Outsourcing In The Presence Of Imperfect Markets

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PART I: MOTIVATION AND OUTLINE

This part is an introduction to the theory of outsourcing and gives a review of the meaning, motives and risks and the different theories to explain the phenomenon. It also motivates the aims of the thesis and defines the scope of the analysis.

Chapter 1

Introduction

In recent years, due to a more closely connected world, outsourcing has become of growing interest to politicians, firms and workers and thus received a lot of attention in the media. However, all these parties have a different understanding of outsourcing, associate it with different effects and are affected in different ways. In a first step, we clarify these confusions and give an overview concerning the different meanings of outsourcing.
To analyse the different effects, we examine the firm and workers individually. First, we focus in detail on the firm and show the determinants that influence the decision on outsourcing. After this step, we characterize the different motives and risks, the enterprise faces. Bringing the determinants and advantages together, we identify different theories to explain the firm's behaviour and thus the increased business practice of outsourcing.
The influence on the workers' outcome is briefly explained by empirical studies. However, the overall employment effect is not clear due to adjustment processes and we therefore distinguish the temporal dimension between short-run and long-run perspective. Taking the short-run public aim of avoiding job losses and wage decline, we identify instruments designed to realize this goal. Here, we point out the essential question of our analysis. Afterwards, we summarize the following chapters and give a brief conclusion.

1.1 Definition, Motives, Risks and Theory

1.1.1 Definition and Synonyms

Although the term "outsourcing" is often used, there is neither in policy nor in the scientific debate an unambiguous definition. The term "outsourcing" is a composition of **Out**side, Re**source**, Us**ing** or **Out**side, Re**sourcing** (Bruch, 1998 and

Bacher, 2000). Therefore, in a general form outsourcing describes the use of external resources respectively the use of external inputs from outside the firm.
To outsource some inputs, the production process has to split into separate production stages. Thus, a vertical or horizontal production is required.[1] Behind this organization of the production process, there is the hope of realizing arbitrage profit due to the use of cost advantages of the division of labour.
Using this general definition, two differentiation criteria exist: i) the location and ii) the degree of independence of the external supplier.
The location can be distinguished between the domestic (same country as the final good producer) and the foreign country. The independency of the supplier can be characterized as fully independent from the final good producer or dependent such as a branch.
In a broader sense, outsourcing is the external procurement of intermediate goods which in the past were produced internally, regardless of the provider's location.[2] However, with our differentiation criteria we can distinguish in domestic and international outsourcing. Often, synonyms such as arm's-length trade or intra-firm outsourcing are used.
Concerning the degree of independency, we refer to external or internal outsourcing.
A combination of these characteristics is possible as well, i.e. a firm's plant abroad is indicated as international intra-firm outsourcing, offshoring or foreign direct investment[3] and an independent intermediate good supplier in a foreign country as input trade or fragmentation.[4]
This distinction is represented in Figure 1.1.

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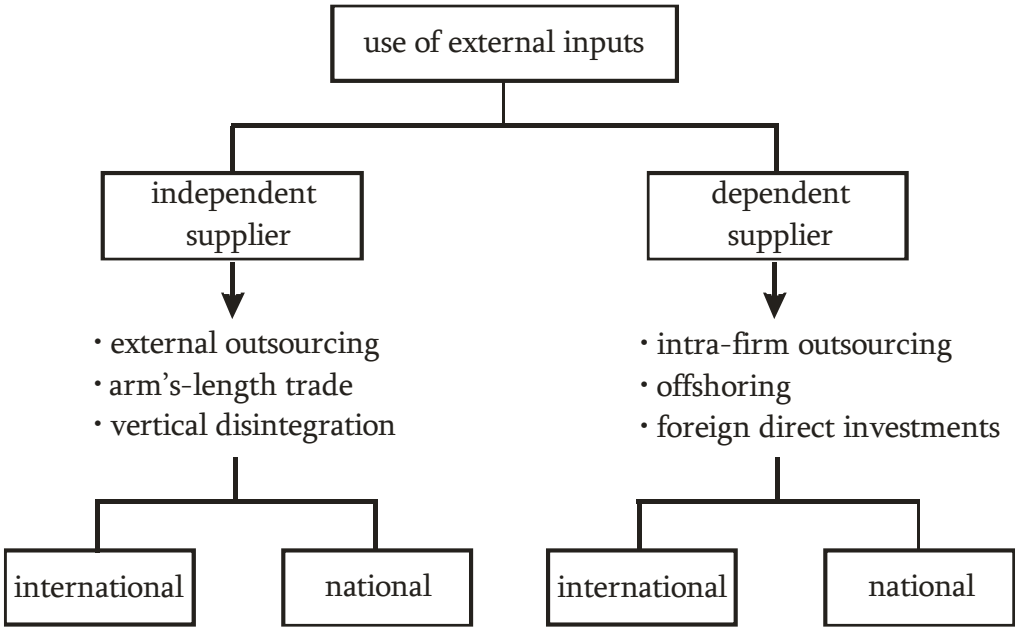
1 A definition is presented in Caves (1971) or Buckley and Casson (1976). Also in Perry (1989) and Williamson (1996), an overview on vertical integration is shown.

