\phi}_{YH} - \frac{(\delta_H\lambda_{YL} + \delta_L\lambda_{YH})}{\Delta_{\Theta}\Delta_{\Lambda}}\theta_{YH}\hat{\phi}_{YH} \quad (47)$$

$$\hat{H}_Y|_{\hat{\phi}_{YH}>0} = \frac{\theta_{YL}\theta_{YH}}{\Delta_{\Theta}}\hat{\phi}_{YH} + \frac{(\delta_H\lambda_{XL} + \delta_L\lambda_{XH})}{\Delta_{\Theta}\Delta_{\Lambda}}\theta_{YH}\hat{\phi}_{YH} \quad (48)$$

as the percentage change of high and low skilled employment in both industries. Again, if International Outsourcing takes place in the relative low skill intensive industry, employment in this industry unambiguously increases for high as well as for low skilled labor. If International Outsourcing takes place in the relative high skill intensive industry, similar results occur. Proposition 4 summarizes the effects of International Outsourcing on employment.

Proposition 4 *With Cobb Douglas elasticities of substitution, effects on employment of all four International Outsourcing scenarios are unambiguous and in line with the change in output. Since International Outsourcing takes place, the outsourcing industry increases employment of low as well as high skilled labor. The industry that remains integrated reduces employment of both skill groups. This result supports the sector bias of International Outsourcing since it depends on the relative skill intensity of the industry relocating production and not on the fragment being outsourced.*

4 Calibration Exercise

While investigating the importance of the elasticity of substitution between low and high skilled labor for International Outsourcing effects theoretically, results showed that, for output and employment, too many parameters have been at stake, squeezing us into a Cobb Douglas world. Thus, using data for the German economy in 2005 (provided by the German micro-census and the Genesis database of the German Federal Statistical office) in order to constrain some parameter values, this section calibrates the model for a wider range of elasticities. To illustrate the effects on relative wages, relative labor unit requirements, output, and employment, a one percentage increase of International Outsourcing is assumed.

To perform the calibration exercise, assumptions on the wages of high and low skilled labor, on the economy's high and low skilled labor endowment, and on the industries' skill intensity are needed. Information on the gross wages for the high as well as the low skilled can be found in the Genesis database offered by the Federal Statistical Office in Germany (Chapter 6.2 "wages and labor costs"). The data provides information on the

gross wage per month for the German manufacturing and service industry in October 2005, disaggregated by skill level. Aggregating the skill groups into either high or low skilled labor and relating the monthly wage to the hours worked per month, we obtain for low skilled workers an average gross wage of 20 euro per hour (w_L) and 32 euro as gross wage per hour for the high skilled (w_H).⁶

To obtain the overall labor endowment we use data from the German micro-census 2005, offering information about the labor force grouped by age and education. Using the same aggregation procedure as above we obtain an economy endowed with 25.3 million low skilled workers and 10.9 million workers educated at a higher skill level.

Finally, parameters indicating the skill intensity of the two industries under consideration are needed. In these kind of models, the industries' skill intensity is defined by the respective labor unit requirements. Since the requirement of low and high skilled labor depends on the production technology of each industry, they are only provided rarely by the empirical literature. Krugman (1995) e.g. calibrates a trade model focusing on a Northern economy and therefore, assumes 50 percent skilled workers in the relative high skill intensive industry and 20 percent in the relative low skill intensive industry.⁷ In this contribution, we follow Krugman (1995) and assume that firms in the low skill intensive industry require 1 hour of low skilled (a_{YL}) and .2 hours of high skilled workers (a_{YH}) to produce one unit of commodity Y . The high skill intensive X industry needs 2 hours of low skilled (a_{XL}) and the same amount of high skilled workers ($a_{XH} = 2$) to produce one unit. However, remember that only relative numbers matter.

Based on these assumptions we can calculate the price structure of the economy with $p = 6.36$ as the relative price of the X good, in terms of Y .

Relative Wages

As shown in the theoretical section, effects of International Outsourcing on relative wages are driven by the industry relocating production fragments. Calibrating the model with data for the German economy we can support this sector bias of International Outsourcing. Table 3 summarizes the results.

