The Impact of Foreign Direct Investment on Unionized Labor Markets

An Economic Analysis with Emphasis on Offshoring

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To my parents and sister.

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Preface

Trade unions have a long tradition of playing an important economic and political role in industrialized countries. In recent decades, trade unions have been confronted with multiple challenges; namely, a decline in the number of union members as well as union density across many countries (see Visser (2006)) and globalization as a complex and multi-faceted ongoing process. One prominent feature generally associated with globalization concerns Foreign Direct Investment (henceforth FDI), which has experienced unprecedented growth rates over the past decades: worldwide FDI flows nearly tripled alone between 1980 and 1990, when globalization became first apparent as a phenomenon (see Graham and Krugman (1993)).

In general, economists distinguish between two forms of FDI: in the case of horizontal FDI, multinational firms duplicate the production of (final) goods in different countries, whereas in the case of vertical FDI, multinational firms decide to relocate different stages of a production process to foreign countries. On a quantitative level, horizontal FDI represents the bulk of FDI, but vertical FDI has come to rise in importance due to innovations in communication and transportation technologies in recent years (see Grossman and Rossi-Hansberg (2008)). Offshoring, in this context, refers to the case of vertical FDI, but encloses the possibility of outsourcing as well, if outsourcing involves intermediate inputs or tasks.

A widespread fear associated with offshoring (or FDI in general) concerns the loss of domestic employment and thus loss of high-living standards through the transfer of jobs to low-wage foreign countries, which regularly gives occasion for public and political debates. The empirical evidence with regard to the impact of FDI on domestic wages and employ-

ment is mixed at best, which requires a thorough theoretical analysis to understand and explain differences in labor market outcomes. Surprisingly, the related economic literature on collective bargaining and FDI is, despite the economic importance, relatively small: not until recent years, the majority of the trade union literature lacked an international dimension especially with regard to offshoring.

This dissertation aims to contribute to the economic analysis of the impact of FDI on unionized labor markets. For this purpose, we consider certain key aspects related to this topic. One key aspect addresses the different implications of horizontal and vertical FDI for unionized labor markets. Contributions from authors such as Egger and Eckel (2009) demonstrated that the option of horizontal FDI improves the fallback position of the multinational firm during wage negotiations, which leads to an increase in the wage elasticity of labor demand, resulting in wage moderation on behalf of the trade unions. The exact opposite effect comes into force in the case of offshoring, because the fragmentation of the production process forces domestic and foreign workers into a complementary relationship, which enables the trade union to shut down the whole production process in case of a strike. This effect, where the union finds itself in a better bargaining position compared to the case of horizontal FDI which leads to an overall decrease of the wage elasticity of labor demand, was first pointed out by authors such as Skaksen and Sørensen (2001) and Lommerud et al. (2009). We pick up on this mechanism by dedicating the first two chapters of this dissertation to the case of offshoring.

Another key aspect with regard to trade unions and FDI concerns the observation that wage dispersion exists not only between but also within countries with regard to low- and high-skilled workers. A general notion on this topic is that the relative wage of unskilled workers in industrialized countries decreases under increased global competitive pressure. We raise the question whether this assertion applies to unionized workers in the presence of offshoring and a heterogenous labor force. Another key aspect that deserves attention concerns the role of the government when the impact of offshoring on the unionized labor market is analyzed and well-known. A last key aspect that we want to consider concerns the coordination of collective bargaining itself, as variation is possible depending on the degree of centralization of bargaining arrangements. This aspect is covered by the third

chapter of this dissertation.

The first chapter, which represents joint work with Carsten Eckel, analyzes the impact of increased offshoring on union wages and domestic employment for a heterogenous labor force. Empirical evidence suggest that wage differences between countries remain substantial on a global scale, which constitutes an explanation for the lasting inclination of firms to relocate production processes from high-wage to low-wage countries. This trend has been enforced by lower trade and communication costs as well as increased fragmentation possibilities of the production chain, which led to a dramatic increase of offshoring as efficiency-seeking sourcing of inputs from foreign countries (see Blinder (2006), Mankiw and Swagel (2006) and Grossman and Rossi-Hansberg (2006)). The perceived global spread in wage differences can largely be attributed to labor market imperfections which predominantly occur in industrialized countries. The labor markets in these countries (especially with regard to Europe) are traditionally characterized by rigidities and the existence of trade unions whose function is to enforce a mark-up on competitive wage levels which creates unemployment. Furthermore, empirical studies perceive not only a spread in wages between but also within countries when considering low- and high-skilled worker groups that participate in global production activities.

Against this background, we develop a simple model in a small open economy with two sectors. The focus lies on the sector that is characterized by monopolistic competition and a heterogenous labor market where the interests of low-skilled workers are represented by a monopoly union. Firms in this sector can choose to offshore the production of intermediate goods to a low-wage foreign country under additional transportation costs with the intention to re-import them back to the home country for final assembly. High-skilled workers are assumed to be 'managers' to these firms and receive all surplus profits as factor compensation.

Given this setting, we aim to answer the question of how falling trade costs affect the firms' optimal offshoring decision and the relative factor reward between low- and high-skilled workers. Furthermore, in the light of falling trade costs, we are interested in the change of domestic labor demand. As a result, this chapter shows that a fall in trade costs induces more offshoring as well as an increase in the wage rates for both low- and high-skilled labor.

Which wage effect dominates over the other depends on the initial degree of offshoring: the relative wage between low- and high-skilled labor is likely to rise when the initial degree of offshoring is neither too low or too high and likely to decrease for offshoring degrees in between. With respect to domestic employment, we find that labor demand is likely to be negative for relatively low and relatively high initial degrees of offshoring and likely to be positive for offshoring degrees in between. Our results contradict the general notion that the relocation of production stages to a low-wage foreign country is always harmful to domestic employment.

The second chapter studies the impact of labor taxation on union wages and domestic employment in the presence of offshoring. Empirical evidence shows that developed countries are generally characterized by relatively high tax ratios. This assertion applies in particular to European countries, whose overall tax ratio (as sum of taxes and social security contributions) add up to 38,4 percent in the GDP-weighted average of the 27 EU member states, compared to 26,9 percent in Japan and 24,8 percent in the USA (see European Commission (2012)). The persistent high tax burden on labor is often believed to be a main source for high unemployment in these countries. A popular idea in the fiscal policy debate concerns the reduction of labor taxes in the hope that lower labor costs induce higher labor demand. Given this situation in the presence of offshoring and unionized labor markets, we address the question how policy makers can optimize their fiscal policy strategy when being confronted with increased market integration.

For this purpose, we consider a single representative firm in a small open economy that has the opportunity to relocate the production of required intermediate inputs to a low-wage foreign country. The domestic workers employed by the firm are represented by a monopoly trade union and pay personal income tax on their earnings that is collected by the government. The focus of our analysis is directed towards wages and employment in the high-wage domestic country. Given this setup, we investigate how the trade union alters its wage-setting behavior in response to changes in offshoring opportunities and to changes in the marginal tax parameter.

Our findings in this chapter are the following: firstly, we find a negative relationship between taxation and domestic labor demand, meaning that an increase in the marginal

tax rate reduces domestic labor. This is because an increase of the marginal labor tax rate leads the union to demand higher wages. This effect is even reinforced because increases in the union wage rate induce further offshoring, which in turn leads to even higher wage demands by the union to compensate for the loss of domestic employment. Secondly, when the considered economy is confronted with falling transportation costs, we find that the total effect on domestic labor crucially depends on the initial degree of labor taxation. In this context, a negative effect on domestic labor is more likely the lower the marginal tax rate and the lower the initial degree of offshoring. The government can dampen this negative on domestic labor induced by a fall in transportation costs by raising the marginal tax rate. If the tax rate is sufficiently high, increased offshoring may even induce a raise in domestic labor demand, depending on the initial degree of offshoring. The most interesting result of this chapter lies in the implication that an increase in the tax rate can be beneficial with respect to domestic labor.

The third chapter introduces the option of horizontal FDI into a model of pattern bargaining that constitutes a sequential wage negotiation practice, where the union first chooses a target firm to negotiate a wage rate. This outcome then serves as a pattern for all subsequent negotiations where, in a strict sense, the union makes a take-it-or-leave-it offer to the remaining firms or where, in a more loose sense, the agreed upon wage rate with the target firm serves as a precedent. When the strict form of pattern bargaining applies and there is agreement among all participants (enforced through strikes if necessary), uniform wage rates across firms are the result. The economic reasoning as to why trade unions might prefer pattern bargaining over other forms of bargaining coordination can be explained by the so-called 'taking labor out of competition' argument: unionized firms in oligopolistic markets usually have an incentive to bargain hard on wages, since lower wages constitute a competitive advantage over market competitors. Pattern bargaining, however, takes the edge out of this incentive, as wage concessions become more acceptable when all other firms agree to them as well, which is in the interest of the union.

In our model, FDI endows firms with a fallback position in case wage negotiations fail, which strengthens their bargaining position. In summary, we compare bargaining environments for the case of autarky and the case of an open economy with FDI, while

distinguishing between alternatives where the union may or may not be endowed with a conflict payoff in case wage negotiations fail.

Our main findings are the following: Firstly, FDI lowers the union's wage rate compared to the autarkic case under pattern bargaining. This is because FDI enables firms to produce output from abroad when the union decides to go on strike in the firm's domestic country, which represents a credible threat and therefore better bargaining position during wage negotiations. Secondly, we find that the union is always better off in a more decentralized bargaining environment which allows for a positive conflict payoff. The economic reason for this result goes beyond the argument that a positive conflict payoff improves the bargaining position of the union, because it alters the conflict payoff to the firm as well. A positive conflict payoff to the union implies that a firm still remains active in the market even when the wage negotiation with another firm fails. This other firm will consequently produce output from abroad to serve the domestic market yet the corresponding conflict payoff is now based on less market share, because the other domestic firm prevails in the market. This mechanism that enhances the outside option of the union can offer an explanation for the trend towards collective bargaining agreements on a more decentralized level. Third, given the choice, the union prefers the domestic rather than the multinational firm to be the target firm. This result can be attributed to the specific procedure that is attributed to pattern bargaining.

All three chapters of this dissertation are self-contained and include their own introductions and appendices such that they can be read independently.

Chapter 1

Offshoring, Trade Unions and Heterogenous Labor[1]

1.1 Introduction

It is a well-known fact that globalization creates increasing competitive pressure between countries, which has led to strong unprecedented implications for the corresponding labor markets. Empirical evidence suggests that wage differences between countries remain substantial on a global scale, which constitutes an explanation for the lasting inclination of firms to relocate production processes from high-wage to low-wage countries.[2] This trend has been enforced by lower trade and communication costs as well as increased fragmentation possibilities of the production chain, which, according to the analysis of US data by several authors such as Blinder (2006), Mankiw and Swagel (2006) and Grossman and Rossi-Hansberg (2006), led to a dramatic increase of offshoring as efficiency-seeking sourcing of inputs from foreign countries.[3] Given the phenomenon offshoring, the perceived global spread in wage differences can largely be attributed to labor market imperfections

[1] This chapter is based on joint work with Prof. Dr. Carsten Eckel.

[2] Sinn (2007) finds that the average wage cost in the manufacturing industry ranged from 1,10 Euro in China to above 27 Euro in countries like Denmark, West Germany and Norway.

[3] Following authors such as Yeaple (2006), Grossman and Rossi-Hansberg (2008) and Rodríguez-Clare (2010), we understand offshoring as the movement of the production of inputs (or intermediate goods and services) to a foreign country with the intention of reimporting them back to the home country. This can occur within the firm (= vertical FDI) or through arms-length transactions (= international outsourcing). Note that the terms *vertical FDI* and *international outsourcing* can be used interchangeably in the context of our model if the offshored activities are complementary in their nature.

which predominantly occur in industrialized countries. The labor markets in these countries (especially with regard to Europe) are traditionally characterized by rigidities and the existence of trade unions whose function is to enforce a mark-up on competitive wage levels, which creates unemployment.[4]

Empirical studies perceive not only a spread in wages *between* but also *within* countries when considering low- and high-skilled worker groups that participate in global production activities. A general notion on wage inequality is that the relative wage of unskilled workers decreases in industrialized countries. Feenstra and Hanson (1996), for example, find for the case of outsourcing a decline in the relative wage of unskilled workers. Jones (2000), on the other hand, adverts to the possibility that the relative wage of unskilled workers in developed countries may increase if labor-intensive production processes are relocated abroad.[5]

Against the background of offshoring, wage dispersion and the fact that substantial numbers of workers in industrialized countries are covered by collective bargaining agreements, we aim to answer the question of what impact trade unions have on labor market outcomes under heterogenous labor and firms' organizational choices in the presence of offshoring. This question has received relatively little attention in theoretical and empirical literature. First and foremost, there are relatively few contributions that deal with offshoring in the vast literature on trade unionism. Most authors consider horizontal FDI and/or outsourcing of final goods when analyzing labor market outcomes of trade unions in open economies, which is usually associated with wage moderation on behalf of trade unions (see for example Zhao (1998), Eckel and Egger (2009)). Offshoring, however, offers an exact opposite implication; namely, higher union wage demands in response to increased offshoring. Examples of authors who first pointed to this effect are Skaksen and Sørensen (2001), Zhao (2001) and Lommerud et al. (2009). All refer to the complementary nature of inputs for the production process that enables trade unions to maintain their bargaining

[4]See, for example, Blanchflower (2007), who provides an overview of international patterns of union membership in 30 OECD and 11 non-OECD countries.

[5]Further examples include Geishecker and Görg (2008), who show for the case of outsourcing that there may be winners and losers with regard to (general) wage levels depending on skill classification of workers. Braun and Scheffel (2007) provide empirical evidence on the effect of outsourcing on union wages for the case of Germany. They find that high- and low-skilled workers (working in industries with high outsourcing intensities) experience a rise and respectively, decline in the union wage premium, while medium-skilled workers remain largely unaffected.

power even when faced with offshoring, as a strike would lead to a complete shutdown of the production process, which leaves firms with no outside option. Horizontal FDI and/or outsourcing of final goods, in contrast, enable firms to gain flexibility in production, as the entire production of goods can be relocated to a foreign country when confronted with a strike by the union. Nevertheless, most contributions on trade unionism and offshoring consider a homogenous labor force only, which is somewhat of a drawback, as most related empirical studies include different skill groups in their estimations, which suggests a gap between theoretical predictions and empirical findings. This paper aims to bridge this gap by allowing for heterogenous labor in the context of trade unions and offshoring. To this end, we consider a model in a small open economy where the focus lies on the sector that is characterized by monopolistic competition and a heterogenous labor market where the interests of low-skilled workers are represented by a monopoly union. Firms in this sector can choose to offshore part of the production to a low-wage foreign country under additional transportation costs with the intention to re-import the offshored (intermediate) goods back home for final assembly. High-skilled workers are assumed to be 'managers' to these firms and receive all surplus profits as factor compensation.

Given this setting, we address the following questions: How does increased market integration affect the firms' choice of allocation of production? [6] How does this affect relative factor rewards between high- and low-skilled workers and what are the employment implications from the high-wage country's perspective? We find that falling trade costs lead to increased offshoring. This has the effect of higher wages for both low- and high-skilled workers. The union demands higher wages in the process of wage negotiations to compensate for the loss in domestic employment. The union is able to enforce higher wages due to the complementary nature of the production process associated with offshoring. High-skilled workers, so-called managers, gain higher wages from offshoring as it enables firms to become more profitable. Given the result that both skill groups experience higher wages under increased offshoring, the relative wage of unskilled labor is likely to increase when the initial degree of offshoring is relatively low or high and likely to decrease, when the initial degree of offshoring lies in between where it is neither too low or high. Increased

[6]The process of trade liberalization is modeled as a gradual reduction in the per unit cost associated with offshoring.

offshoring may increase or decrease total labor demand in the home country depending on the initial value of offshoring, where labor demand is likely to increase with intermediate levels of initial offshoring.

There are, to the best of our knowledge, two previous contributions that are closely related to our work on offshoring, trade unions and heterogenous labor. Egger and Kreickemeier (2008) develop a general equilibrium model of international fragmentation under heterogenous labor, but do not consider trade unions in their analysis. Instead, Egger and Kreickemeier build on a so-called fairness approach to efficiency wages as a source of labor market imperfections. Koskela and Stenbacka (2010) develop a partial equilibrium model to investigate the effects of outsourcing on wage formation and equilibrium unemployment in a heterogenous labor market. However, two restrictive assumptions apply, which differ from our model. First, there is no international fragmentation of production which implies complete substitutionality between activities moved abroad and those remaining in the home country. This has differing implications for the bargaining power of the firm. Second, the objective function of the trade union is based on wage solidarity between high- and low-skilled workers, whereas we consider low-skilled workers to be the only workers that are represented by a trade union.

The remainder of this paper is given as follows. Section 2 introduces the basic structure of the model. Section 3 analyzes the effect of falling transportation costs on key variables of the model. Finally, concluding comments are presented in Section 4.

1.2 The Basic Model

1.2.1 Demand

Consider a two-sector model in a small high-wage country where homogenous (numeraire) good Q and differentiated good X are produced respectively. The preferences of a representative consumer are given by CES utility

$$U = X + Q = \left(\int_0^N x\left(i\right)^{\frac{\sigma-1}{\sigma}} di \right)^{\frac{\sigma}{\sigma-1}} + Q \ , \tag{1.1}$$

where X is a function over a continuum of goods indexed by i with N denoting the number of firms and thus the mass of available varieties in the differentiated goods sector. All varieties are considered to be substitutes where σ constitutes the elasticity of substitution between any two varieties with $\sigma > 1$. Using the Dixit and Stiglitz (1977) approach we obtain optimal consumption for variety $x(i)$:

$$x\left(i\right) = A \ p\left(i\right)^{-\sigma} , \tag{1.2}$$

where $A \equiv P^{\sigma-1} I$ is treated as a constant due to our small country assumption with P as aggregate price and I as world income.

1.2.2 Production

The production of homogenous good Q is characterized by a perfectly competitive product and labor market. Differentiated good X is produced in an environment of monopolistic competition where firms choose to produce a different variety $x(i)$ under identical productivity. Both sectors require labor as the only factor of production: labor L_Q is homogenous in sector Q, whereas labor in sector X is split between high-skilled 'managerial' workers L_H and low-skilled 'normal' workers L. The manufacturing process is characterized by fragmentation: following the approach by Feenstra and Hanson (1996, 1997) final good variety $x(i)$ is assembled from a continuum of complementary interme-

diate goods that are indexed by $z \in [0,1]$. Each intermediate good $y(z(i))$ is produced with a linear-homogenous technology where each unit is associated with a specific unit labor requirement $\gamma(z(i))$ that increases linearly with z. The production function can be written as

$$x(i) = \min\left(\frac{L(z)}{\gamma(z)}\right) \ \forall\ z \in [0,1], \tag{1.3}$$

where $L(z)$ stands for total usage of low-skilled labor in $y(z(i))$.

Furthermore, each firm producing variety $x(i)$ faces a monopoly union which represents all low-skilled workers employed by the firm within a 'right-to-manage' framework.[7] Factor compensation is arranged as such that low-skilled workers receive wage rate $w(i)$ as outcome of the wage setting decision of the monopoly union, whereas high-skilled workers receive all excess profits of the firms in sector X (which is thought of as wage rate w_H).[8] In terms of offshoring, we allow each firm to have some flexibility regarding the location of intermediate good production: intermediate goods can be produced at home or alternatively abroad in a low-wage foreign country where per unit transportation costs t apply to offshored intermediates. To accommodate the assumption that the foreign country is a low-wage country, foreign wage rate w^* is assumed to be smaller than reservation wage ω of domestic sector Q where $Q = \omega L_Q$. The overall reintegration of intermediate goods into final assembly is assumed to take place in the home country at no cost. We further assume that the wage differential between high- and low-wage country is sufficiently high, or respectively, that transportation costs are sufficiently low, that initially there is always some extent of offshoring.[9] The corresponding unit cost function is given by

$$c\left(i; w, w^*, t, \tilde{z}\right) \equiv w\left(i\right) \int_0^{\tilde{z}(i)} \gamma\left(z\right) dz + w^* \int_{\tilde{z}(i)}^1 \gamma\left(z\right) dz + \left(1 - \tilde{z}\left(i\right)\right) t, \tag{1.4}$$

where $\tilde{z}(i)$ marks the cut-off point at which each firm is indifferent between producing $y(\tilde{z})$

[7]The term *right-to-manage* refers to a modus operandi where the firm has the right to choose employment for a given union wage level according to its profit maximization scheme .

[8]Excess labor demand or supply of low-skilled workers in the differentiated goods sector is assumed to be provided for or absorbed by the homogenous good sector Q.

[9]It is straightforward to check that the extent of offshoring depends on unit labor requirement $\gamma(z)$, given factor prices and transportation costs. Intermediate goods with relatively high values of z indicate labor-intensive production and thus higher values of unit labor requirement $\gamma(z)$. The low-wage country posseses a cost advantage in this case. Conversely, the high-wage home country can produce intermediate goods at lower cost for relatively low values of z.

at home or in a foreign country. $\tilde{z}(i)$ implies that all intermediates in the range $[0, \tilde{z}(i))$ are produced at home whereas all intermediates in the range $(\tilde{z}(i), 1]$ are produced abroad. This situation is illustrated in Figure 1.1 where linearity is assumed for simplicity.