2 See Sinn (2005, p. 91): „Outsourcing is the replacement of own produced intermediate goods by buying these from a supplier, which mostly produced abroad." (Translation of the author, original: „Outsourcing ist der Ersatz eigener Vorproduktion durch den Kauf von Vorprodukten bei Zulieferern, die zumeist im Ausland produzieren.")

3 Sinn (2005, p. 91) defines offshoring as the „…replacement of domestic intermediate good production in foreign branches by foreign direct investments." (Translation of the author, original: „Offshoring ist der Ersatz inländischer Vorproduktion durch eigene Niederlassungen, die das Unternehmen auf dem Wege der Direktinvestition im Ausland errichtet.")

4 See Jones and Kierzkowski (2005). Fragmentation of a vertical integrated production process focuses on the distance of the single production stages. If one or more stages are produced abroad, it is similar to offshoring or outsourcing.

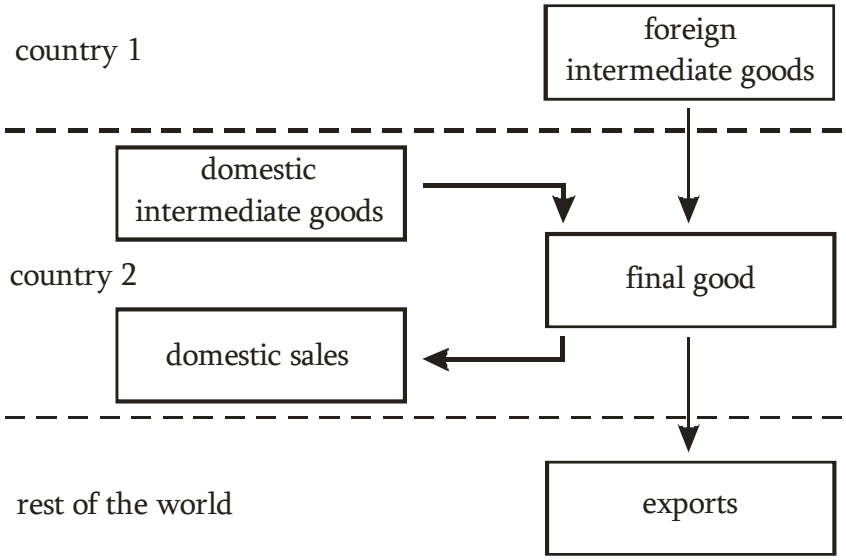
Figure 1.1: differentiation concepts



Other synonyms in the literature for the generic term "outsourcing" are slicing up the value chain, vertical specialization or vertical disintegration, disintegration of production and intra-product specialization, input trade or make-or-buy decision (Hummels et al., 2001).

In the following analysis, we interpret outsourcing as the use of resources from an independent input supplier. To be more precise, the domestic firm buys intermediate goods from abroad and, as a consequence, the domestic performance depth and production capacity decrease. Therefore, in our opinion, the firm faces a make-or-buy decision.
Our definition of outsourcing may be shown graphically, too. Country 1 represents the foreign country, where the input supplier is located and of which the domestic final good producer in country 2 buys the intermediate good. Domestic intermediate goods, which are produced by labour and/or capital, are maybe also used. The produced final good can then be bought in the domestic country and/or as exports in the rest of the world.