Recall that if International Outsourcing takes place in the relative low skill intensive industry (Y), relative wages of the high skilled decrease. If this industry increases

⁶To aggregate the different skill groups, the definition of the internationally comparable "International Standard Classification of Education" (ISCED) from UNESCO (1997) is used. There, graduations of elementary school, of secondary school or of junior high school (comparable with the German "Realschule") are regarded as low skill education, whereas all higher education (grammar school, high school or university) are regarded as high skilled. We also calculated the numbers with respect to vocational training instead. However, results differ only marginally. To obtain the wage per hour we assume 140 hours work per month.

⁷Krugman (1995) bases his assumptions on Wood (1994) and Balassa (1979) who compute these numbers.

Table 3: Percentage change of relative high skilled wages

International Outsourcing Scenario	Percentage Change in Relative High Skilled Wages
$\hat{\phi}_{YL} > 0$	$\hat{w}_H - \hat{w}_L = -2.03$
$\hat{\phi}_{YH} > 0$	$\hat{w}_H - \hat{w}_L = -.65$
$\hat{\phi}_{XL} > 0$	$\hat{w}_H - \hat{w}_L = 1.03$
$\hat{\phi}_{XH} > 0$	$\hat{w}_H - \hat{w}_L = 1.65$

outsourcing of its low skill intensive production block by one percent, relative wages of the high skilled decrease by 2.03 percent. If the industry increases outsourcing of its high skill intensive production part by one percent, relative wages of the high skilled decrease by .65 percent. By contrast, if International Outsourcing takes place in the relative high skill intensive industry, the wage premium flows to the high skilled and increases their relative wages. If the high skill intensive industry expands outsourcing activities of its low skill intensive production block by one percent, relative wages of the high skilled increase by 1.03 percent. If the industry increases outsourcing of its high skill intensive fragment, the relative wage of the high skilled increases by 1.65 percent.

Relative Labor Unit Requirements

Considering the effects of a one percentage increase in International Outsourcing activities on relative labor unit requirements of the high skilled, Figure 2 depicts the findings.

As the figure shows, if International Outsourcing occurs in the relative low skill intensive industry by relocating its low skill intensive production block (scenario i: $\hat{\phi}_{YL} > 0$), relative labor unit requirements of the high skilled increase unambiguously in both industries, for each level of elasticity of substitution. A similar result occurs if International Outsourcing takes place in the relative high skill intensive industry by relocating its high skill intensive production fragment (scenario iv: $\hat{\phi}_{XH} > 0$). There, relative labor unit requirements of the high skilled unambiguously decrease in both industries. These results occur since the wage-effect outperforms the outsourcing-effect in both cases. However, when turning to the two ambiguous scenarios (the two charts below), the outsourcing-effect outperforms the wage-effect for small values of the elasticity of substitution. If $\hat{\phi}_{YH} > 0$ (scenario ii), relative labor unit requirements of the high skilled increase unambiguously in the X industry, the industry that remains integrated, due to the decrease in relative high skilled wages. In the relative low skill