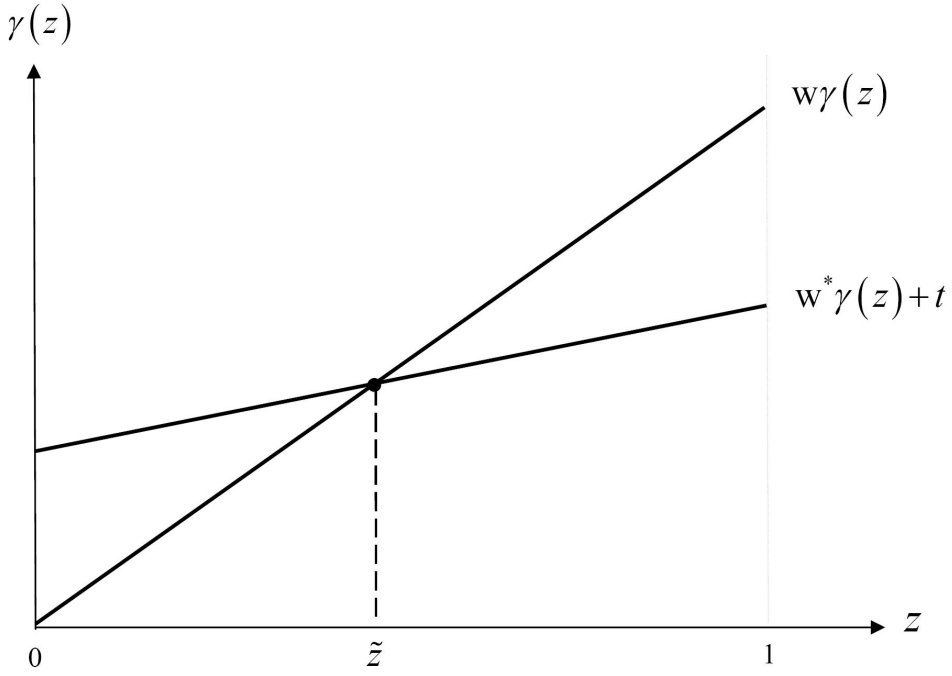


Figure 1.1: Optimal allocation of production

Given equations (2.2) and (2.3), each firm's profit equals

$$\Pi = (p(i) - c)\, x(i) - w_H. \tag{1.5}$$

Note that we let high-skilled managers be inelastically supplied at their aggregate level with $L_H = N$ as high-skilled labor market clearing condition. This implies that L_H determines market entry in sector X. Because all excess profits are distributed among high-skilled managers, firms consider w_H as given market variable.

1.2.3 Utility of the Union

The labor market in sector X is imperfect in the sense that all low-skilled workers in each firm are represented by a monopoly union. The objective of the monopoly union is given

by the rent maximization function

$$\Omega\left(i\right) = \left(w\left(i\right) - \omega\right) L(i) \tag{1.6}$$

with labor demand for unskilled workers being defined as

$$L(i) = x(i) \int_0^{\tilde{z}} \gamma(z) dz. \tag{1.7}$$

At this point it is important to note that the union has an outside-option by going on strike and receiving reservation wage ω in case of disagreement, whereas the firm has no conflict payoff due to the complementary nature of intermediate goods in the production process: a strike against intermediate good production in the domestic country results in a shutdown of the entire production process of final good variety $x(i)$ which preserves the bargaining power of the union.[10] This has an important implication for our model as unions demand higher wages to compensate for the loss in domestic employment when faced with offshoring. This implication is very different from models that include horizontal FDI or outsourcing of final goods (as potential or real threat) in which case firms can produce output even in the event of a strike by relocating complete production processes abroad, resulting in lower wage demands by the union. These opposing implications are important to keep in mind as we continue our analysis of the model.

1.2.4 Solving for Equilibrium

The introduced framework is solved through backwards induction in a three-stage sequence of decision making.[11] Each stage can be described as follows:

[10] Zhao (2001) states empirical examples for this kind of situation where labor strikes against General Motors in Canada and the US in 1996 and 1998 led to a shutdown of production plants in other countries such as Mexico.

[11] The underlying timing structure captures the idea of a long-term oriented production mode where the allocation of production is inflexible at the stage when wages are set by the monopoly union. Koskela and Schöb (2010) term this sequence of events as 'strategic' decision-making. Alternatively, the term 'flexible' decisision-making applies if stage 1 and 2 were reversed where the wage is determined before the firms' offshoring decision. All in all, the specific timing of events has no effect on the qualitative results of our model.

Stage 1: The firm determines the extent of offshoring

Stage 2: The monopoly union sets the domestic wage rate

Stage 3: The firm determines output and employment.

In Stage 3, the firm determines output and employment within its profit maximization scheme for a given level of $\tilde{z}$ and wage rate $w(i)$. Usage of equation (1.2) under symmetry assumption yields the first order condition from the profit function in (3.2) with

$$p = \frac{\sigma}{\sigma - 1} c \tag{1.8}$$

and

$$x = A \frac{(\sigma - 1)^{\sigma}}{\sigma^{\sigma}} c^{-\sigma}. \tag{1.9}$$

The corresponding profit maximization function is given by

$$\Pi = \Theta \; c^{1-\sigma} - w_H \tag{1.10}$$

with $\Theta = \frac{A(\sigma-1)^{\sigma-1}}{\sigma^{\sigma}}$. Equation (2.9) allows us to further specify w_H because all excess profits are assumed to be paid out to high-skilled managers:

$$w_H = \Theta \; c^{1-\sigma}. \tag{1.11}$$

Substituting equation (1.9) into (1.7) yields the profit-maximizing firm-level employment of unskilled labor:

$$L(i) = A \frac{(\sigma - 1)^{\sigma}}{\sigma^{\sigma}} c^{-\sigma} \int_0^{\tilde{z}} \gamma(z) dz. \tag{1.12}$$

Let us now consider Stage 2, where the monopoly union maximizes its objective function according to

$$w(i) = \arg\max_{w(i)} \{(w(i) - \omega) L(i)\} \tag{1.13}$$

subject to the firm's labor demand curve in (2.10). This implies that the monopoly union chooses its optimal wage such that its marginal rate of substitution of employment for wages is equal to the elasticity of the firm's labor demand. Solving (2.12) for $w(i)$ yields

$$w(i) = \frac{\sigma\omega \int_0^{\tilde{z}} \gamma(z)\, dz + w^* \int_{\tilde{z}}^1 \gamma(z)\, dz + (1 - \tilde{z})\, t}{(\sigma - 1) \int_0^{\tilde{z}} \gamma(z)\, dz} \tag{1.14}$$

for given $\tilde{z}$. Comparative static analysis of (1.14) reveals that the union wage for unskilled workers decreases both in σ and $\tilde{z}$:

$$\frac{\partial w(i)}{\partial \sigma} < 0 \qquad \frac{\partial w(i)}{\partial \tilde{z}} < 0. \tag{1.15}$$

Given the profit-maximizing scheme of each firm (Stage 3) and the wage setting behavior of the monopoly union (Stage 2), we can now determine each firm's optimal offshoring decision of production (Stage 1). Differentiation of (2.9) with respect to $\tilde{z}$ yields

$$\frac{d\Pi}{d\tilde{z}(i)} = \Theta(1 - \sigma)\, c(i)^{-\sigma} \frac{dc(i)}{d\tilde{z}(i)} - \frac{dw_H}{d\tilde{z}(i)} = 0, \tag{1.16}$$

where $\frac{dw_H}{d\tilde{z}(i)} = 0$ because firms take w_H as given. It follows from (1.16) that profit maximization with respect to $\tilde{z}$ is fulfilled when

$$\omega\gamma(\tilde{z}) - w^*\gamma(\tilde{z}) = t, \tag{1.17}$$

where internal solution requires $\omega > w^*$.[12] Given equation (1.17) we can determine the relative wage between high-skilled and low-skilled workers in equilibrium:

[12] In the following, we will omit the (i) index for firms due to our symmetry assumption.

$$\frac{w}{w^H} = \left(\frac{\sigma}{\sigma-1}\right)^{(2\sigma-1)} \frac{\sigma\omega \int_0^{\tilde{z}} \gamma(z)\,dz + w^* \int_{\tilde{z}}^1 \gamma(z)\,dz + (1-\tilde{z})(\omega - w^*)\gamma(\tilde{z})}{A \int_0^{\tilde{z}} \gamma(z)\,dz \left(\omega \int_0^{\tilde{z}} \gamma(z)\,dz + w^* \int_{\tilde{z}}^1 \gamma(z)\,dz + (1-\tilde{z})(\omega - w^*)\gamma(\tilde{z})\right)^{1-\sigma}} \tag{1.18}$$

with

$$\frac{\partial}{\partial\omega}\left(\frac{w}{w^H}\right) > 0 \qquad \frac{\partial}{\partial w^*}\left(\frac{w}{w^H}\right) > 0 \qquad \frac{\partial}{\partial\tilde{z}}\left(\frac{w}{w^H}\right) < 0 \qquad \frac{\partial}{\partial\sigma}\left(\frac{w}{w^H}\right) \lessgtr 0.$$

1.3 Impact of Increased Offshoring on the Unionized Labor Market

Trade liberalization is considered to be a catalyzer for globalization. We incorporate this effect into our model by analyzing the impact that falling trade costs have on the domestic labor market with specific focus on the relative wage between high-skilled and low-skilled workers. The direct effect of a fall in t involves the reduction of marginal production costs for every offshored intermediate and thus a change in the allocation of production. Differentiation of equation (1.17) shows that falling t implies a lower value of $\tilde{z}$:

$$\frac{d\tilde{z}}{dt} = \frac{1}{(\omega - w^*)\gamma'(\tilde{z})} > 0 \tag{1.19}$$

with $\gamma'(\tilde{z}) > 0$ via rearrangement of $\frac{d^2\pi}{d\tilde{z}^2}$ which establishes the following proposition:

Proposition 1 *A fall in trade costs leads to increased offshoring.*

This intuitive result can be depicted when recalling Figure 1.1 in Section 1.2.2, where a fall in t leads to a downward shift of the $w_2\gamma(z) + t$ curve as shown in Figure 1.2.

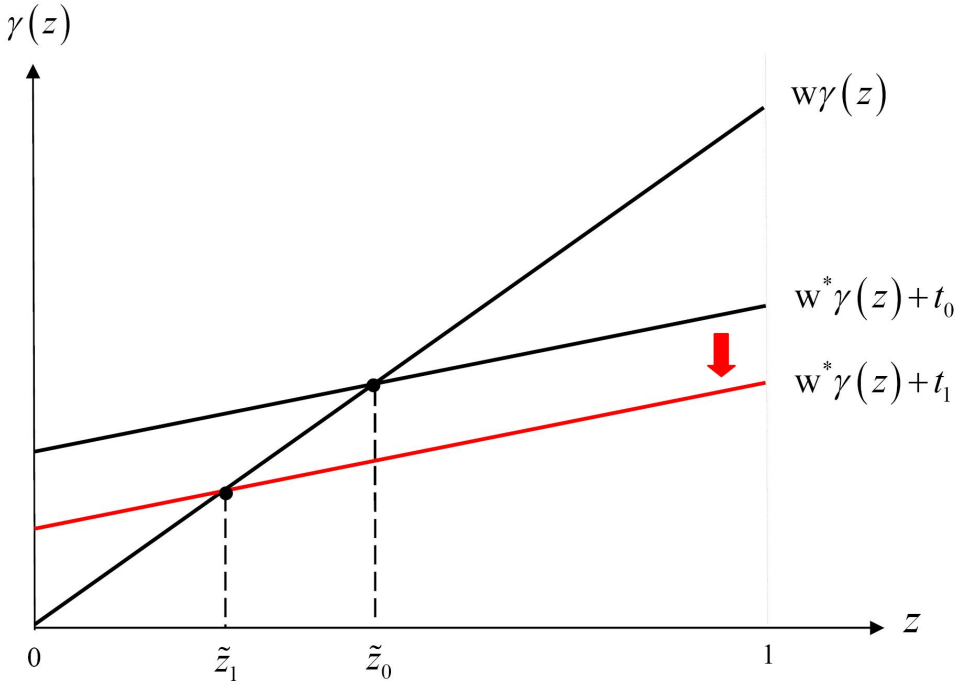


Figure 1.2: Effect of increased market integration on offshoring

1.3.1 Impact on Low- and High-Skilled Wages

Falling transportation costs influence the bargained wage rate through a direct and indirect channel, which work in opposite directions. On the one hand, lower trade costs induce an increase in the wage elasticity of labor demand, because lower trade costs cause wage increases, *ceteris paribus*, to have a larger impact on marginal production costs with the result that wage increases have a larger impact on domestic labor demand. We term this direct effect on the union wage as *wage moderation effect*. On the other hand, lower trade costs give rise to increased offshoring, which reduces the wage elasticity of labor demand, because offshoring causes wage increases to have a smaller impact on marginal production costs, as less unionized workers remain employed in the home country. A less elastic labor demand implies that the trade-off between wages and employment works in favor of the union, resulting in higher wage demands. We term this effect on the union wage rate as *offshoring effect on wages,* thereby keeping in mind that union wages increase with offshoring.

The corresponding function that describes the total effect of a change in t on the union wage rate is given by:

$$\begin{aligned} \frac{dw}{dt} &= \frac{\overset{+}{\partial w}}{\partial t} + \frac{\overset{-}{dw}}{d\tilde{z}}\frac{\overset{+}{d\tilde{z}}}{dt} \\ &= \frac{(1-\tilde{z})(\omega - w^*)\left(\gamma'(\tilde{z})\int_0^{\tilde{z}}\gamma(z)\,dz - (\gamma(\tilde{z}))^2\right) - \gamma(\tilde{z})\left(\omega\int_0^{\tilde{z}}\gamma(z)\,dz + w^*\int_{\tilde{z}}^1\gamma(z)\,dz\right)}{(\sigma-1)\left(\int_0^{\tilde{z}}\gamma(z)\,dz\right)^2(\omega - w^*)\gamma'(\tilde{z})}. \end{aligned} \tag{1.20}$$

Given (1.20), the overall effect on the union wage rate appears not clear-cut: the denominator of (1.20) is clearly positive while the numerator appears ambiguous. To find an answer to this question, let us assume a specific linear function for $\gamma(z)$ such as $\gamma(z) = z$.[13] Expression (1.20) then takes the form

$$\frac{dw}{dt} = -\frac{2\left(w^*(1-\tilde{z}) + \tilde{z}\omega\right)}{(\tilde{z})^3(\sigma-1)(\omega - w^*)} < 0, \tag{1.21}$$

which indicates a clear negative algebraic sign. This implies that the *offshoring effect on wages* dominates over the *wage moderation effect* for all $\tilde{z} \in [0,1]$, so that the overall wage elasticity of labor decreases with falling t. For a better intuition, we portray each effect in Figure 1.3, in which the *wage moderation effect* and *offshoring effect on wages* are depicted in black and blue color respectively.

In the next step we can determine the total effect of a change in t on the managers' wage:

$$\begin{aligned} \frac{dw_H}{dt} &= (1-\sigma)\frac{A(\sigma-1)^{\sigma-1}}{\sigma^\sigma}c^{-\sigma}\left(\frac{\overset{+}{\partial c}}{\partial t} + \frac{\overset{+}{\partial c}}{\partial \tilde{z}}\frac{\overset{+}{d\tilde{z}}}{dt} + \frac{\overset{+}{\partial c}}{\partial w}\frac{\overset{-}{dw}}{dt}\right) \\ &= -A\left(\frac{\sigma-1}{\sigma}\right)^{\sigma-1}c^{-\sigma}(1-\tilde{z}) < 0, \end{aligned} \tag{1.22}$$

which primarily depends on the degree of offshoring and the cost structure of the firm as endogenously determined variables of our model for a given level of A and σ. In this case we can unambiguously assign a negative algebraic sign.

[13] The quality of our results hold independent of the specific function for $\gamma(z)$ as long as the function takes a positive linear form.

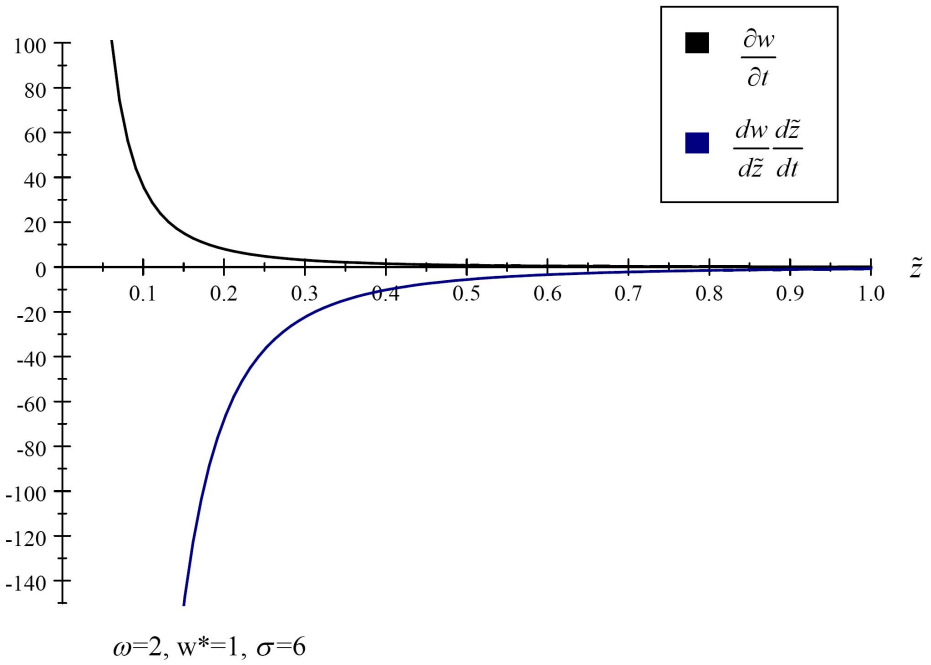


Figure 1.3: Direct and indirect effect of a fall in trade costs on the wage rate

When applying $\gamma(z) = z$, function (1.22) takes the form

$$\frac{dw_H}{dt} = -A\left(\frac{\sigma-1}{\sigma}\right)^{2\sigma-1} \frac{(1-\tilde{z})}{\left(\frac{1}{2}\left(w^* + (\omega - w^*)\left(2\tilde{z} - (\tilde{z})^2\right)\right)\right)^{\sigma}} < 0. \tag{1.23}$$

Given equations (1.20) - (1.23), we can conclude that both wage types for low- and high-skilled wages increase with falling t. The wage for low-skilled union workers increases because the monopoly union demands higher wages in reaction to the higher degree of offshoring which constitutes a loss of domestic jobs to the foreign country. The union is able to enforce these higher wages due to the complementary nature of the production process which leaves the firm no outside-option in case of a strike. On the other hand, the wage for high-skilled managers is linked to the profits of the firm where the direction of the change in w_H determines the total gain or loss for this labor group. Since w_H increases with falling t, profits must rise (via output) as well:

$$\frac{dx}{dt} = -A\sigma\left(\frac{\sigma-1}{\sigma}\right)^{\sigma-1} c^{-\sigma-1}(1-\tilde{z}) < 0, \tag{1.24}$$

$$\frac{d\Pi}{dt} = -A\left(\frac{\sigma-1}{\sigma}\right)^{\sigma-1} c^{-\sigma}\left(1-\tilde{z}\right) < 0. \tag{1.25}$$

Proposition 2 *Increased offshoring (as a result of falling trade costs) leads to a rise of nominal wages for both low-skilled and high-skilled workers.*

1.3.2 Impact on Relative Wage

The total change of the relative wage between low- and high-skilled workers in the light of falling transportation costs is determined by the elasticities of w and w_H in response to a change in t:

$$\eta_w = \frac{dw}{dt}\frac{t}{w} = -\frac{2\left(1+\tilde{z}\right)}{2\tilde{z}\left(6\tilde{z}+2\right)+\left(1-\tilde{z}\right)^2}, \tag{1.26}$$

$$\eta_{w_H} = \frac{dw_H}{dt}\frac{t}{w_H} = \frac{8\kappa\left(1-\tilde{z}\right)}{\frac{4}{7}\left(\left(\tilde{z}\right)^2-2\tilde{z}-1\right)}. \tag{1.27}$$

If the percental change of the union wage rate is larger than the percental change in the managers' wage rate, $\eta_w > \eta_{w_H}$, the relative wage $\frac{w}{w_H}$ will increase in response to a fall in t and decrease respectively, when $\eta_w < \eta_{w_H}$. Both scenarios are possible and depend on the initial degree of $\tilde{z}$ when the fall in transportation costs occurs. To illustrate this, consider Figure 1.4, where equations (1.26) and (1.27) are depicted with exemplary values in accordance with the internal requirements of our model.

Analysis of Figure 1.4 reveals a concave shaped function for η_w, which represents the percental change of the wage rate of low-skilled labor in response to a fall in t. The values of the function are negative because the negative *offshoring effect on wages* dominates over the positive *wage moderation* effect for all $\tilde{z} \in [0,1]$. The percental change of η_w is largest when the initial degree of offshoring is relatively high (which corresponds to low values of $\tilde{z}$) with a maximum at $\tilde{z} = 0$, when all offshoring opportunities are exhausted. This is because the scope for the *offshoring effect on wages* is positively linked to the degree

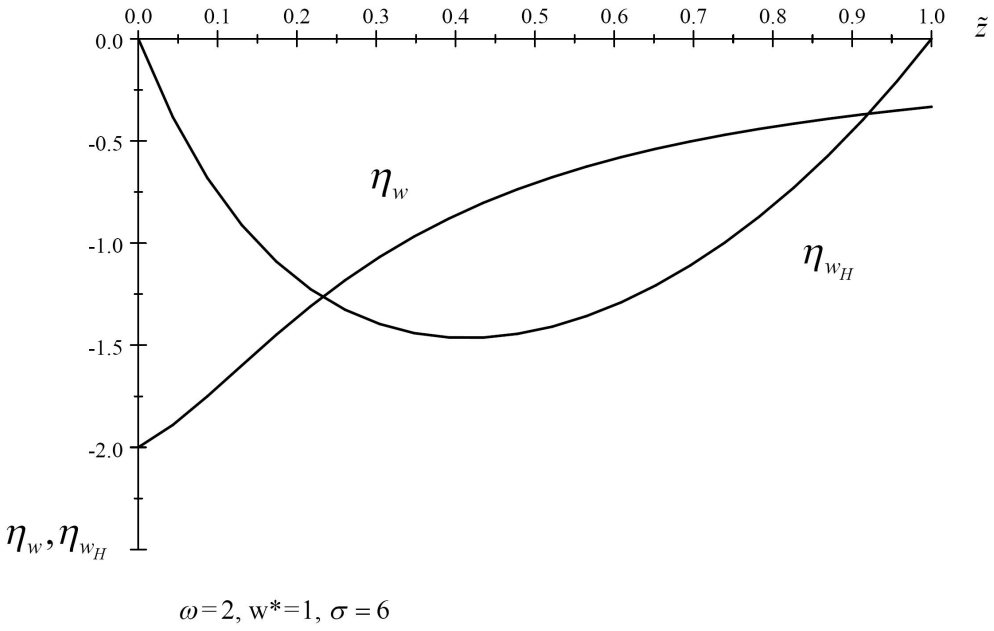


Figure 1.4: Percental change of the wage rate for low- and high-skilled labor

of offshoring.[14] The relationship between η_{w_H} and $\tilde{z}$ takes a u-shaped form where η_{w_H} reaches a maximum at intermediate offshoring levels. To understand this, recall that the compensation of high-skilled labor is negatively linked to production costs. High levels of $\tilde{z}$ indicate high transportation costs so that the initial degree of offshoring is relatively low for these levels and vice versa. At $\tilde{z} = 1$, the firm produces all intermediate goods in the home country, thereby leaving t no scope to lower production costs as they would depend on domestic variables only. As offshoring progresses with falling t, compensation of high-skilled workers increase as well, but so does the compensation of low-skilled workers until the scope to further save on costs through falling transportation costs is exhausted at $\tilde{z} = 0$.