Figure 1.2: design of the outsourcing concept



1.1.2 Determinants, Motives and Risks

The central question in the theory of firms is why a firm covers all production stages, although some inputs maybe bought from outside the firm. This decision problem has been first described in Coase (1937). His core analysis focuses on vertical integration of a firm. Typically, the price mechanism distributes the production factors to the different productions. To avoid transaction costs, vertical integration and therefore the coordination of the different production stages can be beneficial.

In the case of outsourcing, it has to be verified what drives the decision to split the production process. Following Harris (1993), we can identify three reasonable determinants which may explain why more outsourcing is observed. After that, we present the underlying motives and risks to outsource certain production stages to characterize the advantages and disadvantages of outsourcing.

A first determinant of increasing outsourcing activities is the development of new or better information and communication technologies. Owing to mobile phones and the internet, firms can communicate better and faster and thus their transaction costs decrease and promote outsourcing. An example for this is telemedicine. One may contact e.g. a radiologist in another town, send the x-rays by e-mail and obtain return a diagnosis. The same may apply to cost sheet and accounting.

Also, the reduction of trade barriers, the second determinant, further encourages outsourcing. Since firms now have access to new markets and resources, new production locations as well as new trade relations due to outsourcing are open, as it has become easier to build a new plant or import goods. Closely related to this positive argument, one may argue that lower trade barriers increase the competition pressure and firms have to find ways to decrease its' costs. This can be achieved by outsourcing of some production stages.
A third determinant that increases outsourcing activities are public sector reforms. Due to implemented market mechanisms in the public sector and/or the financial situation, the administration often has to adapt public employment and services by transferring public functions and services to private firms. However, this transfer corresponds to our general definition of outsourcing. Examples are the maintenance of parks or the management of tourist offices. Both can be done by private firms which get the mandate from an administration or public utilities.

Resulting from these influences, there are different motives and risks of outsourcing.[5]
A firm's primary goal is to reduce its costs by outsourcing. This can be done in two ways. First, an independent supplier can provide the input with lower marginal costs than the final good producer. This can be explained by experience curve effects or a higher degree of specialization, which increases the productivity. Second, the unit costs of the input producer are lower, which can result from continuous production or a more automated production compared to the integrated firm. An alternative explanation of lower unit costs can be economies of scale. Assume a component is relatively homogenous for different manufacturers. If a production stage requires an investment, an independent supplier can redistribute these fixed costs to various firms. In opposite, the final good producer will typically produce the intermediate good only for himself. Thus, lower average costs lead to lower unit production costs for the independent supplier, ultimately resulting in cheaper production costs for the final good producer. One example for such a component is the airbag in the automobile sector. Each car company can either produce the airbag in-house or buy it from outside the firm and thereby save the associated domestic fixed costs. Since the airbag technology is relatively similar in all types of cars, the

[5] For a summary see also Quelin and Duhamel (2003) and the references therein. Also in the literature of multinational firms (this equates the case of intra-firm outsourcing), reasons for an international production can be found. In a survey article by Dunning (1973) the capital theory, product cycle and location theory and the trade theory are possible explanations.

airbag supplier can manufacture airbags for more than one firm, so that its fixed costs are shared among the different car manufacturers.
The second advantage of outsourcing results from the specialization of the input supplier. Due to this specialization, the input supplier acquires certain knowledge. Buying the intermediate good, the final good producer makes use of this know-how, thereby improving the quality of its own output. In this case one can think of the product label "In cooperation with…", which can be understood as a quality standard, since the notice suggests a collaboration with a well known firm. Due to uniqueness, this can improve the reputation of the final good producer and signal a high quality product by using the know-how of the partner. Consequently, the final good producer realizes an essential competitive advantage and can increase its market share due to a higher output. Thus, the competitiveness of the final good producer will be improved.
A third advantage of outsourcing results from the release of resources, which means that the final good producer gains a higher degree of flexibility and can focus on his core competencies. Thus, the production process becomes less complex and requires less coordination of the individual stages. The resulting additional capacity can be used for more firms relevant activities respectively core competence activities. Also bottleneck can be avoided, because the free capacities increase the actionability and thus the flexibility to react to changes in the business or financial environment.
As we mentioned, the delegation of a production stage can reduce the investment costs for a final good producer. However, not only the financial burden is reduced, but the involved investment risk is shifted to the input supplier. This characterizes also an advantage of outsourcing, since the input supplier bears quality and human resource risks, since he is responsible for providing a certain quantity and/or quality of the intermediate good and has to secure that there are no strikes or other production failures. If the input supplier fails to fulfil the requirements, the contractual relationship mostly stipulates measures such as contract penalties so that the input supplier takes up responsibility for the production.