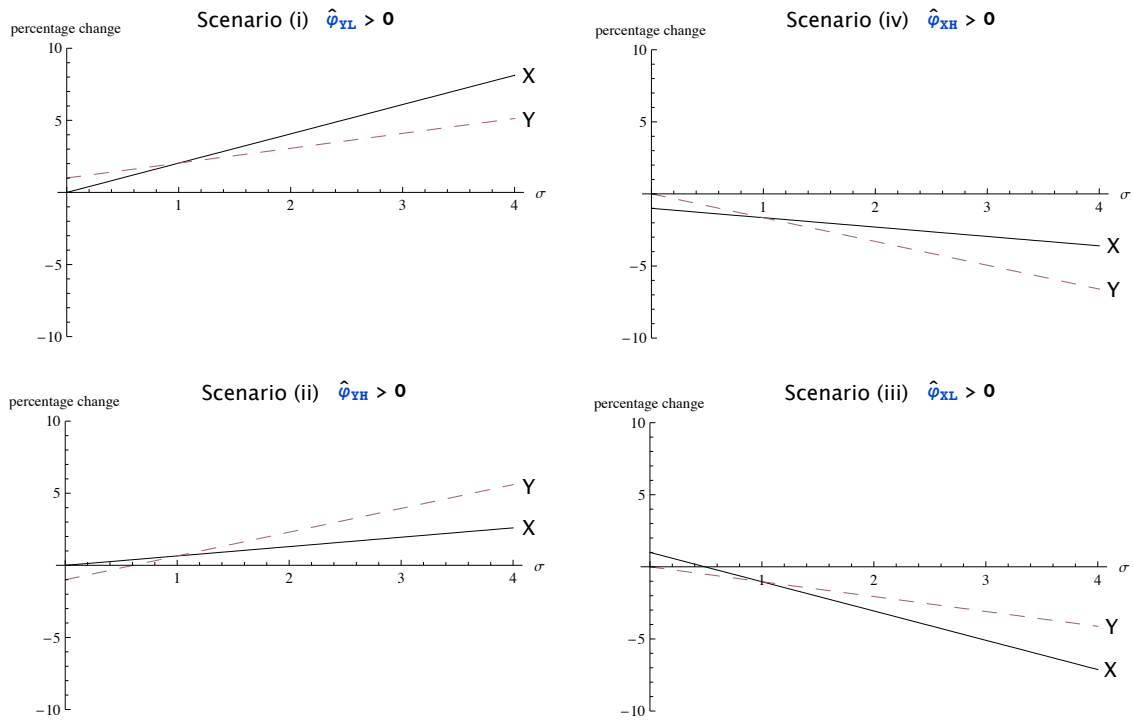


Figure 2: Effects on Relative Labor Unit Requirements of the High Skilled

intensive industry, where the high skill intensive production block gets outsourced, the outsourcing-effect outperforms the wage-effect if the elasticity of substitution is below the critical value of .61, leading to a decrease of relative high skilled labor unit requirements. Thus, as shown with the theoretical results above, within a Cobb Douglas world, relative labor unit requirements of the high skilled increase anyway. In scenario (iii: $\hat{\varphi}_{XL} > 0$), a similar process occurs with the opposite direction and a critical value for the elasticity of substitution of .49.

Output

Turning to the effects of a one percentage increase in International Outsourcing activities on the output of the industries, Figure 3 depicts the results.

In the theoretical examination above, Cobb Douglas elasticities need to be assumed to handle the model. As German parameter values are assumed in this calibration exercise, we do not need to fix the elasticity and thus, are able to achieve further insights. Similar to the effects on relative labor unit requirements, the effects on output are unambiguous in scenarios (i: $\hat{\varphi}_{YL} > 0$) and (iv: $\hat{\varphi}_{XH} > 0$). The industry facing International Outsourcing activities increases its output while the industry holding to its integrated process decreases production. For the two ambiguous scenarios (ii: $\hat{\varphi}_{YH} > 0$)