In comparison, the relative wage between low- and high-skilled workers is likely to increase due to a fall in t, when the value of $\tilde{z}$ is relatively low or high and likely to decrease with intermediate initial values of $\tilde{z}$, that lie in between. Moreover, an exogenous increase in σ produces an even wider bandwith of initial values of $\tilde{z}$ that represents a reduction in the relative wage between low- and high-skilled workers as depicted in Figure 1.5. This is because we observe an upward shift of the η_w curve and a simultaneous downward-shift

[14]The *wage moderation effect* becomes larger with increased offshoring as well, but always less so compared to the offshoring effect on wages.

of the η_{w_H} curve with increasing elasticity of substitution between varieties.

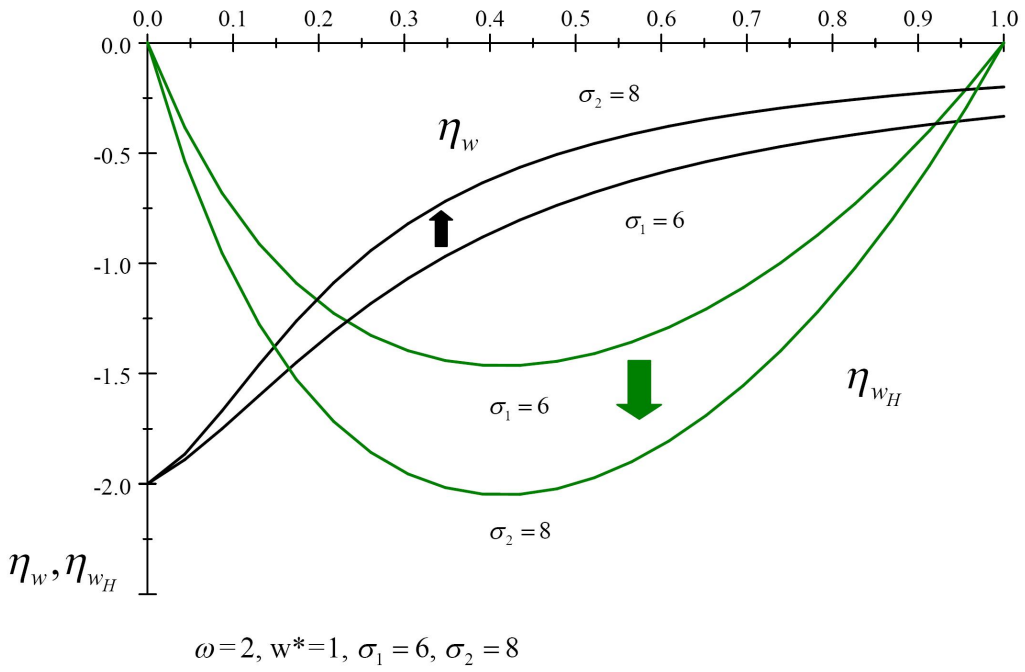


Figure 1.5: Effect of an increase in σ on the relative wage between low- and high-skilled labor

We can summarize our results with regard to the impact of a change in t on the relative wage between low- and high-skilled workers in the following way:

Proposition 3 *The relative wage between low- and high-skilled labor is likely to increase when the initial degree of offshoring is relatively low or high and likely to decrease with an intermediate initial degree of offshoring that lies in between.*

1.3.3 Impact on Domestic Labor Demand

Now that we have analyzed the impact of falling transportation costs on the relative wage between low- and high-skilled workers, we turn to the question of how domestic labor demand for low-skilled union workers is affected by a fall in t (as the number of high-skilled managers is fixed by assumption). This question is relevant since the monopoly union values its utility by means of rent maximization, which consists of both wages and

labor demand for union workers. The total impact of falling transportation costs and thus increased offshoring on firm-level employment of low-skilled workers is given by

$$\begin{aligned} \frac{dL}{dt} &= x\gamma\left(\tilde{z}\right)\overset{+}{\frac{d\tilde{z}}{dt}} + \int_0^{\tilde{z}} \gamma\left(z\right) dz \overset{-}{\frac{dx}{dt}} \\ &= A\left(\frac{\sigma-1}{\sigma}\right)^{\sigma} c^{-\sigma}\left(\frac{\gamma\left(\tilde{z}\right)}{\left(\omega - w^{*}\right)\gamma'\left(\tilde{z}\right)} - \frac{\sigma^{2}}{\left(\sigma-1\right)} c^{-1}\left(1-\tilde{z}\right)\int_0^{\tilde{z}} \gamma\left(z\right) dz\right). \end{aligned} \tag{1.28}$$

It is clear from viewing (1.28) that the total effect on domestic labor demand due to a fall in t depends on the algebraic sign in the bracket of this expression, which comprises the sum of two opposing effects: on the one hand, increased offshoring implies a direct export and thus loss of domestic jobs to a foreign country, which we term *relocation effect*. This negative effect on domestic labor becomes smaller when moving from higher to lower of levels of $\tilde{z}$, which means that the relocation effect is all the more larger the lower the initial degree of offshoring. In absolute terms, the relocation effect is smaller the larger the difference between reservation and foreign wage rate for given unit labor requirement function $\gamma(z)$. On the other hand, increased offshoring may come with an output expanding effect as falling transportation costs lead to a decrease in marginal production costs for each offshored intermediate good, which reduces prices and thus induces more demand for final goods. Higher product demand in turn creates domestic labor demand for the remaining in-house production, which we term *profitability effect*. This effect is larger the higher the elasticity of substitution between varieties. With regard to the initial degree of offshoring, we find a u-shaped relationship between the profitability effect and $\tilde{z}$ because the magnitude of the profitability effect equals zero at the extreme limits of $z \in [0,1]$ for given σ. This is because the output effect is larger the higher the initial degree of offshoring (or equally the smaller the initial value of $\tilde{z}$) but higher degrees of offshoring imply a relatively small amount of workers remaining in domestic production, which limits the scope that this effect has on domestic labor demand. Conversely, if the initial degree of offshoring is relatively low, relatively high numbers of domestic workers are still involved in the production of intermediate goods, but then the output effect (that could have an effect on these workers) would be relatively low.

We can depict equation (1.28) graphically under application of $\gamma(z) = z$ which yields:

$$\frac{dL}{dt} = A\left(\frac{\sigma-1}{\sigma}\right)^{\sigma} c^{-\sigma}\left(\frac{\tilde{z}}{(\omega - w^*)} - \sigma\frac{(1-\tilde{z})\,(\tilde{z})^2}{w^* + \left(2\tilde{z} - (\tilde{z})^2\right)(\omega - w^*)}\right). \tag{1.29}$$

The first term in the bracket of expression (1.29) stands for the relocation and the second term for the profitability effect. If one effect dominated the other for all initial values of $\tilde{z}$, we would have an unambiguous algebraic sign. We can show, however, that this must not necessarily be the case for certain values that are in line with the internal requirements of our framework as can be seen in Figure 1.6.

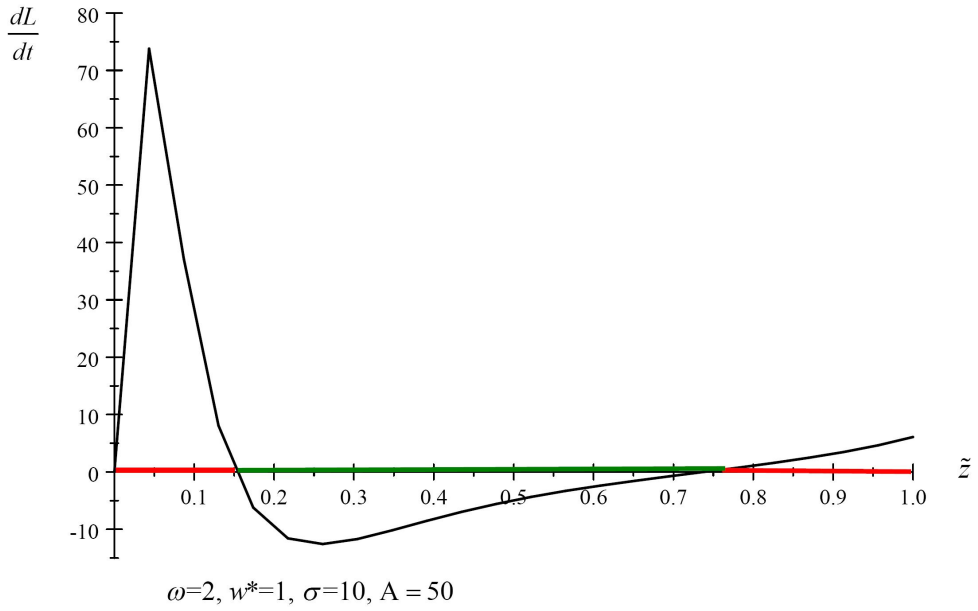


Figure 1.6: Total change of domestic labor demand

The initial values of $\tilde{z}$ marked by the red bars in Figure 1.6 show the bandwith(s) where the relocation effect dominates over the profitability effect which leads to a net fall in domestic labor demand in response to a fall in t. This is the case for offshoring levels at the extreme ends for all possible values of $\tilde{z}$. Analogously, the profitability effect is larger compared to the relocation effect for intermediate initial values of $\tilde{z}$, depicted by the green bar in Figure 1.6 with the result that total domestic labor demand increases with falling t. It is noteworthy that the absolute magnitude of the overall effect on domestic labor seems to be tilted towards lower initial degrees of $\tilde{z}$ which is due to expression $A\left(\frac{\sigma-1}{\sigma}\right)^{\sigma} c^{-\sigma}$ before

the bracket in (1.29), which decreases in $\tilde{z}$. Figure 1.6 thus implies the following labor development for a closed country that starts to introduce offshoring with falling t: the country would first experience a fall in domestic labor, but the magnitude of this decline in domestic labor would be relatively small. With ongoing offshoring activities, the country experiences an increase in domestic labor demand as the profitability effect starts to take effect and even more so until a low threshold value $\tilde{z}$ is reached, where the overall effect on domestic labor turns back to negativity with high magnitude. It is also straightforward to check that an exogenous increase in the elasticity of substitution between varieties σ widens the scope of the domination of the profitability effect over the relocation effect for initial values of $\tilde{z}$, which raises the probability of a country experiencing an increase in domestic labor demand with increased market integration, as illustrated in Figure 1.7.

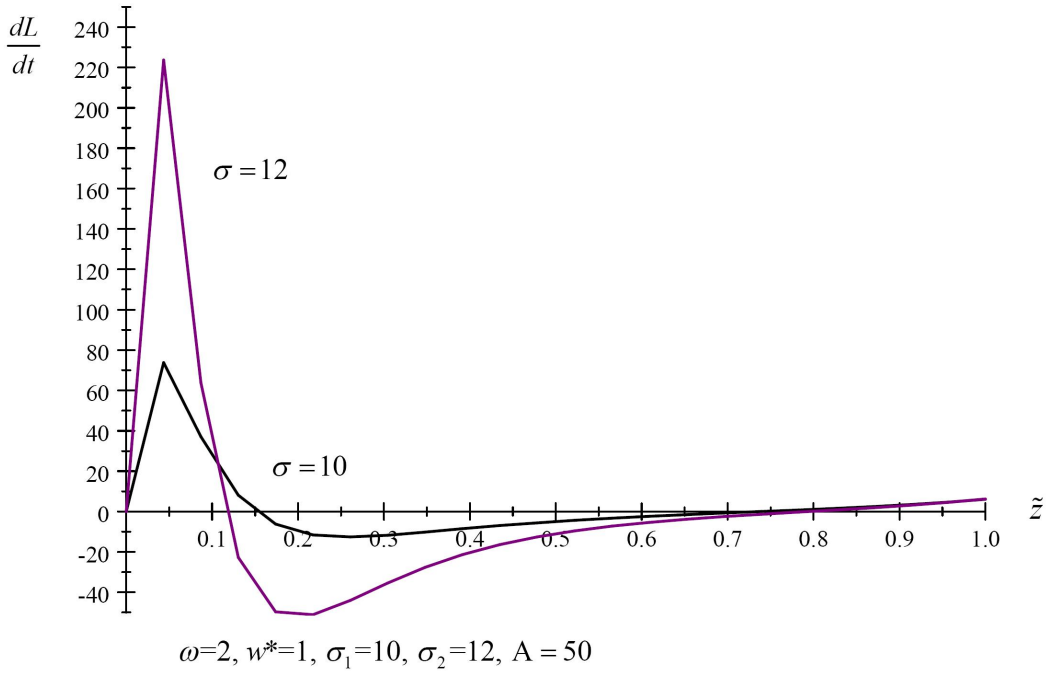


Figure 1.7: Effect of an increase in σ on the total change of domestic labor demand

This leads us to our next proposition:

Proposition 4 *Domestic labor demand may rise or fall in response to increased offshoring depending on the initial value of $\tilde{z}$: the relocation effect and thus negative impact on domestic labor is likely to dominate over the profitability effect for relatively low and high initial values of $\tilde{z}$ when confronted with a fall in t. The profitability effect and thus*

positive impact on domestic labor is likely to dominate over the relocation effect if the degree of initial offshoring is neither too low or too high.

Given the two previous propositions, we can assert the following conclusion for the situation of the union when being confronted with a fall in trade costs: an increase in the wage rate is always accompanied by a fall in domestic labor for relatively low and high values. This effect is largest (both on wages and employment) when the initial degree of offshoring is very advanced. However, comparison of figures 1.5 and 1.6 reveals a bandwith of intermediate initial degrees of offshoring where the union can benefit from both, higher wages and more employment.

1.4 Conclusion

This paper has introduced a model of offshoring and trade unions under heterogenous labor. Our results show that increased market integration leads to more offshoring. With regard to labor, increased offshoring leads to an increase of wages for both low- and high-skilled workers. The former occurs because union workers demand higher wages to compensate for the loss in domestic employment. High-skilled workers or managers gain from offshoring as it enables firms to become more profitable. Which wage type experiences a higher increase depends on the initial degree of offshoring: the relative wage between low- and high-skilled workers is likely to decrease with relatively low or high initial degrees of offshoring and is likely to increase if the initial degree of offshoring neither too high or too low. Empirical studies on this subject will hopefully shed further light on the ambiguities that remain with the underlying model. We are aware of only one empirical study by Braun and Scheffel (2007) that analyzes the effect of outsourcing on union wages.[15] Further theoretical work should contain the relaxation of some of the restrictive assumptions that were undertaken for the sake of simplicity and tractability in our model. In particular, this concerns the restrictive assumption of fixed entry and exit of firms in the differentiated goods sector. Furthermore, endogenization of the reservation wage would

[15]Note that these empirical findings need to be handled with care when comparing them with our theoretical results as Braun and Scheffel make no explicit statement regarding the complementary and/or substitutional character of the outsourcing activities captured in their available data.

permit more interaction between both sectors considered in the model. In summary, the issue of offshoring in the presence of trade unions and heterogenous labor remains to be an ongoing important topic in the minds of concerned people. Further research on this issue seems to be required to establish well-grounded policy recommendations in order to rise to the challenges of an integrated global economy.

Chapter 2

The Impact of Labor Taxes on Unionized Labor Markets in the Presence of Offshoring

2.1 Introduction

Developed countries are generally characterized by relatively high tax ratios. This applies in particular to European countries, whose overall tax ratio (as sum of taxes and social security contributions) added up to 38,4% in the GDP-weighted average of the 27 EU member states, compared to 26,9% in Japan and 24,8% in the USA.[1] The persistent high tax burden on labor is often believed to be a main source for high unemployment in these countries. A popular idea in the fiscal policy debate concerns the reduction of labor taxes in the hope that lower labor costs induce higher labor demand. Theoretical contributions with regard to progressivity-neutral labor taxes seem to support this view, (see for example Lockwood and Manning (1993) or Muysken et. al (1999)), yet the

[1] A number of countries undertook structural tax reforms to reduce the overall tax burden at the beginning of the millenium, which caused the unweighted personal income tax average of OECD countries to fall from 67% in 1981 to 49% in 1994 and 43% in 2006. This trend, however, seems to have petered out with the beginning of the financial crisis in 2008 (see the Appendix for a graph depicting the long-term trend in the overall tax ratio in % of GDP for the EU). For more detailed information see Johansson et al. (2008) and European Commission (2012).

empirical evidence is not as clear-cut.[2] The problem of high unemployment in a world with growing globalization pressure induces the additional fear in developed countries, that offshoring (as a means of relocating labor-intensive parts of the production from high-wage to low-wage countries) leads to a crowding-out of domestic jobs by foreign jobs.[3] Given the fact that substantial numbers of workers in developed countries are covered by collective bargaining agreements, a relevant question arises regarding the role that trade unions play in this situation: What impact do trade unions have on labor market outcomes and firms' organizational choices in the presence of offshoring? And how can policy-makers use this knowledge to optimize their fiscal policy strategies?

This paper aims to answer these questions in order to shed further light on the impact of labor taxation on the domestic wage bargaining outcome in the presence of offshoring. The specific focus of our analysis is motivated by the following observations: First, most models on labor taxation and trade unions are restricted to an autartic view, thus blending out global developments (e.g. Hersoug (1984), Sampson (1986), Palokangas (1987), Aronsson and Sjögren (2004)). Markets, however, are often dominated by multinational firms that take advantage of wage differences by offshoring production to lower-wage countries. This has strong implications for the domestic wage bargaining outcome, which is left blended out under autarky, as offshoring leads to a change in the wage elasticity of labor demand, which should be taken into account by tax policy-makers. We pick up on this by allowing for offshoring within our framework. Second, the majority of literature that considers wage bargaining on a global scale (irrespective of labor taxation) restricts the analysis to *final goods*, which implies some degree of substitutability between domestic and foreign workers. Given this situation, there exists a broad consensus on the idea that the fear of (actual or potential) job losses leads to wage moderation on behalf of trade unions and thus an increase in the wage elasticity of labor demand on the domestic labor market (e.g.

[2]Layard and Nickel (1997), for example, find only a small significant effect regarding the relationship between the overall tax burden und unemployment, based on cross-section regressions for 20 OECD countries.

[3]Following authors such as Yeaple (2006), Grossman and Rossi-Hansberg (2008) and Rodríguez-Clare (2010), we understand offshoring as the movement of the production of inputs (or intermediate goods and services) to a foreign country with the intention of reimporting them back to the home country. This can occur within the firm (= vertical FDI) or through arms-length transactions (= international outsourcing). Note that the terms *vertical FDI* and *international outsourcing* can be used interchangeably in the context of our model if the offshored activities are complementary in their nature.

Zhao (1998), Eckel and Egger (2009)). Our contribution challenges this line of reasoning since offshoring is only attributed to the extent of *intermediate goods/inputs*. This results in the slight but distinctive difference that domestic and foreign workers find themselves in a complementary relationship which leads to a decrease in the wage elasticity of labor demand as offshoring exogenizes a larger share of marginal production costs. As the wage-employment tradeoff turns more favorable with less elastic labor demand, the trade union compensates the loss of employment caused by offshoring with higher wage demands.[4] It is the complementary nature of intermediate goods that enables trade unions to enforce higher wages based on their ability to blockade the whole production chain by refusing to produce the required intermediate input that is still in 'domestic hands' (see, for example, Skaksen and Sørensen (2001), Lommerud et al. (2009)).[5]

Based on these notions, we consider a single representative firm in a small open economy that has the opportunity to relocate the production of required intermediate inputs to a lower-wage foreign country. The domestic workers employed by the firm are represented by a monoply trade union and pay personal income tax (henceforth wage or labor tax) on their earnings that is collected by the government. The focus of our analysis is directed towards wages and employment in the high-wage domestic country, thus blending out the low-wage foreign country as an exogenous factor. Given this setup, we investigate how the trade union alters its wage-setting behavior in response to changes in offshoring opportunities and to changes in the marginal tax parameter.

To the best of our knowledge, there exists no theoretical framework that considers the implications of offshoring within a labor tax and wage bargaining framework. The closest contribution to our agenda is given by Koskela and Schöb (2010) who analyze how outsourcing and labor tax reforms affect the wage setting behavior of trade unions. They show that outsourcing of final goods leads trade unions to moderate their wage claims and that further tax progression can be beneficial for employment (an issue that is not

[4]See Lommerud et al. (2009), p. 112.

[5]Skaksen and Sørensen (2001) were one of the first contributors to point to the possibility that workers may demand higher wages as compensation for employment losses if there exists a suffcient high degree of complementarity between home and host country activities. Lommerud et al. (2009) also build their analysis regarding the effect of deunionization on international outsourcing on this finding. The different terms used by these authors, FDI with high degree of complementarity and international outsourcing, can be summarized under our definition of offshoring.

adressed in this paper). Furthermore, they find that falling outsourcing costs lead to an increase in domestic employment as long as the share of outsourced workers is not too large.

Building on a simple proportional tax modeling approach and adapting it to offshoring, our analysis reveals the following results: first, the relationship between taxation and domestic labor demand is negative, meaning that an increase in the marginal tax rate reduces domestic labor. This is because an increase of the marginal labor tax rate leads the union to demand higher wages. These higher wages create an incentive for offshoring, which in turn leads to even higher wage demands by the union to compensate for the loss of domestic employment. Second, when the considered economy is confronted with falling transportation costs, the total effect on domestic labor crucially depends on the initial degree of labor taxation. In this context, a negative effect on domestic labor is more likely the lower the marginal tax rate and the lower the initial degree of offshoring. The government can dampen this negative on domestic labor induced by a fall in transportation costs, by raising the marginal tax rate. If the tax rate is sufficiently high, increased offshoring may even induce a raise in domestic labor demand, depending on the initial degree of offshoring.

The remainder of this paper is organized as follows: we introduce the basic structure of the model in Section 2 and solve for equilibrium in Section 3. We then go to on to analyze the effect of increased market integration on the domestic labor market with focus on tax policy implications. Finally, concluding remarks follow in Section 5.

2.2 The Basic Model

2.2.1 Profits and Allocation of Production

Let us consider a market for a homogoneous final good in a high-wage industrialized country that is characterized by a monopolistic firm and inverse linear demand

$$p = a - \beta y \tag{2.1}$$

where p denotes product price and y total output. The firm operates in a fragmented manufacturing sector that is small compared to the rest of the economy. Following Feenstra and Hanson (1996, 1997), final good y is assembled from a continuum of intermediate goods that are indexed by $z \in [0, 1]$. Each intermediate good $x(z)$ is produced with a linear-homogenous technology that requires labor as the only production factor. In addition, each unit of $x(z)$ comes with a unit labor requirement $\gamma(z)$ that increases linearly with z. The production function can be written as

$$y = \min\left(\frac{L(z)}{\gamma(z)}\right) \ \forall \ z \in [0, 1] \tag{2.2}$$

where $L(z)$ stands for total usage of labor in $x(z)$. In terms of offshoring, the firm has the possibility as well an incentive to relocate the production of labor-intensive intermediate goods to a low-wage foreign country. The corresponding per unit cost function is given by

$$c(w, w^*, t, \tilde{z}) = w \int_0^{\tilde{z}} \gamma(z)dz + w^* \int_{\tilde{z}}^1 \gamma(z)dz + (1 - \tilde{z})t \tag{2.3}$$

where w^* stands for the exogenous foreign competitive wage rate, t for the per unit transportation cost that applies to all offshored intermediates and where $\tilde{z}$ marks the cut-off point at which the firm is indifferent between producing $x(\tilde{z})$ at home or in a foreign country.[6]

[6]To accommodate the assumption that foreign country is a low-wage country we assume that $b > w^*$ where b denotes unemployment benefits as fall-back position of unionized workers. For more details, see Section 2.2.2 .

Given equations (2.2) and (2.3), the firm's profit equals

$$\pi = (a - \beta y)y - c(w, w^*, t, \tilde{z})y \tag{2.4}$$

with $\frac{\partial \pi}{\partial y} = a - 2\beta y - c(w, w^*, t, \tilde{z})$ and $\frac{\partial \pi}{\partial c} = -y$.

Concerning the allocation of production it is straightforward to check that the extent of offshoring depends on unit labor requirement $\gamma(z)$, given factor prices and transportation costs.[7] All intermediates in the range $[0, \tilde{z})$ are produced at home in a high-wage country whereas all intermediates in the range $(\tilde{z}, 1]$ are produced abroad in a low-wage country. This situation is illustrated in Figure 2.1 where linearity is assumed for simplicity.

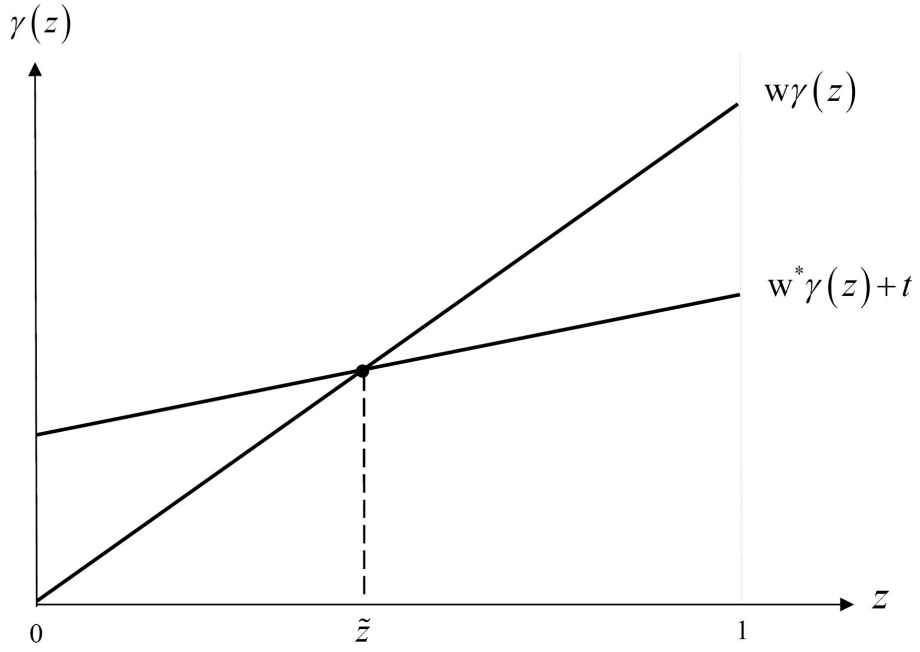


Figure 2.1: Optimal offshoring decision of the firm

[7]Intermediate goods with relatively high values of z indicate labor-intensive production and thus high values of unit labor requirement $\gamma(z)$. In this case, the low-wage country possesses a cost advantage whereas the high-wage country can produce intermediate goods at a lower cost for relatively low values of z.

2.2.2 Labor Taxation and Union Utility

The government is assumed to employ a proportional labor tax τ which is levied on the union wage rate w with $0 < \tau < 1$. The net-of-tax wage that the domestic worker receives can be expressed by

$$w^n = (1 - \tau)w. \tag{2.5}$$

We further assume that the objective of the monopoly union is represented by the rent maximization function

$$\Omega = (w^n - b) \int_0^{\tilde{z}} L(z)dz \tag{2.6}$$

with domestic labor demand defined as

$$L = \int_0^{\tilde{z}} L(z)dz = y \int_0^{\tilde{z}} \gamma(z)dz \tag{2.7}$$

where b denotes exogenous unemployment benefits which constitute an outside-option for unionized workers.[8] Note that $w^n > b$ constitutes a necessary condition for $\Omega > 0$.

2.3 Solving for Equilibrium

Given the basic model, we consider a sequence of contract periods where each contract period consists of a four-stage game:

Stage 1: The government fixes labor tax parameter τ.

Stage 2: The firm determines the extent of offshoring: $\tilde{z}$.

Stage 3: The monopoly union sets the domestic wage rate w.

Stage 4: The firm determines output and employment.

[8] Instead of unemployment benefits one could also think of a reservation wage which can be obtained in another economic sector with a competitive labor market structure.

The assumption that the union's wage setting decision is made *after* the firm has made its offshoring decision is based on the notion that a firm's organizational structure can be interpreted as a long-term commitment. This long-term view of offshoring enables the firm to anticipate how its offshoring decision will affect stages 3 and 4.[9] To find a solution for our proposed sequence of decision making, we solve the model through backwards induction.

2.3.1 Optimal Output and Employment

In stage 4, the firm determines output and employment to maximize profits for a given level of tax parameters, offshoring $\tilde{z}$ and domestic wage rate w. The first order condition from equation (3.2) yields

$$y = \frac{1}{2\beta}\left(a - c(w, w^*, t, \tilde{z})\right), \tag{2.8}$$

which leads to the firm's optimal profits:

$$\pi = \beta y^2 = \frac{1}{4\beta}\left(a - c(w, w^*, t, \tilde{z})\right)^2. \tag{2.9}$$

Substituting equation (2.8) into (2.7) gives the profit-maximizing domestic labor demand

$$\int_0^{\tilde{z}} L(z)dz = y\int_0^{\tilde{z}} \gamma(z)dz = \frac{1}{2\beta}\left(a - c(w, w^*, t, \tilde{z})\right)\int_0^{\tilde{z}} \gamma(z)dz. \tag{2.10}$$

The corresponding wage elasticity of labor demand is given by:

$$\eta \equiv -\frac{\partial \int_0^{\tilde{z}} L(z)dz}{\partial w}\frac{w}{\int_0^{\tilde{z}} L(z)dz} = \frac{w\int_0^{\tilde{z}} \gamma(z)\,dz}{a - c(w, w^*, t, \tilde{z})}. \tag{2.11}$$

[9] The interpretation of offshoring as a long-term commitment is common but not universial in the wage bargaining literature. Koskela (2010), for example, analyzes a reversed sequence of events for the case of outsourcing, termed *flexible outsourcing*, where the firm can decide upon the amount of outsourcing activity after the domestic wage has been set by the trade union. The same distinction can be found in Koskela and Schöb (2010), who distinguish between long-term 'strategic' and short-term 'flexible' outsourcing. The qualitative results, however, do not change when considering a different sequential arrangement, just in quantitative terms.

2.3.2 Wage Setting Behavior of the Union

The monopoly union possesses all bargaining power and is therefore able to set the domestic wage rate unilaterally according to its utility maximization scheme, while taking the labor tax parameters and the offshoring amount $\tilde{z}$ as given and anticipating the consequences of its wage setting decision on the firm's labor demand (the outcome of stage 4). Accordingly, the gross union wage rate in stage 3 is determined by

$$w = \arg\max_{w} \left\{ \Omega = (w^n - b) \int_0^{\tilde{z}} L(z)\, dz \right\} \tag{2.12}$$

subject to the firm's profit-maximizing labor demand (see equation 2.10 in Section 2.3.1). This implies that in equilibrium wages will be set such that a percentage increase in the union's utility due to an increase in w is equal to the elasticity of the firm's labor demand. Solving the maximization problem yields the optimal domestic union wage for a given level of $\tilde{z}$:[10]

$$w = \frac{(1-\tau)\left(a - w^* \int_{\tilde{z}}^1 \gamma(z)\, dz - (1-\tilde{z})\, t\right) + b \int_0^{\tilde{z}} \gamma(z)\, dz}{2(1-\tau) \int_0^{\tilde{z}} \gamma(z)\, dz}. \tag{2.13}$$

Note that in case of disagreement the union has an outside option by going on strike and receiving unemployment benefit b, whereas the firm has no conflict payoff due to the complementary nature of the production process: a strike puts an end to the production of intermediate inputs in its respective home country, which are unconditionally necessary for the assembly of final good y.[11] This has the consequence that the trade union maintains or even strenghtens its bargaining power under offshoring (as the firm has more to lose because offshoring enables it to become more profitable) resulting in higher wage demands to compensate the loss of domestic employment (formal prove for this assertion will be given in Section 2.3.3).

[10] See the Appendix.

[11] The firm could still produce all offshored intermediates in a foreign country, but could not make use of them without the domestic counterpart so that the production of final good y would amount to zero.

This implication differs greatly from models that include horizontal FDI or outsourcing of final goods as in Koskela and Schöb (2010). In this case the firm can produce output even in the event of a strike in the firm's home country by redirecting the production of entire goods abroad, thus strenghtening the bargaining position of the firm which results in wage moderation on behalf on the union. It is important to be aware that we have the exact opposite wage effect in our model.

2.3.3 Offshoring Decision of the Firm

In this section, we determine the optimal offshoring amount of the firm. Total differentiation of the profit function in equation (2.9) with respect to $\tilde{z}$ yields

$$\frac{d\pi}{d\tilde{z}} = -y\left(\frac{\partial c}{\partial \tilde{z}} + \frac{\partial c}{\partial w}\frac{\partial w}{\partial \tilde{z}}\right) \stackrel{!}{=} 0$$

from which follows that profit-maximization with respect to $\tilde{z}$ is fulfilled when

$$\frac{b}{1-\tau}\gamma\left(\tilde{z}\right) = w^{*}\gamma\left(\tilde{z}\right) + t. \tag{2.14}$$

Under this condition the firm is indifferent between producing $\tilde{z}$ at home or in a foreign country, which is the formal equivalent to the intersection point in Figure 2.1. Note that an internal solution requires $\frac{b}{1-\tau} > w^{*}$, which we assume to be satisfied, otherwise the firm would have no incentive for offshoring. At first glance it may seem surprising that the firm's optimal offshoring decision does not depend on in-house production cost w but rather on $\frac{b}{1-\tau}$, which we may call the after-tax unemployment benefit of domestic workers. The reason for this is that the profitability of offshoring depends on the total available rents that the monopoly union can extract from the firm. Using equation (2.14) we can determine the union's optimal wage response to offshoring:

$$\frac{dw}{d\tilde{z}} = \frac{\left(\frac{b}{1-\tau} - w\right)\gamma\left(\tilde{z}\right)}{\int_{0}^{\tilde{z}}\gamma\left(z\right)dz} < 0 \tag{2.15}$$

where an internal solution requires $w^{n} - b > 0$, which implies $w > \frac{b}{1-\tau}$.

As long as some production of intermediate goods remains in the home-country, the monopoly union is able to extract higher wages under increased offshoring (which corresponds to a fall in $\tilde{z}$) for the remaining employed workers in home country. This mechanism is driven by the fact that offshoring decreases the wage elasticity of labor demand, $\frac{\partial \eta}{\partial \tilde{z}} > 0$, as it leads wage increases to have a smaller effect on marginal production costs and therefore also on domestic employment. The implication from expression (2.15) can easily be summarized in the following proposition:

Proposition 5 *Offshoring increases the domestic union wage rate.*

Based on this finding we continue our comparative static analysis with regard to changes in offshoring opportunities and changes in tax policy.

2.3.4 Labor Taxation of the Government

Let us now consider stage 1 of our proposed sequence of decision making, where the government fixes labor tax parameters τ, to analyze their impact on the domestic labor market. Note that we do not consider a fully balanced government budget owing to the partial equilibrium nature of our analysis, as some sectors may engage in offshoring, but not the whole economy.

Changes in labor tax policy directly affect the wage setting behavior of the monopoly union and thus indirectly affect the offshoring decision of the firm as well. Based on the optimal wage setting behavior of the monopoly union in equation (2.13), it is straightforward to calculate the direct effect of a change in τ on the union wage rate w:

$$\frac{\partial w}{\partial \tau} = \frac{b}{2\left(1-\tau\right)^2} > 0. \tag{2.16}$$

Hence an increase in the marginal labor tax rate results in higher wage demands of the union. The corresponding total effect is given by:

$$\begin{aligned} \frac{dw}{d\tau} &= \frac{\overset{+}{\partial w}}{\partial \tau} + \frac{\bar{dw}}{d\tilde{z}} \frac{\bar{d\tilde{z}}}{d\tau} \\ &= \frac{b}{2\left(1-\tau\right)^2} - \frac{\left(\frac{b}{1-\tau} - w\right)\gamma\left(\tilde{z}\right)}{\int_0^{\tilde{z}} \gamma\left(z\right) dz} \frac{b\gamma\left(\tilde{z}\right)}{\left(\frac{b}{1-\tau} - w^*\right)\left(1-\tau\right)^2 \gamma'\left(\tilde{z}\right)} > 0. \end{aligned} \tag{2.17}$$

From expression (2.17) we can see that the direct effect of a change in τ on the union wage rate is even reinforced by the indirect effect as firms adapt their optimal offshoring decision to the forgone change of the union wage rate. Take for example an increase of the marginal labor tax rate, which leads the monopoly union to demand higher wages. Higher wages create an incentive for offshoring by the firm which in turn leads to even higher wage demands by the union to compensate for the loss of domestic employment. This reinforcement effect due to a rise in τ is the result of the assumed complementary relationship between intermediate goods and therefore does not exist in labor taxation models with horizontal FDI and/or outsourcing, where the indirect effect results in wage moderation rather than wage augmentation.

Based on this knowledge we can now calculate the total effect of a change in τ on domestic labor demand:

$$\begin{aligned} \frac{d}{d\tau} \int_0^{\tilde{z}} L(z) dz &= y\gamma\left(\tilde{z}\right) \frac{\bar{d\tilde{z}}}{d\tau} + \frac{\bar{dy}}{d\tau} \int_0^{\tilde{z}} \gamma\left(z\right) dz \\ &= -y \frac{b\left(\gamma\left(\tilde{z}\right)\right)^2}{\left(\frac{b}{1-\tau} - w^*\right)\left(1-\tau\right)^2 \gamma'\left(\tilde{z}\right)} - \frac{b}{4\beta\left(1-\tau\right)^2} \left(\int_0^{\tilde{z}} \gamma\left(z\right) dz\right)^2 < 0. \end{aligned} \tag{2.18}$$

Given (2.18), we can unambiguously sign the total employment effect of a change in τ: an increase will result in a decline of domestic labor demand for given parameters and vice versa. This finding can be attributed to the aforementioned reinforcement effect regarding the wage setting behavior of the union. Marginal labor tax increases (decreases) have a positive (negative) impact on union wage claims and this wage effect is reinforced as firms adapt their offshoring decision to the change of the wage rate, which can then be directly linked to labor demand.

Proposition 6 *An increase in the marginal labor tax rate leads unambiguously to a decrease in domestic employment in the presence of offshoring.*

2.4 Impact of Labor Taxation and Increased Market Integration on Labor Market Outcomes

In this section we want to analyze how wages and employment in home country are affected when offshoring opportunities improve, for example due to a fall in transportation costs, as a synonym for increased market integration. Total differentiation of equation (2.14) shows that lower transportation costs lead to an expansion of offshoring:

$$\frac{d\tilde{z}}{dt} = \frac{1}{\left(\frac{b}{1-\tau} - w^*\right)\gamma'(\tilde{z})} > 0 \tag{2.19}$$

with $\gamma'(\tilde{z}) > 0$ which can be derived from second-order-condition $\frac{d^2\pi}{d\tilde{z}^2}$. The result that a fall in t leads to more offshoring is intuitively comprehensible as falling transportation costs reduce the unit cost for every offshored intermediate good in foreign country. Graphically, this corresponds to a downward shift of the $w^*\gamma(z) + t$ curve in Figure 2.2 where the new intersection of curves depicts a lower value of $\tilde{z}$.

Given (2.15) and (2.19) we can determine the total effect of a change in t on the union wage rate:

$$\frac{dw}{dt} = \frac{\bar{\partial w}}{\partial t} + \frac{\bar{dw}}{d\tilde{z}}\frac{\overset{+}{d\tilde{z}}}{dt} = -\frac{\frac{1}{2}(1-\tilde{z})}{\int_0^{\tilde{z}}\gamma(z)\,dz} + \frac{\left(\frac{b}{1-\tau} - w\right)\gamma(\tilde{z})}{\int_0^{\tilde{z}}\gamma(z)\,dz}\frac{1}{\left(\frac{b}{1-\tau} - w^*\right)\gamma'(\tilde{z})} < 0. \tag{2.20}$$

The economic mechanism at work in (2.20) is the same as stated in Proposition 1 where a fall in transportation costs simply acts as a factor that triggers a change in $\tilde{z}$ which leads the monopoly union to raise wage demands to compensate for the loss in domestic employment due to increased offshoring.

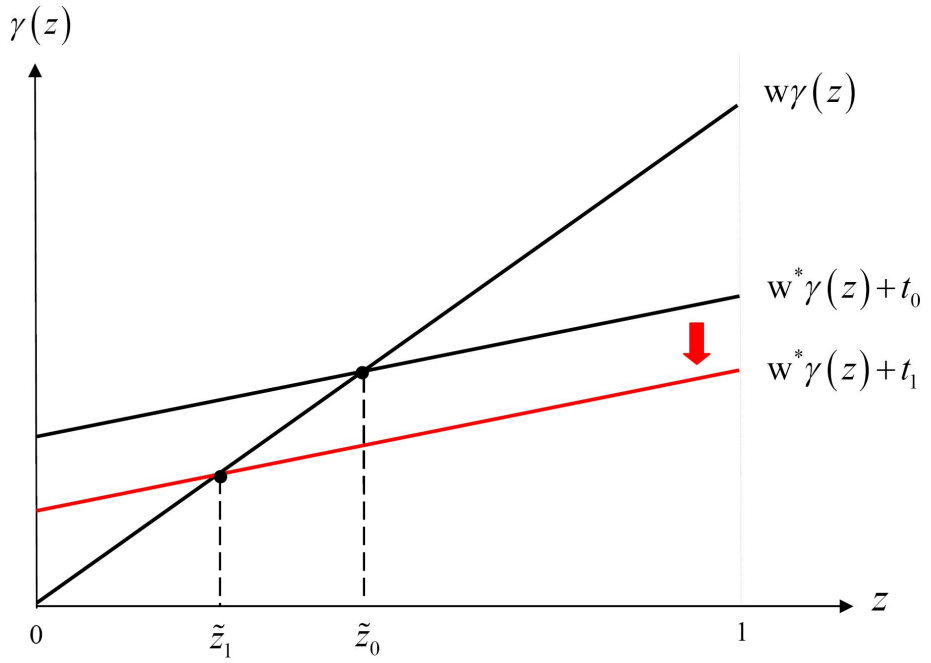


Figure 2.2: Effect of falling transportation costs on the optimal offshoring decision of the firm

The corresponding total effect on output due to a fall in t is given by:

$$\frac{dy}{dt} = -\frac{1}{2\beta}\left(\overset{+}{\frac{\partial c}{\partial t}} + \overset{+}{\frac{\partial c}{\partial \tilde{z}}}\overset{+}{\frac{d\tilde{z}}{dt}} + \overset{+}{\frac{\partial c}{\partial w}}\overset{-}{\frac{dw}{dt}}\right) = -\frac{1}{4\beta}(1-\tilde{z}) < 0. \tag{2.21}$$

We can see from expression (2.21) that falling transportation costs lead to an overall improvement of the cost situation for the firm, which leads to lower prices and thus to more demand and output. The first and second term in the brackets correspond to a reduction in costs by means of a direct and indirect channel, the latter leading to an optimal reallocation of the production structure in terms of offshoring. Both cost reducing effects counteract and exceed the third term in the brackets, a cost increasing effect attributed to higher wage demands of the monopoly union as described in (2.20). The magnitude of (2.21), which we henceforth term *output expanding effect*, depends on the slope of the inverse demand function β as an indicator for market size and the initial degree of $\tilde{z}$. Specifically, this effect is larger when β and $\tilde{z}$ are smaller: a smaller value of β stands for a larger market size, where product demand is more elastic, whereas a smaller initial value of $\tilde{z}$ dampens the wage augmenting effect of the union, as smaller values of $\tilde{z}$

are associated with less labor intensive intermediate goods and thus less replacement of domestic workers with foreign workers.[12]

Continuing our analysis, we learn from (2.21) that

$$\frac{d\pi}{dt} = 2\beta y \frac{\bar{dy}}{dt} = -\frac{1}{2}(1-\tilde{z})\, y < 0, \tag{2.22}$$

meaning that the overall profits of the firm also rise when transportation costs fall. Since the monopoly union holds all bargaining power it is coherent that a rise in profits also beneficial to the union's utility:

$$\frac{d\Omega}{dt} = (b - w^n)\left(\frac{1}{4\beta}(1-\tilde{z})\int_0^{\tilde{z}} \gamma(z)dz + y\gamma(\tilde{z})\right) < 0 \tag{2.23}$$

for given labor tax parameter τ.