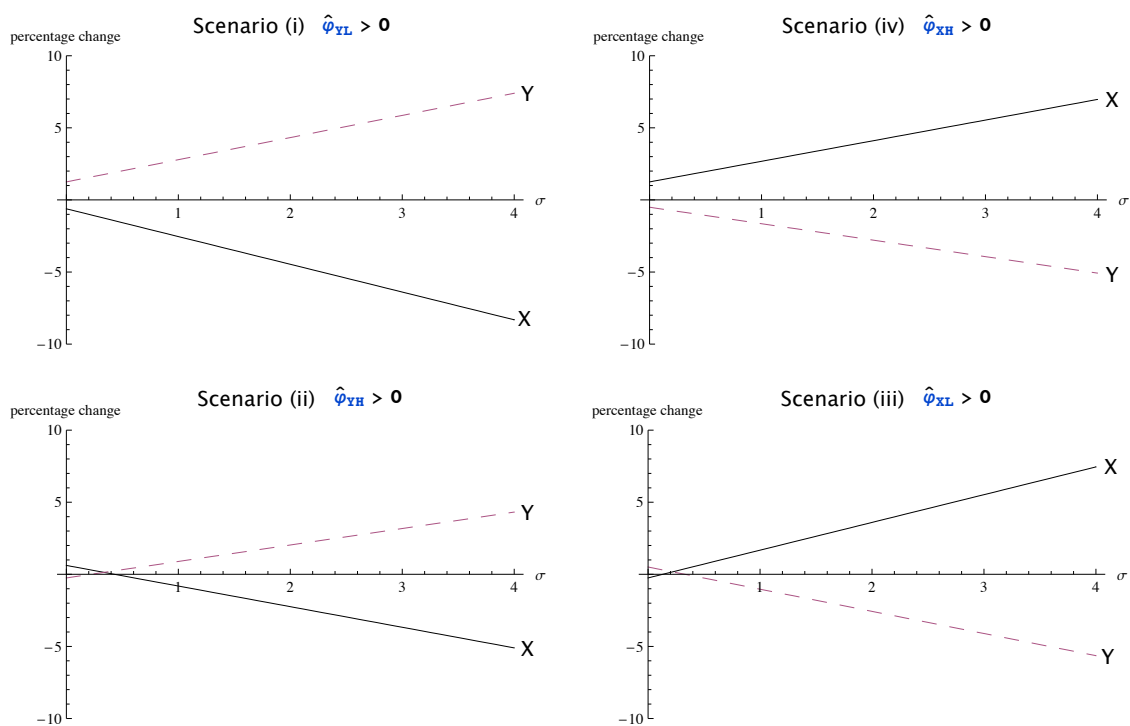


Figure 3: Effects on Output

and (iii: $\hat{\varphi}_{XL} > 0$) we obtain again that the industries' elasticity of substitution between high and low skilled labor has to exceed a critical value. The critical value (scenario ii: .43 and scenario iii: .34) is in both cases smaller than unity. Thus, exceeding these values, unambiguous results occur, confirming the sector bias of International Outsourcing. The industry where International Outsourcing takes place expands production while the industry remaining integrated contracts.

Employment

A similar picture emerges for the effects of International Outsourcing on employment. Figure 4 depicts the results.

Since we examine employment of low and high skilled labor in each of the two industries, four lines need to be considered in each chart of this figure. Again, in the two scenarios (i: $\hat{\varphi}_{YL} > 0$) and (iv: $\hat{\varphi}_{XH} > 0$), unambiguous results occur. The industry relocating production abroad increases employment of both skill groups, low as well as high skilled labor. By contrast, the industry holding to its integrated production pattern has to reduce employment of both skill groups. Considering the two ambiguous scenarios, again, unambiguous results can only be achieved for elasticities of substitution above a critical value (scenario ii: .52 and scenario iii: .39). The critical

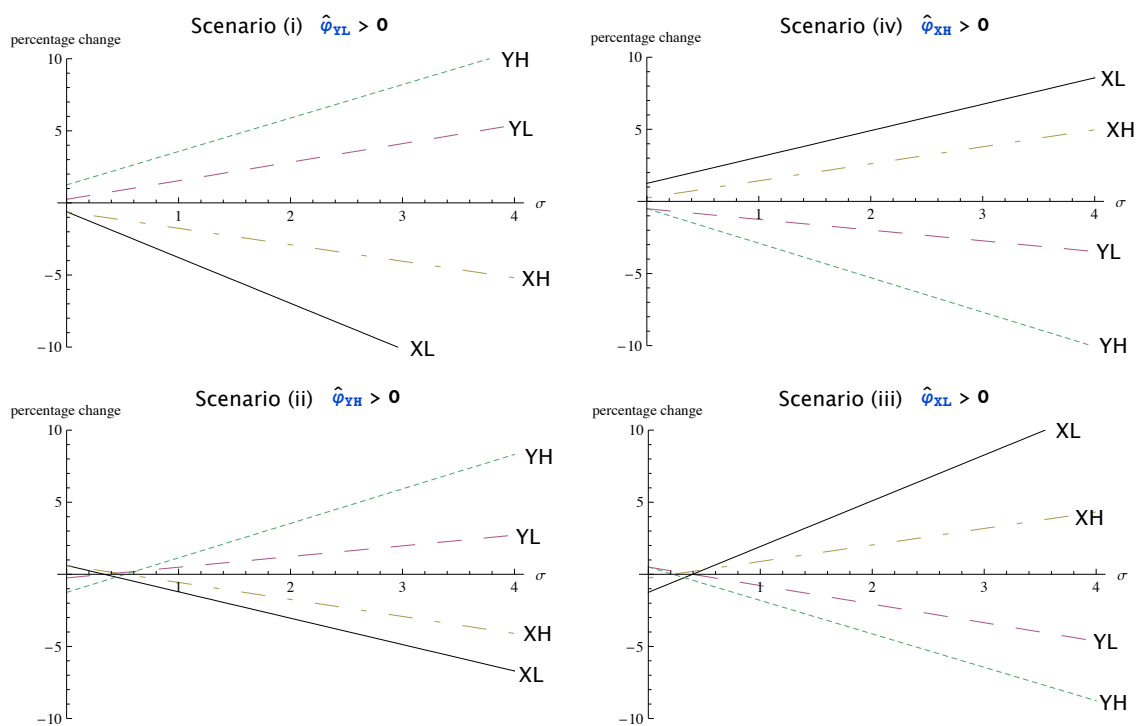


Figure 4: Effects on Employment

value, however, is in both scenarios beneath unity. With elasticities exceeding these values, the sector bias of International Outsourcing can also be confirmed with respect to employment effects: The skill intensity of the industry relocating production matters, rather than which production block gets outsourced.⁸