In the next step we are interested in how falling transportation costs (and thusa higher degree of offshoring) affect domestic labor demand. The overall effect on domestic labor appears not to be clear-cut as it consists of the sum of two opposing effects:

$$\begin{aligned} \frac{d}{dt}\int_0^{\tilde{z}} L(z)dz &= \overbrace{y\gamma(\tilde{z})\frac{d\tilde{z}}{dt}}^{+} + \overbrace{\int_0^{\tilde{z}} \gamma(z)\, dz\, \frac{dy}{dt}}^{-} \\ &= y\frac{\gamma(\tilde{z})}{\left(\frac{b}{1-\tau} - w^*\right)\gamma'(\tilde{z})} - \frac{1}{4\beta}(1-\tilde{z})\int_0^{\tilde{z}} \gamma(z)\, dz \lesseqgtr 0. \end{aligned} \tag{2.24}$$

The first term corresponds to the direct loss of domestic employment as a result of increased offshoring, whereas the second term is an indirect effect that applies to the aforementioned output expansion in (2.21), which results in a positive effect on domestic employment. Which effect dominates the other depends predominantly on the initial degree of τ and $\tilde{z}$. To understand this and to keep the model tractable, let us assume a spe-

[12] Recall that the monopoly union demands higher wages to compensate for the loss in domestic employment caused by offshoring.

cific function for $\gamma(z)$ that contains the assumption that unit labor requirement increases linearly with z, for simplicity $\gamma(z) = z$. Function (2.24) then takes the form

$$\frac{d}{dt}\int_0^{\tilde{z}} L(z)dz = \frac{1}{8\beta}\left(\tilde{z}\frac{\overbrace{\left(2a - w^*\left(\tilde{z}-1\right)^2\right) - \frac{b}{1-\tau}\left(2-\tilde{z}\right)\tilde{z}}^{+}}{\frac{b}{1-\tau} - w^*} + \overbrace{\left(\tilde{z}-1\right)\left(\tilde{z}\right)^2}^{-}\right). \tag{2.25}$$

The first insight we can gain from (2.25) is that the change in total labor demand in response to a fall in transportation costs does not depend on β (and thus market size). Second, the first term in the brackets of (2.25) stands for the aforementioned direct loss of domestic jobs to foreign country in light of falling transportation costs. This effect is illustrated in Figure 2.3, from which we can infer that the negative substitution effect on domestic labor becomes smaller with lower initial values of $\tilde{z}$ (and thus higher degree of offshoring) as well as higher levels of τ.[13] The linearity of the depicted function(s) can be attributed to our assumption that labor intensity decreases linearly with offshoring. Furthermore, higher levels of taxation induce a lower negative effect on domestic labor for all initial values of $\tilde{z}$ because a higher value of τ is detrimental to both output and the effect of a change in falling transportation costs on offshoring $\frac{d\tilde{z}}{dt}$.[14]

Third, turning to the second term in the brackets of (2.25), we can see that it implies a u-shaped relationship with regard to the indirect labor demand effect of further offshoring and the initial degree of offshoring $\tilde{z}$ in light of falling transportation costs, as depicted in Figure 2.4. This is because the product $\int_0^{\tilde{z}} \gamma(z)\, dz \frac{dy}{dt}$ for given β equals zero at the extreme limits of $z \in [0,1]$, as both terms counteract each other with respect to the initial degree of $\tilde{z}$: recall from equation (2.21) that the magnitude of the output expanding effect $\frac{dy}{dt}$ is larger the smaller the initial value of $\tilde{z}$ (or alternatively the higher the initial degree of offshoring). This means, however, that relatively few domestic workers are involved in the overall production process, measured by the term $\int_0^{\tilde{z}} \gamma(z)\, dz$, which limits the scope

[13] Note that all chosen numerical values in our figures fulfill the internal requirements of the model, namely $y > 0$ and $w > \frac{b}{1-\tau} > w^*$.

[14] Recall from equation (2.19) that the effect of a change in transportation costs on the degree of offshoring is smaller the larger the wage differences between the home country and foreign country for a given tax rate and given labor intensities. An increase in the tax rate, *ceteris paribus*, enforces this effect.

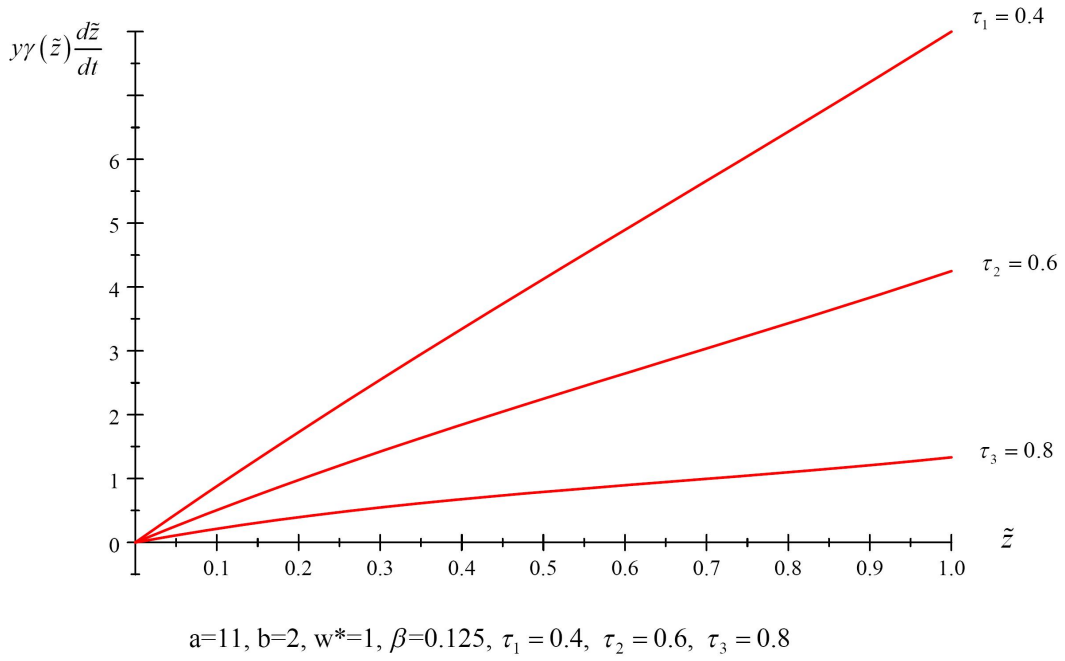


Figure 2.3: Negative effect on domestic labor due to falling trade costs

of the output expanding effect to induce more employment for these workers as offshoring increases even further. The same line of argumentation can be applied to relatively high inital values of $\tilde{z}$, where the scope of the output expanding effect is very high, but the actual magnitude of the output expanding effect very low.

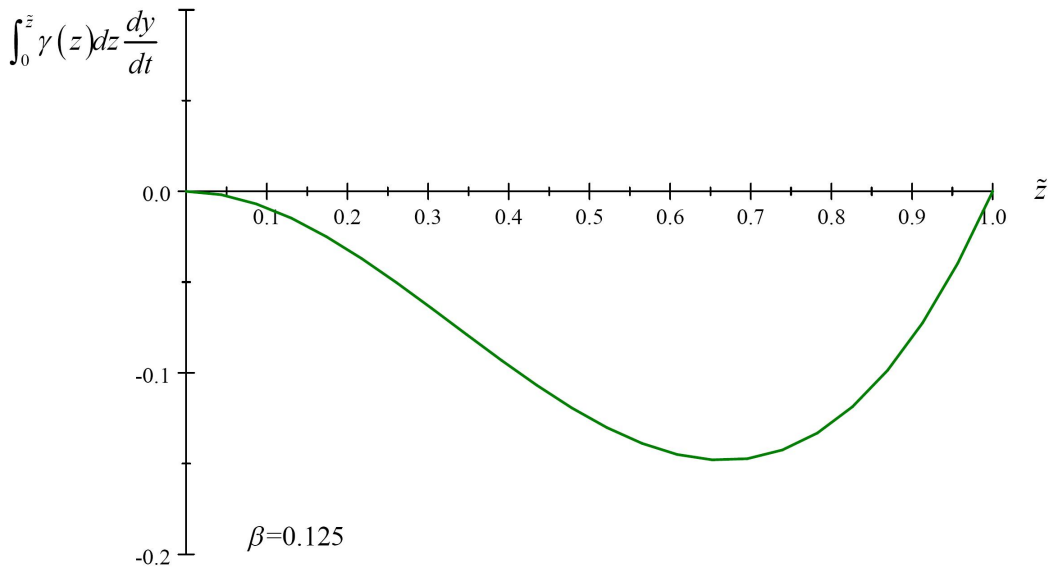


Figure 2.4: Positive effect on domestic labor due to falling trade costs

Now that we have discussed the two opposing effects on domestic labor demand in response to a fall in transportation costs, we can combine these two effects to determine conditions under which the total effect on domestic labor demand is positive and/or negative. It has become apparent from Figure 2.3, that the level of taxation plays an important role to determine the algebraic sign of (2.24).

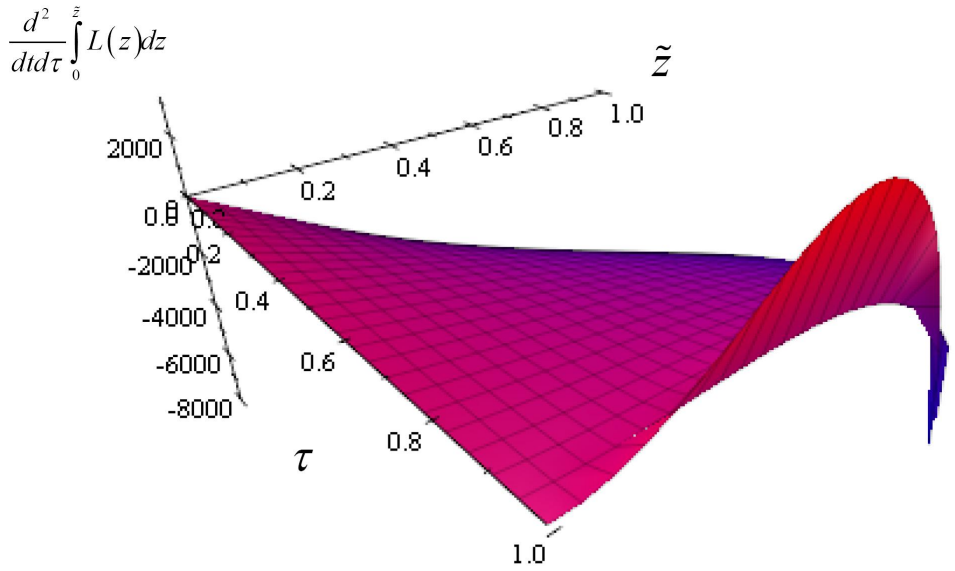
Differentiation of (2.25) with respect to τ yields

$$\begin{aligned}\frac{d^2}{dtd\tau}\int_0^{\tilde{z}} L(z)dz &= \overbrace{\frac{\tilde{z}}{\left(\frac{b}{1-\tau}-w^*\right)}}^{+}\overbrace{\frac{dy}{d\tau}}^{-} + \overbrace{\frac{8y\beta\left(1-\tau\right)+\left(b-w^*\left(1-\tau\right)\right)\left(3\tilde{z}-2\right)\tilde{z}}{8\beta\left(b-w^*\left(1-\tau\right)\right)}}^{+/-}\overbrace{\frac{d\tilde{z}}{d\tau}}^{-} \\ &= b\tilde{z}\frac{\left(b-w^*\left(1-\tau\right)\right)\left(4-5\tilde{z}\right)\tilde{z}-\left(1-\tau\right)\left(2a-w^*\right)}{8\beta\left(1-\tau\right)\left(b-w^*\left(1-\tau\right)\right)^2} \lesseqgtr 0. \qquad (2.26)\end{aligned}$$

Figure 2.5 depicts equation (2.26) on a three-dimensional scale depending on τ and $\tilde{z}$. It is straightforward to check that $\frac{d^2}{dtd\tau}\int_0^{\tilde{z}} L(z)dz$ is negative for most combinations of τ and $\tilde{z}$, especially when $\tilde{z}$ becomes relatively high, but less so with increasing τ, because a higher tax rate decreases the magnitude of $\frac{d\tilde{z}}{dt}$ and therefore negative impact on domestic labor demand in the light of falling transportation costs. Moreover, if the tax rate is relatively high, $\frac{d^2}{dtd\tau}\int_0^{\tilde{z}} L(z)dz$ can turn both positive and negative depending on the initial degree of offshoring.

Proposition 7 *A negative effect on domestic labor associated with increased offshoring is more likely the lower the marginal tax rate and the lower the initial degree of offshoring. A government can cushion this negative effect on domestic labor by raising the marginal tax rate. If the tax rate is sufficiently high, increased offshoring may even induce a raise in domestic labor demand, depending on the initial degree of offshoring.*

Our result that higher taxation can be benefical to domestic employment stands in constrast to our finding in Section 2.3.4, where we asserted a negative relationship between taxes and employment. This apparent contradiction is put into perspective when we recall that the tax-employment assertion of Proposition 3 essentially constitutes a best-response reaction when the government is confronted with increased offshoring, triggered by a fall in transportation costs, to ease the negative effect on domestic labor.



a=21, b=2, w*=1, β=0.001

Figure 2.5: Influence of taxation on the total change of domestic labor demand when trade costs fall

This stands in contrast to a situation, where the government may choose to raise the marginal tax rate for a given level of offshoring, thereby setting a mechanism in motion that results in less domestic labor demand (higher taxes induce the trade union to demand higher wages which creates an incentive for more offshoring which leads the union to demand even higher wages).

Figure 2.6 depicts the situation where total domestic labor may increase or decline in response to a change in t, based on the assumption that the marginal tax rate is sufficiently high. The analytical solutions for those initial values of $\tilde{z}'$ where a fall in transportation costs has no effect on domestic labor demand with $\frac{d}{dt}\int_0^{\tilde{z}} L(z)dz = 0$ are given by:

$$\begin{aligned} \tilde{z}_1' &= 0, \\ \tilde{z}_2' &= \frac{3}{4} - 2\sqrt{\frac{\left(\frac{9b}{1-\tau} - 16a - w^*\right)}{64\left(\frac{b}{1-\tau} - w^*\right)}}, \\ \tilde{z}_3' &= 2\sqrt{\frac{\left(\frac{9b}{1-\tau} - 16a - w^*\right)}{64\left(\frac{b}{1-\tau} - w^*\right)}} + \frac{3}{4}, \end{aligned} \tag{2.27}$$

where $\tau > 1 - \frac{9b}{16a+w^*}$ constitutes a mathematical requirement, which translates into a relatively high tax rate. Otherwise $\frac{d}{dt}\int_0^{\tilde{z}} L(z)dz$ is positive for all initial values $\tilde{z}'$. Furthermore, to accomodate the assumption that $z \in [0,1]$, sufficient conditions $a > \frac{1}{2}w^*$ and $a > \frac{1}{2}\left(\frac{b}{1-\tau}\right)$ must be fulfilled for $\tilde{z}_2' > 0$ and $\tilde{z}_3' < 1$ as $\tilde{z}_2' < \tilde{z}_3'$ in absolute terms.

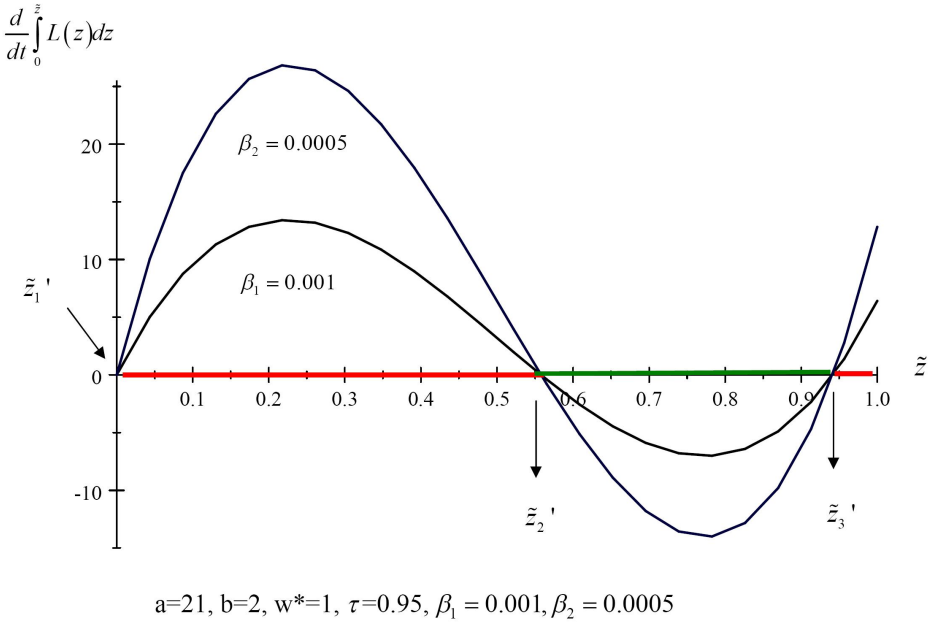


Figure 2.6: Total change in domestic labor demand due to fall in trade costs for a sufficiently high tax rate

Differentiation of $\frac{d}{dt}\int_0^{\tilde{z}} L(z)dz$ with respect to $\tilde{z}$ yields a maximum and minimum point at

$$\tilde{z}_1^* = \frac{b - w^*(1-\tau) - \frac{1}{3}\sqrt{3}\sqrt{(b - w^*(1-\tau))(3b - (1-\tau)(4a + w^*))}}{2(b - w^*(1-\tau))}, \tag{2.28}$$

$$\tilde{z}_2^* = \frac{b - w^*(1-\tau) + \frac{1}{3}\sqrt{3}\sqrt{(b - w^*(1-\tau))(3b - (1-\tau)(4a + w^*))}}{2(b - w^*(1-\tau))} \tag{2.29}$$

where the second order conditions are fulfilled as $\frac{d^2\int_0^{\tilde{z}} L(z)dz}{dtd\tilde{z}}(\tilde{z}_1^*) < 0$ and $\frac{d^2\int_0^{\tilde{z}} L(z)dz}{dtd\tilde{z}}(\tilde{z}_2^*) > 0$.[15]

[15]Proof can be found in the Appendix.

Using equations (2.27) - (2.29), we find formal proof that $\tilde{z}_1' < \tilde{z}_1^* < \tilde{z}_2' < \tilde{z}_2^* < \tilde{z}_3'$. The distance between $\tilde{z}_2'$ and $\tilde{z}_3'$ represents the bandwith of initial values of $\tilde{z}$, where the output expanding effect dominates over the negative substitution effect of labor. Thus if the initial degree of offshoring lies between $\tilde{z}_2'$ and $\tilde{z}_3'$, a fall in transportation costs will induce an increase in total labor demand. The reverse argumentation applies to all other initial values of $\tilde{z}$. This result is interesting in the sense that this scenario allows for several cut-off points that induce a change in total domestic labor demand. Other wage bargaining models that analyze the impact of increased offshoring on domestic labor demand usually feature only one cut-off point.[16]

Proposition 8 *If product demand is elastic and the tax rate sufficiently high, total labor demand will decrease for relatively high and low values of initial offshoring and increase for these values of $\tilde{z}$ in between.*

Furthermore, it is worth noting that exogenous changes in the parameters inherent in $\tilde{z}_2'$ and $\tilde{z}_3'$ lead to an overall widening or shrinking of the above-mentioned bandwith of initial $\tilde{z}$ values:[17]

$$\frac{\partial \tilde{z}_2'}{\partial b} < 0, \qquad \frac{\partial \tilde{z}_2'}{\partial w^*} > 0, \qquad \frac{\partial \tilde{z}_2'}{\partial \tau} < 0, \tag{2.30}$$

$$\frac{\partial \tilde{z}_3'}{\partial b} > 0, \qquad \frac{\partial \tilde{z}_3'}{\partial w^*} < 0, \qquad \frac{\partial \tilde{z}_3'}{\partial \tau} > 0.$$

We can summarize the implications of (2.30) in the following way: factors that decrease the magnitude of the negative effect on domestic labor which corresponds to an increase in b and τ or a decrease in w^*, lead to a widening of the bandwith of initial values of $\tilde{z}$ that represents the domination of the output expanding effect over the negative substitution effect of labor (assuming that the tax rate is sufficiently high to have an ambiguous effect

[16] Lommerud et. al (2009), for example, find that increased offshoring has a positive effect on labor demand if the initial share of offshoring is relatively low, but this positive labor demand diminishes into negativity with continued offshoring. It is also worth noting that they use the term *outsourcing* for the relocation of production inputs to a foreign country in their model, which falls under our definition of offshoring.

[17] See the Appendix.

on total labor demand). The result is, *ceteris paribus*, an increase in the likeliness that a fall in t will increase total domestic labor demand depending on initial value of $\tilde{z}$.

Our consideration of a unionized labor market that is affected by offshoring affirms the general notion that a reduction in progressivity-neutral labor taxation has a positive effect on employment. This effect is not so clearly unambiguous in models that include horizontal FDI or outsourcing as labor taxation may lead to wage moderation in these kind of models which is not the case in our framework.

2.5 Conclusion

We have analyzed the implications of improved offshoring opportunities and labor taxation on wages and employment in a unionized labor market. The main results can be summarized in the following way: First, offshoring leads trade unions to demand higher wages as compensation for the loss in domestic employment. Second, an increase in the marginal tax rate leads unambiguously to a decrease in labor demand. This is because higher taxes bring about higher wage demands by the trade union and firms react to this change by expanding their offshoring activities, which induces trade unions to demand even higher wages. Third, falling transportation costs create an incentive for firms to expand their offshoring activities. Offshoring may have a positive and negative effect on domestic employment depending on the initial degree of offshoring and the tax rate. The negative effect is the direct result of the offshoring-induced export of domestic jobs to the foreign country, whereas a positive effect may occur due to an output expanding effect as falling transportation costs improve the cost structure of the firm, which lowers prices and thus increases product demand. If product demand is elastic and the tax rate sufficiently high, labor demand is likely to decrease for relatively high and low values of initial offshoring and likely to increase for initial offshoring values in between. Fourth, the government can counteract a potential negative labor demand effect when being confronted with increased offshoring. On a more general level we can confirm that the consideration of offshoring in a framework with unionized labor does not alter the general notion that a reduction in progressivity-neutral labor taxation has a positive effect on employment.

Appendix

Long-term trend in the overall tax ratio in % of GDP for the EU

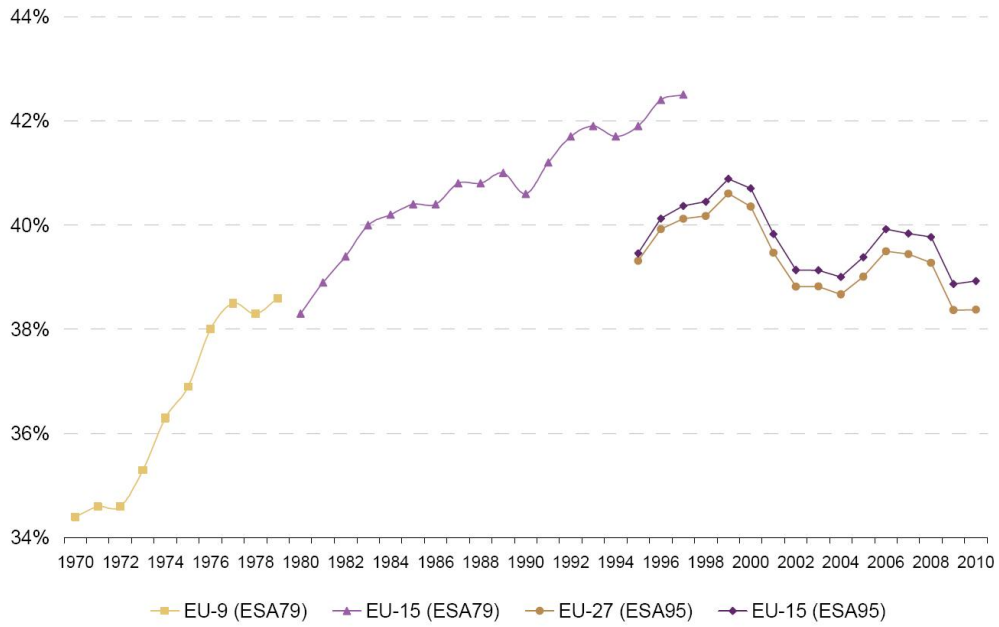


Figure A.1: Long-term trend in the overall tax ratio (including social security contributions) in % of GDP for the EU

Note *This figure is extracted from European Commission (2012). The statistical break is due to the change from ESA79 to ESA95 (European system of national and regional accounts).*

Proof of maximum and minimum with regard to the total change in domestic labor for a fall in transportation costs

The first and second derivatives of equation (2.25) with respect to $\tilde{z}$ are given by:

$$\frac{d\int_0^{\tilde{z}} L(z)dz}{dtd\tilde{z}} = \frac{6\tilde{z}\left(1-\tilde{z}\right)\left(b-w^*\left(1-\tau\right)\right)-\left(1-\tau\right)\left(2a-w^*\right)}{8\beta\left(b-w^*\left(1-\tau\right)\right)}, \tag{2.31}$$

$$\frac{d^2\int_0^{\tilde{z}} L(z)dz}{dtd\tilde{z}} = \frac{1}{4\beta}\left(6\tilde{z}-3\right). \tag{2.32}$$

Inserting the critical points (2.28) and (2.29) where $\frac{d\int_0^{\tilde{z}} L(z)dz}{dtd\tilde{z}} = 0$ yields the second order conditions for a maximum and minimum with:

$$\frac{d^2\int_0^{\tilde{z}} L(z)dz}{dtd\tilde{z}}(\tilde{z}_1^*) = -\frac{\sqrt{3\left(b-w^*\left(1-\tau\right)\right)\left(3b-\left(1-\tau\right)\left(4a+w^*\right)\right)}}{4\beta\left(b-w^*\left(1-\tau\right)\right)} < 0, \quad (2.33)$$

$$\frac{d^2\int_0^{\tilde{z}} L(z)dz}{dtd\tilde{z}}(\tilde{z}_2^*) = \frac{\sqrt{3\left(b-w^*\left(1-\tau\right)\right)\left(3b-\left(1-\tau\right)\left(4a+w^*\right)\right)}}{4\beta\left(b-w^*\left(1-\tau\right)\right)} > 0 \quad (2.34)$$

with $\tau > 1 - \frac{3b}{(4a+w^*)}$ as mathematical requirement.

Comparative static analysis

It is straightforward to obtain the effects of changes in a, τ, w^*, $\tilde{z}$, b and t on the optimal union wage:

$$\begin{aligned}
\frac{\partial w}{\partial a} &= \frac{1}{2\int_0^{\tilde{z}}\gamma\left(z\right)dz} > 0,\\
\frac{\partial w}{\partial \tau} &= \frac{b}{2\left(1-\tau\right)^2} > 0,\\
\frac{\partial w}{\partial w^*} &= \frac{\gamma\left(\tilde{z}\right)}{2\int_0^{\tilde{z}}\gamma\left(z\right)dz} > 0,\\
\frac{\partial w}{\partial b} &= \frac{1}{2\left(1-\tau\right)} > 0,\\
\frac{\partial w}{\partial t} &= -\frac{\frac{1}{2}\left(1-\tilde{z}\right)}{\int_0^{\tilde{z}}\gamma\left(z\right)dz} < 0,\\
\frac{\partial w}{\partial \tilde{z}} &= \frac{\left(1-\tau\right)\left(w^*\gamma\left(\tilde{z}\right)+t\right)+b\gamma\left(\tilde{z}\right)-2\left(1-\tau\right)\gamma\left(\tilde{z}\right)w}{2\left(1-\tau\right)\int_0^{\tilde{z}}\gamma\left(z\right)dz} \lessgtr 0.
\end{aligned} \quad (2.35)$$

All derivatives have the expected sign. The effect of $\tilde{z}$ on the optimal wage appears at first glance ambiguous but can be determined when inserting the equilibrium condition for optimal offshoring as given in (2.14):

$$\frac{dw}{d\tilde{z}} = \frac{\left(\frac{b}{1-\tau}-w\right)\gamma\left(\tilde{z}\right)}{\int_0^{\tilde{z}}\gamma\left(z\right)dz} < 0 \quad (2.36)$$

as necessary condition requires $w > \frac{b}{1-\tau}$. Total differentiation of (2.14) yields:

$$\frac{d\tilde{z}}{dt} = \frac{1}{\left(\frac{b}{1-\tau} - w^*\right)\gamma'(\tilde{z})} > 0, \tag{2.37}$$

$$\frac{d\tilde{z}}{d\tau} = -\frac{b\gamma(\tilde{z})}{\left(\frac{b}{1-\tau} - w^*\right)(1-\tau)^2\gamma'(\tilde{z})} < 0. \tag{2.38}$$

Furthermore, the cutoff points where a fall in transportation costs has no effect on total domestic labor demand are given by

$$\begin{aligned} \tilde{z}_1' &= 0, \\ \tilde{z}_2' &= \frac{3}{4} - 2\sqrt{\frac{\left(\frac{9b}{1-\tau} - 16a - w^*\right)}{64\left(\frac{b}{1-\tau} - w^*\right)}}, \\ \tilde{z}_3' &= 2\sqrt{\frac{\left(\frac{9b}{1-\tau} - 16a - w^*\right)}{64\left(\frac{b}{1-\tau} - w^*\right)}} + \frac{3}{4}. \end{aligned} \tag{2.39}$$

Differentiation of $\tilde{z}_2'$ and $\tilde{z}_3'$ with respect to b, w^* and τ gives:

$$\frac{\partial \tilde{z}_2'}{\partial b} = -\frac{(1-\tau)}{8\Delta}\frac{2a-\omega}{(b-\omega(1-\tau))^2} < 0, \qquad \frac{\partial \tilde{z}_2'}{\partial w^*} = \frac{(1-\tau)}{8\Delta}\frac{2a(1-\tau)-b}{(b-\omega(1-\tau))^2} > 0,$$
$$\frac{\partial \tilde{z}_2'}{\partial \tau} = -\frac{b}{8\Delta}\frac{2a-\omega}{(b-\omega(1-\tau))^2} < 0,$$

$$\frac{\partial \tilde{z}_3'}{\partial b} = \frac{(1-\tau)}{8\Delta}\frac{2a-\omega}{(b-\omega(1-\tau))^2} > 0, \qquad \frac{\partial \tilde{z}_3'}{\partial w^*} = -\frac{(1-\tau)}{8\Delta}\frac{2a(1-\tau)-b}{(b-\omega(1-\tau))^2} < 0,$$
$$\frac{\partial \tilde{z}_3'}{\partial \tau} = \frac{b}{8\Delta}\frac{2a-\omega}{(b-\omega+\tau\omega)^2} > 0, \tag{2.40}$$

where $\Delta \equiv \sqrt{\frac{\left(\frac{9b}{1-\tau}-16a-w^*\right)}{64\left(\frac{b}{1-\tau}-w^*\right)}}$.

Chapter 3

Pattern Bargaining and FDI

3.1 Introduction

Pattern bargaining has been a long-observed phenomenon since the aftermath of World War II and refers to a wage negotiation practice that is used by industry-wide trade unions to determine wages. The procedural method of pattern bargaining implies a sequential course of action, where the union first chooses a target firm to negotiate a wage rate. This outcome then serves as a pattern for all subsequent negotiations where, in a strict sense, the union makes a take-it-or-leave-it offer to the remaining firms or where, in a more loose sense, the agreed upon wage rate with the target firm serves as a precedent. When the strict form of pattern bargaining applies and there is agreement among all participants (enforced through strikes if necessary), uniform wage rates across firms are the result. The economic reasoning as to why trade unions might prefer pattern bargaining over other bargaining arrangements can be explained by the so-called 'taking labor out of competition' argument: unionized firms in oligopolistic markets usually have an incentive to bargain hard on wages, since lower wages constitute a competitive advantage over market competitors. Pattern bargaining, however, takes the edge out of this incentive, as wage concessions become more acceptable when all other firms agree to them as well, which is in the interest of the union.

On an empirical level, pattern bargaining has been most notably a feature of U.S. collective bargaining in oligopolistic industries such as automobiles, steel and aerospace,

but can to some extent be observed in collective bargaining arrangements in Western European countries such as Austria, Denmark, Germany, Norway and Sweden as well. In the case of Germany, for example, area-wide wage agreements (*Flächentarifverträge*) constitute the counterpart to pattern bargaining in the aforementioned strict sense, whereas company-wide collective wage agreements (*Firmentarifverträge*) or so-called 'me too agreements' (where firms voluntarily agree to terms and wages negotiated by other firms) can be counted to the more loose interpretation of pattern bargaining. Empirical research suggests that pattern bargaining still plays a substantial role in unionized labor markets, but that the phenomenon itself has experienced a declining trend in magnitude.[1] Parallel to this trend has been a tendency towards 'organized decentralization' in most European countries, leading to more collective agreements on a more decentralized level with individual firms.[2]

Given the fact that pattern bargaining constitutes a long-observed ongoing phenomenon, it is somewhat surprising that economic research on this topic is quite rare. The aim of our paper is therefore to enrich this strand of literature by widening the point of view on pattern bargaining in terms of horizontal FDI. Our framework builds on Dobson (1994) and Marshall and Merlo (2004), which can be considered as the first basic research on pattern bargaining with a concrete modeling approach. Dobson (1994) compares simultaneous to sequential wage bargaining scenarios in a model that includes an industry-wide union and two firms competing in cournot fashion with each other. His findings suggest that sequential bargaining leads to asymmetric wage rates caused by the differences in the union's disagreement payoff at each bargaining stage, where the bargaining power is higher in the successive bargain. Marshall and Merlow (2004) expand this framework by allowing for uniformity in wages (or alternatively in costs) across firms, which corresponds to our understanding of pattern bargaining in the aforementioned 'strict sense'. They show that pattern bargaining is preferred by the union over all other bargaining scenarios, but simultaneously raise the question of why firms agree to pattern bargaining in the first place, as each of the considered two firms prefer a different bargaining environment compared to pattern bargaining. Creane and Davidson (2011) pick up on

[1] See, for example, Seltzer (1951), Levinson (1960), Freedman and Fulmer (1982) for empirical and anecdotal evidence.

[2] See, for example, Traxler (1995), Sisson and Marginson (2002) and Ochel (2005).

this issue by introducing uncertainty over productivity in their model to create instances where both the union and firms prefer pattern bargaining over sequential bargaining.

What the three aforementioned papers have in common is that they take an autarkic viewpoint only. To the best of our knowledge, there exists only one contribution by Calmfors and Larsson (2011) that takes on a modeling approach with pattern bargaining in a small open economy, yet their research question is focused on different monetary regimes. The novelty of our paper lies in the introduction of FDI into a model of pattern bargaining, thereby building on the idea that FDI endows firms with an outside option in case wage negotiations fail, which strengthens their bargaining position. This effect has been neglected in the pattern bargaining literature so far. Moreover, we distinguish bargaining environments where the union may or may not be endowed with an outside option in case wage negotiations fail. This serves the purpose of allowing implications to be drawn regarding the influence of the degree of collective bargaining centralization on labor market outcomes under pattern bargaining: the case of no outside option for the union implies that the union has everything to lose or gain depending on the success of wage negotiations. This wage bargaining arrangement could, for example, be enforced by an employers' association, so that this case implies a more centralized bargaining environment like in the case of area-wide wage agreements in Germany. In contrast, a positive outside option for the union can arise if the union can reach an agreement with one firm even if wage negotiations fail with another. This corresponds to the case of a more decentralized bargaining environment on the basis of firm-level collective wage agreements, for example. Another important feature of our model is based on an assumed asymmetry in firms' capabilities to undertake FDI; namely, that firm 1 possesses the option of FDI whereas firm 2 does not. This allows us to distinguish cases where the union might prefer one or the other firm to take on the target role.

Our main findings are the following: First, FDI lowers the union's wage rate compared to the autarkic case under pattern bargaining. This is because FDI enables firms to produce output from abroad when the union decides to go on strike in the firm's domestic country, which represents a credible threat and therefore better bargaining position during wage negotiations. Second, we find that the union is always better off in a more decentralized bargaining environment which allows for a positive conflict payoff. The economic reason

for this result goes beyond the argument that a positive conflict payoff improves the bargaining position of the union, because it alters the conflict payoff to the firm as well. A positive conflict payoff to the union implies that a firm still remains active in the market even when the wage negotiation with another firm fails. This other firm will consequently produce output from abroad to serve the domestic market yet the corresponding conflict payoff is now based on less market share, because the other domestic firm prevails in the market. This mechanism that enhances the outside option of the union can offer an explanation for the trend towards collective bargaining agreements on a more decentralized level. Third, given the choice, the union prefers the domestic rather than the multinational firm to be the target firm. This result can be attributed to the specific procedure that is attributed to pattern bargaining. Recall that negotiations with the target firm result in a wage rate that becomes mandatory for the entire industry. If the solely domestically active firm takes on the role of the target firm, FDI finds no entrance into the wage negotiations and the other multinational firm must accept the resulting wage rate without playing out its FDI option. Last but not least, we find that pattern bargaining is more beneficial to all participating firms if the multinational firm carries out the role of the target firm. This effect is strengthened when the union possesses no conflict payoff.

The remainder of this paper is given as follows: In Section 2, we introduce the basic framework of our model. In Section 3 we analyze different bargaining environments (namely simultaneous and pattern bargaining) depending on different conflict payoffs to the union under autarky. The fourth and final section builds upon the main part of our model with the consideration of FDI under different pattern bargaining regimes. Concluding remarks are offered in Section 5.

3.2 Basic Model

In this section we introduce the basic model of our analysis which is a simplified version of the Marshall and Merlo (2004) framework with similar notation and assumptions regarding functional forms.[3] At the starting point we consider an industry where two firms produce a homogenous good using the same technology which exhibits constant returns to scale. The firms are exposed to Cournot competition with inverse linear demand given by

$$p_i(x_i, x_j) = a - x_i - x_j, \qquad i, j = 1, 2,\ i \neq j \tag{3.1}$$

where $a > 0$. Labor is assumed to be the only factor of production with marginal product of labor equalling one such that $x_1 = l_1$ and $x_2 = l_2$. All workers at each firm are represented by the same industry-wide trade union so that the wage rate w_i paid by each firm is determined via bargaining in a right-to-manage manner, meaning that the union wage rate is determined first with firms subsequently choosing output and thus employment according to their profit-maximization scheme. The profit function of the ith firm equals

$$\pi_i = (a - x_i - x_j)\, x_i - w_i l_i, \qquad i, j = 1, 2,\ i \neq j \tag{3.2}$$

from which we can deduct the standard Cournot-Nash equilibrium result for output and employment

$$x_i(w_i, w_j) = l_i = \frac{a + w_j - 2w_i}{3}, \qquad i, j = 1, 2,\ i \neq j \tag{3.3}$$

as well for profits

$$\pi_i(w_i, w_j) = \frac{(a + w_j - 2w_i)^2}{9}, \qquad i, j = 1, 2,\ i \neq j. \tag{3.4}$$

Note that if firm i were to operate in the considered market as a monopolist, optimal

[3] We keep the model simple by abstracting from variables such as the degree of substitutability between products and differences in firm efficiency in order to focus on the influence of FDI on market outcomes in different bargaining environments.

output and profit levels would amount to

$$x_i^m(w_i) = l_i^m = \frac{a - w_i}{2}, \qquad i = 1, 2 \tag{3.5}$$

and

$$\pi_i^m(w_i) = \frac{1}{4}(a - w_i)^2, \qquad i = 1, 2 \tag{3.6}$$

for given wage rate w_i. Turning our attention back to the industry-wide union, its utility is characterized by the wage bill maximizing function

$$\Omega_u(w_1, w_2) = w_1 l_1(w_1, w_2) + w_2 l_2(w_1, w_2). \tag{3.7}$$

Using equations (3.4) and (3.5) we can go on to model the wage negotiation process between the union and firm i in form of a Nash bargaining problem to find a Nash solution to

$$w_i^* = \arg\max_{w_i} \left[\Omega_u(w_i, w_j^*) - d_i\right] \cdot \left[\pi_i(w_i, w_j^*) - \Psi_i\right], \quad i, j = 1, 2,\ i \neq j \tag{3.8}$$

where w_j^* represents the equilibrium wage rate paid by the other firm and where d_i and Ψ_i denote the outside-option of the union and firm i, respectively. Positive outside-options represent a fallback-position if negotiations fail and are therefore beneficial for the bargaining position of the corresponding negotiation party.

In the next step we apply the Nash bargaining concept to different bargaining environments both under autarky and horizontal FDI, while considering different outside options for the union and each firm. With regard to bargaining environments, we distinguish between two cases where negotiations are conducted either (a) simultaneously or (b) in sequence using the so-called 'pattern bargaining in wages' approach, where the union bargains over a wage rate with a target firm and the outcome of this first negotiation round becomes binding to the remaining firm.[4] Furthermore, with regard to outside option d_i,

[4] See Marshall and Merlo (2004).

we adopt the idea expressed in Dobson (1994), that the union's payoff in case of disagreement depends on the structural wage bargaining arrangements within the industry. If, for example, firms agree beforehand on a cooperative bargaining strategy such as to hold off production until a wage agreement is reached for all firms, the disagreement payoff and thus outside-option of the union equals $d_i = 0$. This scenario appears plausible in the presence of an employers' association in more centralized bargaining systems for example. If wage bargaining takes place on a more decentralized level, the union might find a wage agreement with a firm that is willing to produce output even in the event of disagreement with the other firm, in which case the disagreement payoff to the union becomes positive $d_i > 0$. With regard to the outside option of the firm(s), we allow for the distinction betweeen autarky and FDI. The option of FDI enables firms to produce output abroad to serve the considered market in the event of a domestic strike, which strengthens the firms' bargaining position such that $\Psi_i > 0$. This flexibility in production is not given under autarky so that firms earn zero profits in case of disagreement implying $\Psi_i = 0$. Note that we allow for an asymmetry in the firms' ability to conduct FDI in our model, thereby accomodating the empirical observation that some firms engage in international activities and others do not.