5 Conclusion

As the sector bias of International Outsourcing shows, low skilled labor receives a wage premium and thus, benefits, if outsourcing takes place in the relative low skill intensive industry. If International Outsourcing takes place in the relative high skill intensive industry, the high skilled benefit in receiving the wage markup. In general equilibrium, when examining the effects on labor unit requirements, output and employment, this wage-effect gets accompanied by an outsourcing-effect. Since the outsourcing-effect can work in the opposite direction and even outperform the wage-effect, results are only clear-cut in two of four possible scenarios: either if the relative low skill intensive industry relocates its low skill intensive production fragment, or if the relative high skill intensive industry relocates its high skill intensive one. By contrast, if the relative low

⁸With respect to the implications on employment, one has to consider, that the results would depend crucially on specific labor market institutions. Especially in major European economies, like Germany, low skilled unemployment is supposed to occur. This exercise, however, aims in calibrating the formal model shown above, and not in providing any empirical evidence for the German economy.

skill intensive industry relocates its high skill intensive production block, or the relative high skill intensive industry its low skill intensive one, International Outsourcing effects are ambiguous.

In this paper, general equilibrium effects of International Outsourcing are analyzed within a formal model, using the modern duality approach in international trade theory, and calibrated assuming German micro-census data. As the results show, the elasticity of substitution between low and high skilled labor is the parameter at force solving the puzzle. With the elasticity exceeding a critical value (the value is beneath unity), the results on relative labor unit requirements, output and employment can be solved unambiguously, confirming the sector bias of International Outsourcing: Provided that International Outsourcing takes place in the relative low skill intensive industry, relative wages of the low skilled increase. In general equilibrium, this wage-effect outperforms the outsourcing-effect. Thus, both industries substitute high for low skilled labor. As the relative low skill intensive industry gets more competitive on world markets, relative output of this industry increases. This expansion induces labor flows of both skill groups toward the outsourcing industry. Reverse effects occur if International Outsourcing takes place in the relative high skill intensive industry. In both cases, the effects occur either if the respective industry relocates its low or its high skill intensive production fragment. Table 4 summarizes the formal results.

The findings are of high political relevance as well. As illuminated in the introduction, the two scenarios where International Outsourcing has ambiguous results are empirically quite important. Concerning policy issues, it is necessary to consider the complete picture of International Outsourcing effects. With the results achieved above, this contribution tries to fill this gap. If the elasticity of substitution exceeds a critical value (that is beneath unity), all four scenarios of the sector bias of International Outsourcing can be solved unambiguously. Thus, this pattern illuminates the importance of the sector bias of International Outsourcing and shows, that several cases exist where International Outsourcing can be beneficial for low skilled labor, even if it takes place in an industrialized economy.

For future research, it would be worth investigating the empirical importance of the sector bias of International Outsourcing as well. Since most empirical work bases on the factor bias of International Outsourcing and thus, on more aggregated industry levels, evidence on the implications if International Outsourcing occurring in industries differing with respect to their skill intensity would be of high interest.

Table 4: Sector Bias of International Outsourcing (theoretical results)

scenario	low skill int. industry		high skill int. industry	
	low skill part	high skill part	low skill part	high skill part
relative wages of the high skilled	↓	↓	↑	↑
relative labor unit requirements of the high skilled	↑	$(\sigma^Y > \frac{\Delta e}{\theta_{XH}})$ ↑	$(\sigma^X > \frac{\Delta e}{\theta_{YL}})$ ↓	↓
output		$(\sigma^Y = 1)$	$(\sigma^X = 1)$	
	high skill int. industry ↓	high skill int. industry ↓	high skill int. industry ↑	high skill int. industry ↑
	low skill int. industry ↑	low skill int. industry ↑	low skill int. industry ↓	low skill int. industry ↓
employment		$(\sigma^Y = 1)$	$(\sigma^X = 1)$	
	high skill int. industry ↓	high skill int. industry ↓	high skill int. industry ↑	high skill int. industry ↑
	low skill int. industry ↑	low skill int. industry ↑	low skill int. industry ↓	low skill int. industry ↓

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