3.3 Autarky

3.3.1 Simultaneous Bargaining without Outside Option (A)

The first bargaining environment to be considered concerns simultaneous bargaining as a benchmark case where both firms bargain with the trade union simultaneously. We additonally assume for this section that the conflict payoff to the union equals zero with $d_i = 0$, which leaves the union with no outside-option. The equilibrium union wage rates under this scenario are determined by solving the following system of equations:

$$\begin{aligned} w_1^{A^*} &= \arg\max_{w_1} \left[\Omega_u(w_1, w_2^{A^*})\right] \cdot \left[\pi_1(w_1, w_2^{A^*})\right], \\ w_2^{A^*} &= \arg\max_{w_2} \left[\Omega_u(w_1^{A^*}, w_2)\right] \cdot \left[\pi_2(w_1^{A^*}, w_2)\right]. \end{aligned} \tag{3.9}$$

which due to the simultaneous nature of the bargaining arrangement is based on the anticipated equilibrium wage rate w_j^{A*} with $i, j = 1, 2$, $i \neq j$. The first-order condition for (3.9) yields

$$w_1^{A^*} = \frac{1}{16}\left(5a + 8w_2^{A^*} - \sqrt{3}\sqrt{32w_2^{A^*}\left(a - w_2^{A^*}\right) + 3a^2}\right) \tag{3.10}$$

and

$$w_2^{A^*} = \frac{1}{16}\left(5a + 8w_1^{A^*} - \sqrt{3}\sqrt{32w_1^{A^*}\left(a - w_1^{A^*}\right) + 3a^2}\right) \tag{3.11}$$

for each firm respectively. By combining the first order conditions with each other and keeping in mind that we can apply the symmetry assumption on the two firms, we obtain the equilibrium wage rates as a function of the parameters in our model:

$$w_1^{A^*} = w_2^{A^*} = \frac{1}{10}a. \tag{3.12}$$

Inserting the equilibrium wage rates into (3.3) and (3.4) gives the equilibrium output and profit levels:

$$x_1^{A^*} = l_1^{A^*} = x_2^{A^*} = l_2^{A^*} = \frac{3}{10}a, \tag{3.13}$$

$$\pi_1^{A^*} = \pi_2^{A^*} = \frac{9}{100}a^2. \tag{3.14}$$

Moreover we can obtain the equilibrium value for the utility of the union from (3.12) and (3.13):

$$\Omega_u(w_1^{A^*}, w_2^{A^*}) = \frac{3}{50}a^2 \tag{3.15}$$

3.3.2 Simultaneous Bargaining Based on Monopoly Levels ($\mathbf{A^m}$)

The bargaining environment in this section is closely related to Section 3.3.1, the only difference being that we allow for a positive conflict payoff $d_i > 0$. In case of disagreement

between the union and firm i, the conflict payoff to the union is assumed to equal the wage bill that results when the other firm j remains in the market to operate as a monopolist given the anticipated equilibrium wage rate $w_j^{A^{m*}}$ with $i, j = 1, 2$, $i \neq j$. Consequently, we now solve for

$$\begin{aligned} w_1^{A^{m*}} &= \arg\max_{w_1} \left[\Omega_u(w_1, w_2^{A^{m*}}) - w_2^{A^{m*}} l_2^m \left(w_2^{A^{m*}}\right)\right] \cdot \left[\pi_1(w_1, w_2^{A^{m*}})\right], \\ w_2^{A^{m*}} &= \arg\max_{w_2} \left[\Omega_u(w_1^{A^{m*}}, w_2) - w_1^{A^{m*}} l_1^m \left(w_1^{A^{m*}}\right)\right] \cdot \left[\pi_2(w_1^{A^{m*}}, w_2)\right]. \end{aligned} \tag{3.16}$$

The corresponding first-order conditions are given by

$$w_1^{A^{m*}} = \frac{1}{8}\left(a + 4w_2^{A_m^*}\right) \tag{3.17}$$

and

$$w_2^{A^{m*}} = \frac{1}{8}\left(a + 4w_1^{A^{m*}}\right), \tag{3.18}$$

from which we obtain the equilibrium wage rates:

$$w_1^{A^{m*}} = w_2^{A^{m*}} = \frac{1}{4}a. \tag{3.19}$$

The equilibrium output and profit levels equal

$$x_1^{A^{m*}} = l_1^{A^{m*}} = x_2^{A^{m*}} = l_2^{A^{m*}} = \frac{1}{4}a, \tag{3.20}$$

$$\pi_1^{A^{m*}} = \pi_2^{A^{m*}} = \frac{1}{16}a^2. \tag{3.21}$$

The utility of the union in equilibrium is given by

$$\Omega_u(w_1^{A^{m*}}, w_2^{A^{m*}}) = \frac{1}{8}a^2. \tag{3.22}$$

A quick comparison between bargaining environments A and A^m reveals the intuitive result that the trade union is better off when being endowed with a positive conflict payoff $d_i > 0$: wages and consequently union utility are higher under A^m, while firms face lower profits under A^m compared to A.

3.3.3 Pattern Bargaining without Outside Option (B)

This bargaining environment corresponds to the aforementioned situation where the union chooses a target firm to negotiate a common wage rate for the whole industry, based on the underlying assumption that the non-target firm accepts or commits to the wage rate negotiated by the target firm in a take-it-or-leave manner. Under autarky, the symmetry of the two firms ensures identical results under pattern bargaining independent of which firm is selected as target firm. Thus we can determine the equilibrium values by solving

$$\begin{aligned} w_i^{B^*} &= \arg\max_w \left[\Omega_u(w,w)\right] \cdot \left[\pi_i(w,w)\right], \\ w_j^{B^*} &= w_i^{B^*} \end{aligned} \tag{3.23}$$

with $i, j = 1, 2$, $i \neq j$. This yields

$$w_1^{B^*} = w_2^{B^*} = \frac{1}{4}a \tag{3.24}$$

as equilibrium wage rates under pattern bargaining without outside option. Plugging (3.24) into (3.3) and (3.4) gives

$$x_1^{B^*} = l_1^{B^*} = x_2^{B^*} = l_2^{B^*} = \frac{1}{4}a, \tag{3.25}$$

$$\pi_1^{B^*} = \pi_2^{B^*} = \frac{1}{16}a^2 \tag{3.26}$$

for equilibrium output, employment and profits. Union utility in equilibrium amounts to

$$\Omega_u(w_1^{B^*}, w_2^{B^*}) = \frac{1}{8}a^2. \tag{3.27}$$

At this instance it is worthwhile to note that the results obtained in this section are identical to those obtained from bargaining environment A^m (simultaneous bargaining based on monopoly levels), implying that the trade union is equally well off under pattern bargaining even if no conflict payoff is granted compared to the situation of simultaneous bargaining where a positive conflict payoff is part of the assumed bargaining environment. Comparison of bargaining environments A and B, both cases with $d_i = 0$, reveals an even more clear incentive for the union to prefer pattern bargaining over simultaneous bargaining.

3.3.4 Pattern Bargaining Based on Monopoly Levels ($\mathbf{B^m}$)

Similar to Section 3.3.2, we supplement bargaining environment B with a positive conflict payoff to the union. This conflict payoff comes into play when disagreement springs between the union and firm i during wage negotiations and builds on monopoly values with regard to firm j. We can again neglect the question which firm is selected as target firm as the assumed symmetry of the firms holds for this case as well. The equilibrium wage rates are solutions to

$$\begin{aligned} w_i^{B^{m*}} &= \arg\max_w \left[\Omega_u(w,w) - w_j^{m*} l_j^{m*}\left(w_j^{m*}\right)\right] \cdot \left[\pi_i(w,w)\right], \\ w_j^{B^{m*}} &= w_i^{B^{m*}} \end{aligned} \tag{3.28}$$

with $i, j = 1, 2$, $i \neq j$. Note that the outside option of the union in (3.28) is not based on the anticipated equilibrium wage rate any more (as was the case with simultaneous bargaining), but on w_j^{m*}. This is the wage rate that applies if the union and firm i find no agreement in the previous negotation round, resulting in a one-to-one wage bargaining situation between the union and remaining firm j that takes the form

$$w_j^{m*} = \arg\max_{wj} \left[w_j l_j^m \left(w_j \right) \right] \cdot \left[\pi_j^m (w_j) \right]$$

based on monopoly levels (3.5) and (3.6) with

$$w_j^{m*} = \frac{1}{4} a \tag{3.29}$$

resulting in optimum. Solving expression (3.28) for equilibrium wage rates yields

$$w_1^{B^{m*}} = w_2^{B^{m*}} = \frac{\left(10 - 3\sqrt{2}\right)}{16} a \tag{3.30}$$

with equilibrium values for output and profit equalling

$$x_1^{B^{m*}} = l_1^{B^{m*}} = x_2^{B^{m*}} = l_2^{B^{m*}} = \frac{\left(\sqrt{2} + 2\right)}{16} a \tag{3.31}$$

and

$$\pi_1^{B^{m*}} = \pi_2^{B^{m*}} = \frac{\left(\sqrt{2} + 2\right)^2}{256} a^2. \tag{3.32}$$

The equilibrium value of union utility is given by

$$\Omega_u(w_1^{B^{m*}}, w_2^{B^{m*}}) = \frac{\left(\sqrt{2} + \frac{7}{2}\right)}{32} a^2. \tag{3.33}$$

3.3.5 Summary

We can summarize the results of Section 3.3 in Table 3.1 with A = simultaneous bargaining without outside option, A^m = simultaneous bargaining based on monopoly levels, B = pattern bargaining without outside option and B^m = pattern bargaining based on monopoly levels.

Table 3.1: Outcomes under different bargaining regimes in autarky

Bargaining environment	w_1^*, w_2^*	Ω_u^*	π_1^*, π_2^*
A	0.1 a	0.06 a^2	0.09 a^2
A^m	0.25 a	0.125 a^2	0.063 a^2
B	0.25 a	0.125 a^2	0.063 a^2
B^m	0.36 a	0.153 a^2	0.046 a^2

It is straightforward to check that the union prefers bargaining environment B^m over all other options, whereas the two firms will conversely opt for bargaining environment A as it yields the highest profits compared to the other listed alternative bargaining environments. This result confirms previous findings by Marshall and Merlo (2004). The economic reason why unions prefer pattern bargaining over simultaneous bargaining lies in the fact that a wage increase harms a firm independent of the wage rate paid by the other firm, but less so if the own wage increase induces a corresponding wage increase at the other firm as well. This effect is ensured by the concept of pattern bargaining, where firms become less reluctant to agree to wage concessions as they are aware that this will not harm their competitive standing in the market. With regard to outside options, we find that a positive conflict payoff to the union $d_i > 0$ is beneficial to the union and detrimental to the firms' profits independent of the existing bargaining environment. We can summarize these results in the following proposition:

Proposition 9 *The union prefers pattern bargaining over simultaneous bargaining and finds itself in a better bargaining position with a positive conflict payoff independent of the existing bargaining regime. The reverse case applies to firms, which prefer simultaneous bargaining over pattern bargaining. Higher conflict payoffs to the union are detrimental to the profits of the firms.*

3.4 FDI

Following an approach by Dinopoulos and Mezzetti (1991), we broaden our point of view in this section by embedding the option to shift production abroad via horizontal FDI into our model. The process of multinationalization is assumed to come at no additional cost, but only firm 1 can produce abroad, while firm 2 continues to produce in its respective home country only. This creates an asymmetry in FDI capabilities which allows us distinguish cases where the union might prefer one or the other firm to take on the target role. Moreover, FDI can be used to serve domestic consumers only, while the foreign wage rate w^* is assumed to be of such nature that the marginal cost of producing abroad exceeds the marginal cost of producing at home (implying that the domestic reservation rate is lower than w^*), so that firm 1 has a clear preference to produce in home country. Producing abroad, however, is assumed to yield positive profits overall (albeit being lower compared to producing in home country), so that an internal solution of our model requires $\Psi_1 > 0$ under FDI.[5] Given this setup, the option of FDI alters the nash bargaining game as firm 1 gains an outside option which in case of disagreement turns into positive reservation profits. This strengthens the bargaining position of the firm since FDI can be used as a threat during the wage negotations. Note that just the (credible) threat of FDI is sufficient to have an impact on the bargaining process as long as the potential profits that are obtainable abroad are positive, which reduces the role of the foreign country to an exogenous factor. The consideration of FDI has another important implication for our model: if the union is not endowed with an outside option such that $d_2 = 0$, Ψ_1 as outside-side option of firm 1 is based on monopoly profits. The reason for this lies in the following argument: if wage negotiations between the union and firm 1 fail and the union decides to go on strike, $d_2 = 0$ implies that neither firm 1 or firm 2 can produce in home country, which leaves firm 1 the opportunity to serve the domestic market from abroad via FDI. In contrast, if wage negotiations between the union and firm 1 fail and the union decides to go on strike while possessing a positive outside option $d_2 > 0$, both firms continue to share the domestic market as duopolists with firm 2 producing in home country and firm 1 from abroad. Outside options d_2 and Ψ_1 would then be based on

[5] Our analysis can be extended to the case where fixed costs apply under FDI. They can be neglected insofar in our model, as long as FDI returns positive profits to the firm.

Cournot values depending on the foreign wage rate w^*:

$$\hat{x}_1 = \hat{l}_1 = \frac{a + w_2 - 2w^*}{3}. \tag{3.34}$$

$$\hat{x}_2(w^*, w_2) = \hat{l}_2 = \frac{a + w^* - 2w_2}{3} \tag{3.35}$$

$$\hat{\pi}_1(w^*, w_2) = \left(\frac{a + w_2 - 2w^*}{3}\right)^2 \tag{3.36}$$

$$\hat{\pi}_2(w^*, w_2) = \left(\frac{a + w^* - 2w_2}{3}\right)^2. \tag{3.37}$$

3.4.1 Pattern Bargaining and FDI without Outside Option (C^{FDI})

This bargaining environment is similar to the setup of bargaining environment B (pattern bargaining without outside-option), the only difference being that we allow the outside option of the firm to be positive with $\Psi_1 > 0$. Due to the asymmetry assumption in FDI capabilities we must distinguish between two cases, where each firm adopts the role of the target firm.

Firm 1 is the Target Firm

If firm 1 is chosen to be the target firm, the equilibrium wage rates are the solution to

$$\begin{aligned} w_1^{C_1^{FDI*}} &= \arg\max_w \left[\Omega_u(w, w)\right] \cdot \left[\pi_1(w, w) - \Psi_1\left(w^*\right)\right], \\ w_2^{C_1^{FDI*}} &= w_1^{C_1^{FDI*}}, \end{aligned} \tag{3.38}$$

where Ψ_1 is based on monopoly profits for given foreign wage rate w^*. The equilibrium wage rates are then given by:

$$w_1^{C_1^{FDI*}} = w_2^{C_1^{FDI*}} = \frac{\lambda\left(3a-\lambda\right)+6w^*\left(2a-w^*\right)-7a^2}{4\lambda} \tag{3.39}$$

with:

$$\lambda \equiv \left(\begin{array}{c} a\left(3w^*-2a\right)\left(4a-3w^*\right)+ \\ 3\sqrt{\left(a-w^*\right)^2\left(102a^3w^*+96a\left(w^*\right)^3-31a^4-147a^2\left(w^*\right)^2-24\left(w^*\right)^4\right)} \end{array} \right)^{\frac{1}{3}}.$$

Inserting the equilibrium wage rates into (3.3) and (3.4) yields

$$x_1^{C_1^{FDI*}} = l_1^{C_1^{FDI*}} = x_2^{C_1^{FDI*}} = l_2^{C_1^{FDI*}} = \frac{\lambda\left(a+\lambda\right)-6w^*\left(2a-w^*\right)+7a^2}{12\lambda}, \tag{3.40}$$

$$\pi_1^{C_1^{FDI*}} = \pi_2^{C_1^{FDI*}} = \left(\frac{\lambda\left(a+\lambda\right)-6w^*\left(2a-w^*\right)+7a^2}{12\lambda}\right)^2 \tag{3.41}$$

for equilibrium output, employment and profits. Using (3.39) and (3.40) we obtain

$$\Omega_u(w_1^{C_1^{FDI*}}, w_2^{C_1^{FDI*}}) \tag{3.42}$$

$$= \frac{\left(a\lambda-12aw^*+\lambda^2+6\left(w^*\right)^2+7a^2\right)\left(3a\lambda+12aw^*-\lambda^2-6\left(w^*\right)^2-7a^2\right)}{24\lambda^2}.$$

as equilibrium value for the utility of the union.

Firm 2 is the Target Firm

If firm 2 is chosen to be the target firm, the equilibrium wage rates are the solution to

$$\begin{aligned} w_2^{C_2^{FDI*}} &= \arg\max_w \left[\Omega_u(w,w)\right] \cdot \left[\pi_2(w,w)\right], \\ w_1^{C_2^{FDI*}} &= w_2^{C_2^{FDI*}}, \end{aligned} \tag{3.43}$$

where (3.43) is identical to the nash bargaining problem in section 3.3.3. This implies that the equilibrium values resulting from (3.43) are the same as under bargaining environment B (pattern bargaining without outside option), where we assumed a closed economy. This result stems from the assumption that firm 2 does not dispose of the FDI option which implies $\Psi_2 = 0$, while the pattern bargaining arrangement ensures that firm 1 accepts the wage rate negotiated between the union and firm 2. This leaves us to replicate the equilibrium results from bargaining environment B with:

$$w_1^{C_2^{FDI*}} = w_2^{C_2^{FDI*}} = \frac{1}{4}a, \tag{3.44}$$

$$x_1^{C_2^{FDI*}} = l_1^{C_2^{FDI*}} = x_2^{C_2^{FDI*}} = l_2^{C_2^{FDI*}} = \frac{1}{4}a, \tag{3.45}$$

$$\pi_1^{C_2^{FDI*}} = \pi_2^{C_2^{FDI*}} = \frac{1}{16}a^2, \tag{3.46}$$

$$\Omega_u(w_1^{C_2^{FDI*}}, w_2^{C_2^{FDI*}}) = \frac{1}{8}a^2. \tag{3.47}$$

3.4.2 Pattern Bargaining and FDI based on Cournot Levels ($\mathbf{C^{FDI^m}}$)

In this section we consider pattern bargaining and FDI in the presence of a positive conflict payoff to the union $d_2 > 0$. The union can build on d_2 preceding failed wage negotations between the union and firm 1. This subsequently leaves the union to enter wage negotiations with firm 2 based on cournot values, as firm 1 remains as competitor in the market via FDI. We must again distinguish between two cases, where each firm adopts the role of the target firm.

Firm 1 is the Target Firm

If firm 1 is chosen to be the target firm, the equilibrium wage rates are solutions to

$$\begin{aligned} w_1^{C_1^{FDI^{m*}}} &= \arg\max_w \left[\Omega_u(w,w) - \hat{w}_2^* \hat{l}_2\left(\hat{w}_2^*, w^*\right)\right] \cdot \left[\pi_1(w,w) - \Psi_1\left(w^*, \hat{w}_2^*\right)\right], \quad (3.48) \\ w_2^{C_1^{FDI^{m*}}} &= w_1^{C_1^{FDI^{m*}}}, \end{aligned}$$

where $\hat{w}_2^*$ constitutes the wage rate that applies when wage negotiations between the union and firm 1 fail, resulting in a one-to-one wage bargaining situation based on equations (3.35) and (3.37) between the union and firm 2 that takes the form

$$\hat{w}_2^* = \arg\max_{w_2} \left[\hat{w}_2 \hat{l}_2\left(\hat{w}_2, w^*\right)\right] \cdot \left[\hat{\pi}_2\left(\hat{w}_2, w^*\right)\right]$$

with

$$\hat{w}_2^* = \frac{1}{8}\left(a + w^*\right) \quad (3.49)$$

as optimal wage outcome. By solving (3.48) we obtain the equilibrium wage rates

$$w_1^{C_1^{FDI^{m*}}} = w_2^{C_2^{FDI^{m*}}} = \frac{\phi\left(6a - \phi\right) + w^*\left(46a - 37w^*\right) - 17a^2}{8\phi} \quad (3.50)$$

with

$$\phi \equiv \left(\begin{array}{c} 2a\left(66aw^{*}-57\left(w^{*}\right)^{2}-17a^{2}\right)+ \\ \sqrt{\begin{array}{c} -3757a^{6}+30906a^{5}w^{*}-114819a^{4}\left(w^{*}\right)^{2} \\ +240844a^{3}\left(w^{*}\right)^{3}-291699a^{2}\left(w^{*}\right)^{4}+188922a\left(w^{*}\right)^{5}-50653\left(w^{*}\right)^{6} \end{array}} \end{array} \right)^{\frac{1}{3}}.$$

Inserting (3.50) rates into (3.3) and (3.4) yields equilibrium values

$$x_1^{C_1^{FDI^{m*}}} = l_1^{C_1^{FDI^{m*}}} = x_2^{C_1^{FDI^{m*}}} = l_2^{C_1^{FDI^{m*}}} = \frac{\phi\left(2a+\phi\right)+\omega\left(-46a+37\omega\right)+17a^{2}}{24\phi} \quad (3.51)$$

$$\pi_1^{C_1^{FDI^{m*}}} = \pi_2^{C_1^{FDI^{m*}}} = \left(\frac{\phi\left(2a+\phi\right)+\omega\left(-46a+37\omega\right)+17a^{2}}{24\phi}\right)^{2} \quad (3.52)$$

for output, employment and profits. The union utility in equilibrium is given by

$$\begin{aligned} & \Omega_u\left(w_1^{C_1^{FDI^{m*}}}, w_2^{C_1^{FDI^{m*}}}\right) \quad (3.53) \\ = \; & \frac{\left(\phi\left(2a+\phi\right)+\omega\left(-46a+37\omega\right)+17a^{2}\right)\left(\phi\left(6a-\phi\right)+\omega\left(46a-37\omega\right)-17a^{2}\right)}{96\phi^{2}}. \end{aligned}$$

Firm 2 is the Target Firm

Similar to section 3.4.1, this bargaining environment corresponds to the case in which firm 2 acts in the role of the target firm with $d_1 > 0$. The equilibrium wage outcomes are the solutions to

$$\begin{aligned} w_2^{C_2^{FDI^{m*}}} &= \arg\max_{w}\left[\Omega_u(w,w)-w_1^{m*}l_1^{m}\left(w_1^{m*}\right)\right]\cdot\left[\pi_2(w,w)\right], \quad (3.54) \\ w_1^{C_2^{FDI^{m*}}} &= w_2^{C_2^{FDI^{m*}}}, \end{aligned}$$

where (3.54) is identical to the nash bargaining problem under bargaining environment B^m (pattern bargaining based on monopoly levels) in closed economy. The equilibrium values are therefore given by

$$w_1^{C_2^{FDI^{m*}}} = w_2^{C_2^{FDI^{m*}}} = \frac{\left(10 - 3\sqrt{2}\right)}{16}a, \tag{3.55}$$

$$x_1^{C_2^{FDI^{m*}}} = l_1^{C_2^{FDI^{m*}}} = x_2^{C_2^{FDI^{m*}}} = l_2^{C_2^{FDI^{m*}}} = \frac{\left(\sqrt{2} + 2\right)}{16}a, \tag{3.56}$$

$$\pi_1^{C_2^{FDI^{m*}}} = \pi_2^{C_2^{FDI^{m*}}} = \frac{\left(\sqrt{2} + 2\right)^2}{256}a^2, \tag{3.57}$$

$$\Omega_u(w_1^{C_2^{FDI^{m*}}}, w_2^{C_2^{FDI^{m*}}}) = \frac{\left(\sqrt{2} + \frac{7}{2}\right)}{32}a^2. \tag{3.58}$$

3.4.3 Summary

The equilibrium results obtained in Section 3.4 are summarized in Table 3.2, 3.3 and 3.4:

Table 3.2: Wage rates under pattern bargaining and FDI

Bargaining environment	$w_1^*,\ w_2^*$
C_1^{FDI}	$\frac{\lambda(3a-\lambda)+6w^*(2a-w^*)-7a^2}{4\lambda}$
$C_2^{FDI} = B$	$0.25\ a$
$C_1^{FDI^m}$	$\frac{\phi(6a-\phi)+w^*(46a-37w^*)-17a^2}{8\phi}$
$C_2^{FDI^m} = B^m$	$0.36\ a$

Table 3.3: Union utility under pattern bargaining and FDI

Bargaining environment	Ω_u^*
C_1^{FDI}	$\frac{\left(a\lambda-12aw^*+\lambda^2+6(w^*)^2+7a^2\right)\left(3a\lambda+12aw^*-\lambda^2-6(w^*)^2-7a^2\right)}{24\lambda^2}$
$C_2^{FDI} = B$	$0.125\ a^2$
$C_1^{FDI^m}$	$\frac{\left(\phi(2a+\phi)+w^*(-46a+37w^*)+17a^2\right)\left(\phi(6a-\phi)+w^*(46a-37w^*)-17a^2\right)}{96\phi^2}$
$C_2^{FDI^m} = B^m$	$0.153\ a^2$

Table 3.4: Profits under pattern bargaining and FDI

Bargaining environment	$\pi_1^*,\ \pi_2^*$
C_1^{FDI}	$\left(\frac{\lambda(a+\lambda)-6w^*(2a-w^*)+7a^2}{12\lambda}\right)^2$
$C_2^{FDI} = B$	$0.063\ a^2$
$C_1^{FDI^m}$	$\left(\frac{\phi(2a+\phi)+w^*(-46a+37w^*)+17a^2}{24\phi}\right)^2$
$C_2^{FDI^m} = B^m$	$0.046\ a^2$

At first glance, the results in the tables appear not to be clear-cut for a direct comparison, but we can overcome this inconvenience by conducting a graphical analysis. We begin by comparing the equilibrium wage rates for bargaining environments C_1^{FDI} and C_2^{FDI} which implies a comparison of pattern bargaining regimes beween autarky and FDI for $d_i = 0$. The equilibrium union wage rates for these bargaining environments are depicted by the black lines depending on the foreign wage rate w^* in Figure 3.1.

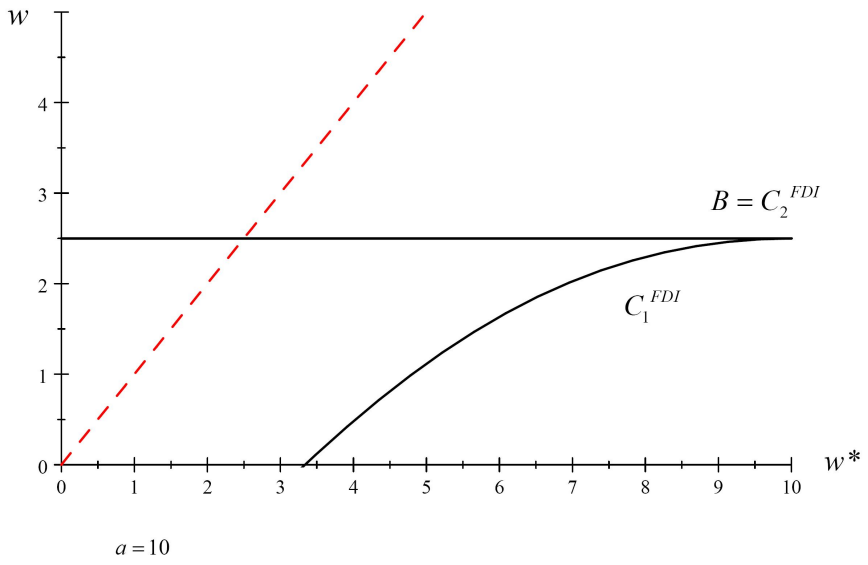


Figure 3.1: Wage rates under pattern bargaining and FDI without outside option

All values to the right of the red 45° line accommodate the assumption of our model that the foreign wage rate w^* is higher than the domestic counterpart. The figure also accommodates the assumption that wage rates are positive and that the FDI payoff in case of conflict must be positive $\Psi_1 > 0$, which is fulfilled when $w^* < 10$ for given $a = 10$. Thus we obtain a corridor where the foreign wage rate must not be too low for wage rates to be positive in general and not too high in order for FDI to be a credible threat. The corresponding situation for bargaining environments $C_1^{FDI^m}$ and $C_2^{FDI^m}$ (depicted by blue lines) is illustrated in Figure 3.2 where $\Psi_1 > 0$ is fulfilled when $w^* < 6$ for given $a = 10$.[6]

Given Figures 3.1 and 3.2, we can draw the conclusion that the introduction of FDI lowers the union's wage rate. This is because FDI, *ceteris paribus*, improves the bargaining position of the firm. This assertion holds for all considered bargaining environments independent of whether the union disposes of a conflict payoff or not.

Proposition 10 *The introduction of FDI lowers the union's wage rate under pattern bargaining.*

[6]The upper boundary for the foreign wage rate varies between bargaining environments depending on the assumed outside option of the union. If $d_i = 0$, the conflict payoff to the firm is based on monopoly values, which allows for a higher scope of the foreign wage rate compared to the case where $d_i > 0$, where Ψ_1 and consequently the foreign wage rate must be lower to yield $\Psi_1 > 0$.

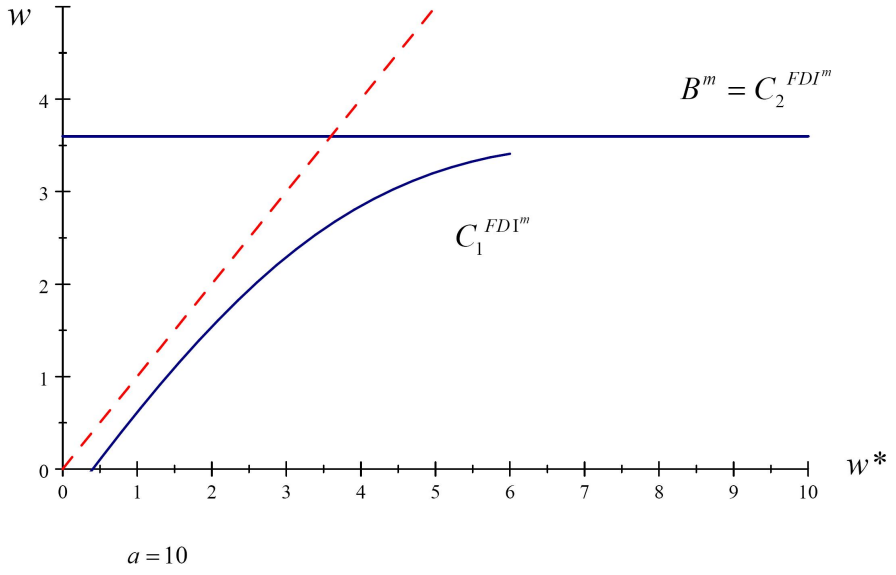


Figure 3.2: Wage rates under pattern bargaining and FDI based on cournot levels

The intuition that lower wage rates are detrimental to the union's utility is confirmed in Figure 3.3 in which we portray the utility values for all four considered pattern bargaining environments C_1^{FDI}, C_2^{FDI}, $C_1^{FDI^m}$ and $C_2^{FDI^m}$.[7]

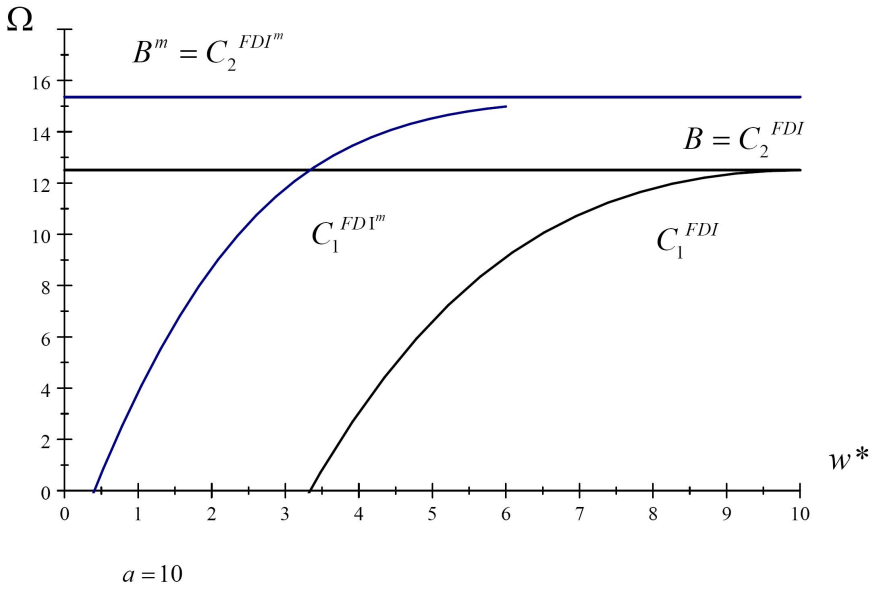


Figure 3.3: Union utility under pattern bargaining and FDI

[7]The bargaining environments where the positive conflict payoff to the union is positive with $d_i > 0$ are marked in blue again.

Recall that C_2^{FDI} and $C_2^{FDI^m}$ correspond to the pattern bargaining environments B and B^m which we already analyzed under autarky. The utility of the union is higher under $C_2^{FDI^m} = B^m$ than $C_2^{FDI} = B$ due to the positive conflict payoff that the union possesses in the former bargaining environment, but both autarky cases yield higher utility when compared to their bargaining counterpart $C_1^{FDI^m}$ and $C_2^{FDI^m}$.[8] This implies that the union has a preference for national firm 2 and not multinational firm 1 to be the target firm, because the concept of pattern bargaining ensures that the negative impact of FDI on the union's utility can be avoided when the solely domestically active firm is chosen to carry out the target role. This can be verified when considering the nash bargaining problems in section 3.4.1 and section 3.4.2, in which firm 2 is assumed to take on the target role and where FDI as the outside option of the firm finds no entrance into the wage bargaining scheme. Moreover, a direct comparison between bargaining environments C_1^{FDI} and $C_1^{FDI^m}$ reveals that the union is better off when equipped with a positive conflict payoff. The economic reason for this result goes beyond the argument that a positive conflict payoff improves the bargaining position of the union, however, because a positive conflict payoff to the union alters the conflict payoff to the firm as well. This is because the possibility of a positive conflict payoff to the union allows firm 2 to remain active in the market if wage negotiations fail, which forces firm 1 to base its conflict payoff upon reservation profits with less market share (Cournot competition). The different conflict payoffs to the firm depending on the conflict payoff to the union are depicted in Figure 3.4, where we can see that the conflict payoff to the firm is lower in pattern bargaining environment $C_1^{FDI^m}$ with $d_2 > 0$.

Proposition 11 *When confronted with FDI under pattern bargaining, the union is better off in a more decentralized bargaining environment which allows for a positive conflict payoff. Given the choice, the union prefers the domestic rather than the multinational firm to be the target firm.*

[8]Note that a direct comparison between bargaining environments $C_2^{FDI} = B$ and $C_1^{FDI^m}$ discloses the possibility for a situation where the union might prefer firm 1 to be the target firm. However, this comparison does not really hold, since the bargaining environments differ in their assumed conflict payoff to the union. If $C_2^{FDI} = B$ is amended by the option of a positive conflict payoff to the union as in $C_2^{FDI^m}$, the union will prefer firm 2 to be the target firm again.

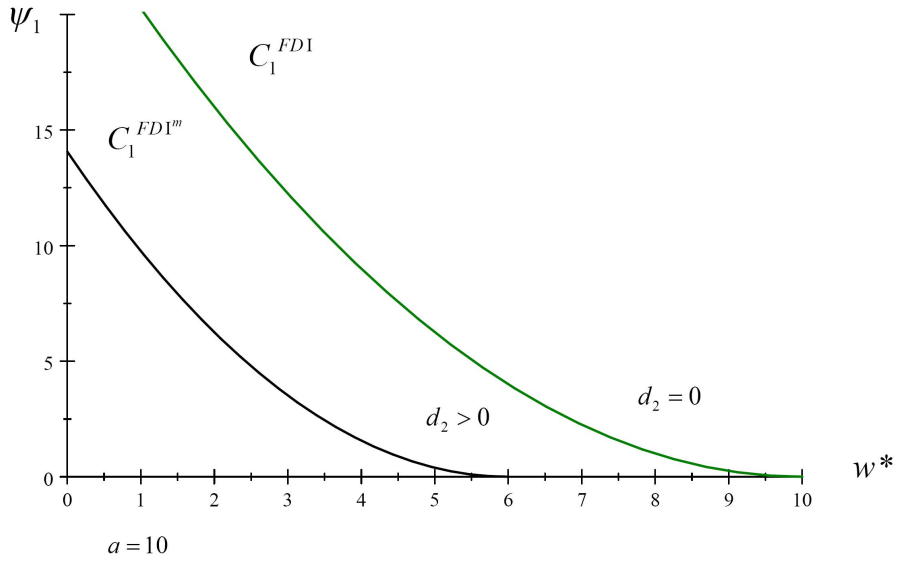


Figure 3.4: Conflict payoffs depending on the outside option of the union

The equilibrium profits depending on the four considered pattern bargaining environments C_1^{FDI}, C_2^{FDI}, $C_1^{FDI^m}$ and $C_2^{FDI^m}$ are illustrated in Figure 3.5, from which we can assert that FDI is beneficial to both firms compared to autarky and even more so if the union possesses no outside option.

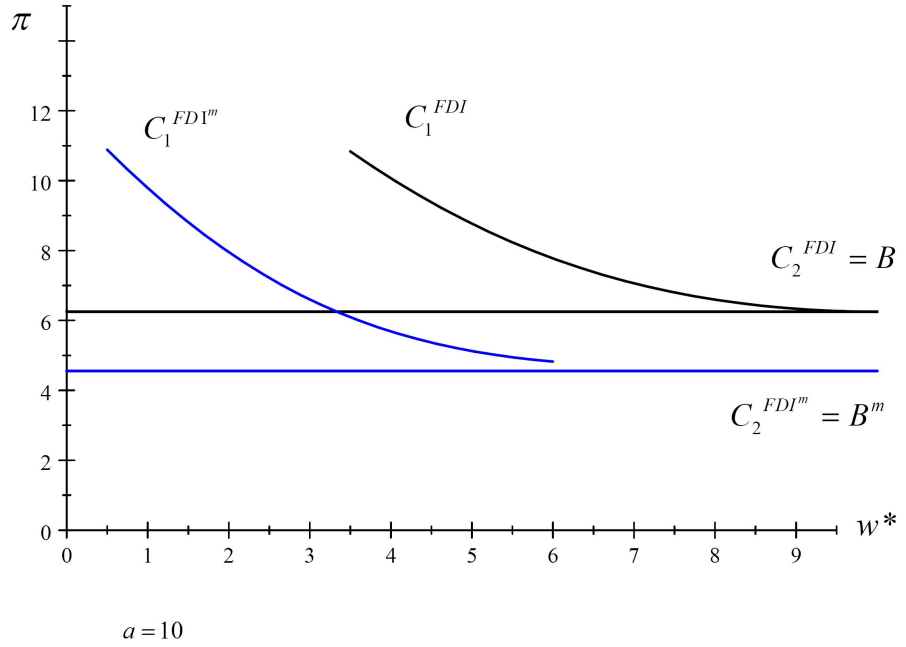


Figure 3.5: Profits under pattern bargaining and FDI

Proposition 12 *FDI is beneficial to all firms under pattern bargaining compared to autarky, if the FDI undertaking firm is chosen to be the target firm. This effect is strengthened when the union possesses no outside option.*

3.5 Conclusion

In this paper, we have analyzed the effect of horizontal FDI on labor market outcomes under pattern bargaining. Our main finding is that the threat of FDI has the power to lower the bargained wage rate in the domestic country, because FDI improves the bargaining position of the firm. This results in a lower payoff to the union and consequently higher profits for the firms compared to the case of autarky. This effect is moderated if the union possesses a positive conflict payoff, not only because it improves the bargaining position of the union, but also because it alters the conflict payoff to the firm as well. Furthermore, the assumed asymmetry between the firms' capability to undertake FDI reveals that the union prefers the domestic rather than the multinational firm to be the target firm, as the concept of pattern bargaining ensures avoidance of the negative impact of FDI on the union's utility when the solely domestically active firm is chosen to carry out the target role.

Our results can provide some explanations for empirical observations with regard to pattern bargaining. In particular, we have identified a mechanism where the union's outside option functions in the way as to weaken the conflict payoff to the firm which softens the negative impact of FDI on domestic wage bargaining outcomes. This provides a possible explanation for the observed trend towards less centralization in collective bargaining systems for the case of pattern bargaining. Nevertheless, our framework offers only first insights on the topic of pattern bargaining and FDI, making further research on this topic neccessary.

Appendix

For the purpose of completeness, we provide the concrete Nash bargaining problems used in the model. Let us begin with the bargaining environments in autarky. For the case of simultaneous bargaining without outside option (A) we obtain:

$$\begin{aligned} w_1^{A^*} &= \arg\max_{w_1} \left(w_1 \frac{a + w_2^{A^*} - 2w_1}{3} + w_2^{A^*} \frac{a + w_1 - 2w_2^{A^*}}{3} \right) \\ &\quad \left(\frac{a + w_2^{A^*} - 2w_1}{3} \right)^2, \\ w_2^{A^*} &= \arg\max_{w_2} \left(w_1^{A^*} \frac{a + w_2 - 2w_1^{A^*}}{3} + w_2 \frac{a + w_1^{A^*} - 2w_2}{3} \right) \\ &\quad \left(\frac{a + w_1^{A^*} - 2w_2}{3} \right)^2, \end{aligned} \tag{3.59}$$

where w_j^{A*} denotes the anticipated equilibrium wage rate with $i, j = 1, 2$, $i \neq j$. The Nash bargaining problem for the case of simultaneous bargaining based on monopoly levels (A^m) is given by:

$$\begin{aligned} w_1^{A^{m*}} &= \arg\max_{w_1} \left(w_1 \frac{a + w_2^{A^{m*}} - 2w_1}{3} + w_2^{A_m^*} \frac{a + w_1 - 2w_2^{A^{m*}}}{3} - w_2^{A_m^*} \frac{a - w_2^{A^{m*}}}{2} \right) \\ &\quad \left(\frac{a + w_2^{A^{m*}} - 2w_1}{3} \right)^2, \\ w_2^{A^{m*}} &= \arg\max_{w_2} \left(w_1^{A^{m*}} \frac{a + w_2 - 2w_1^{A^{m*}}}{3} + w_2 \frac{a + w_1^{A^{m*}} - 2w_2}{3} - w_1^{A^{m*}} \frac{a - w_1^{A^{m*}}}{2} \right) \\ &\quad \left(\frac{a + w_1^{A^{m*}} - 2\frac{w_2}{t}}{3} \right)^2. \end{aligned} \tag{3.60}$$

Turning to pattern bargaining, the Nash bargaining problem for the case without conflict payoff to the union (B) is given by

$$\begin{aligned} w_j^{B^*} &= \arg\max_{w} \left(w \frac{a + w - 2w}{3} + w \frac{a + w - 2w}{3} \right) \cdot \left(\frac{a + w - 2w}{3} \right)^2, \\ w_i^{B^*} &= w_j^{B^*} \end{aligned} \tag{3.61}$$

with $i, j = 1, 2$, $i \neq j$, where the equilibrium wage rate is the same, independent of which

firm adopts the role of the target firm. The Nash bargaining problem for the case of pattern bargaining environment based on monopoly levels (B^m) yields

$$\begin{aligned} w_j^{B^{m*}} &= \arg\max_w \left(w\frac{a+w-2w}{3} + w\frac{a+w-2w}{3} - \frac{1}{4}a\frac{\left(a-\frac{1}{4}a\right)}{2} \right) \\ &\quad \left(\frac{a+w-2w}{3}\right)^2, \\ w_i^{B^{m*}} &= w_j^{B^{m*}} \end{aligned} \tag{3.62}$$

with $i, j = 1, 2$, $i \neq j$. Equations (3.59) - (3.62) represent the autarkic perspective. We now turn to the Nash bargaining cases in which FDI constitutes an outside option to firm 1. The Nash bargaining problem for the pattern bargaining case without outside option (C_1^{FDI}), assuming that firm 1 takes on the role of the target firm, is given by

$$\begin{aligned} w_1^{C_1^{FDI*}} &= \arg\max_w \left(w\frac{a+w-2w}{3} + w\frac{a+w-2w}{3} \right) \left(\left(\frac{a+w-2w}{3}\right)^2 - \left(\frac{a-\omega}{2}\right)^2 \right), \\ w_2^{C_1^{FDI*}} &= w_1^{C_1^{FDI*}}. \end{aligned} \tag{3.63}$$

The Nash bargaining problem when firm 2 is chosen to act as target firm (C_2^{FDI}) is the same as in (3.61). When both the union and firm 1 possess an outside option, the case pattern bargaining and FDI based on Cournot levels ($C_1^{FDI^m}$) applies with

$$\begin{aligned} w_1^{C_1^{FDI^{m*}}} &= \arg\max_w \left(w\frac{a+w-2w}{3} + w\frac{a+w-2w}{3} - \frac{1}{8}(a+\omega)\frac{a+\omega-2\left(\frac{1}{8}(a+\omega)\right)}{3} \right) \\ &\quad \left(\left(\frac{a+w-2w}{3}\right)^2 - \left(\frac{a+\left(\frac{1}{8}(a+\omega)\right)-2\omega}{3}\right)^2 \right), \\ w_2^{C_1^{FDI^{m*}}} &= w_1^{C_1^{FDI^{m*}}} \end{aligned} \tag{3.64}$$

as corresponding Nash bargaining problem. The Nash bargaining problem when firm 2 takes on the role of the target firm ($C_2^{FDI^m}$) is the same as in (3.62).

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