But outsourcing does not only provide advantages.
Perhaps, the biggest disadvantage associated with outsourcing is the dependency. This includes the loss of control and flexibility, since the input producer decides for instance about the time, quantity or quality of the supply. The problem grows if outsourcing is defined as an investment decision. Due to the long-term character, it is not possible to react very flexibly to difficulties in the relationship and thus it is hard to reverse the organizational choice, especially if the outsourcing partner has market power such as a monopoly and there are no or only limited alternatives. Due

to the long-run property of the outsourcing decision, a final good producer may also lose the skills and knowledge of producing the input. Thus, the loss of production control as well as the competence loss by reducing perhaps the number of qualified employees, lessen the capacity to bridge even a short interruption of input supply through own production.

From dependency another risk or disadvantage may derive. Since the intermediate supplier has a decisive influence on the final good production, the final manufacture has to avoid opportunistic behaviour by the input producer and the so-called "hold-up" problem. An example may illustrate this problem. Assume that for a certain property of the intermediate good specific investments are necessary to design the input to the buyer's order. Intuitively, one may expect that it is easy to write down the special requirements in a contract. The problem is, however, that it is sometimes difficult to verify the articles of agreement by a third party and thus the contract is incomplete.[6] Through this knowledge the input supplier acts opportunistically and underinvestment, so that less than the maximum joint profit will be realized.

From the above mentioned risks, higher production costs may occur since the final good producer has to undertake control activities.

A third risk concerning outsourcing affects the profit of a firm via the product demand. The relocation of some production stages to a foreign country may negatively affect the public image of a firm, which may lead to a boycott of buying the goods if the consumers have preferences for goods that are produced in the home country. To signal an integrated production, the output has to be labelled by "Made in …". If this is not the case, consumers will substitute the product by similar domestic goods. But employees can also damage the image of a firm. If parts of the production process are outsourced, the remaining employees can show solidarity with the rationalized workers by striking or having a lower working morale. These reactions can lead to a stop or lower quality of production, which reduces the profits.

Table 1.1 briefly summarizes the mentioned advantages and disadvantages.[7]

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6 A definition of incomplete contracts is given by Spencer (2005, p. 1109): „... an outsourcing contract is incomplete if a supplier undertakes relationship-specific investment so as to specialize production to the needs of a buyer or vice versa, but contracts cannot be written conditional on the level of investment.". Another explanation for the incompleteness is that the economic environment is too complex and unpredictable to design the contract that accounts all possible outcomes. For a more detailed relationship of incomplete contracts and the hold-up problem see Schmitz (2001).

7 See also Matiaske and Mellewigt (2002) and Cronin et al. (2004).

Table 1.1: motives and risks

motives	risks
▪ decreasing costs – lower marginal costs – fixed cost degression	▪ dependency – loss of control – less flexibility
▪ improved performance – gain of know-how	▪ opportunistic behaviour – underinvestment
▪ concentration on core activities – use of free resources – flexibility	▪ loss of image – lower demand – less quality – strikes
▪ risk shifting – lower financial burden	

Note, that the above mentioned motives and risks of outsourcing are not complete. Also, not all the advantages and disadvantages occur in practice. However, this section should clarify that it is indispensable to calculate the chance-risk ratio before an outsourcing decision is made.

1.1.3 Theories of Explaining Outsourcing

Theories of explaining outsourcing may be derived from the various motives and risks. Therefore, we give a brief answer to the question "outsourcing-or-not", using the most common theoretical approaches.[8]

Transaction Cost Economics

Interviews show that the main motive to engage in outsourcing is the cost reduction advantage. However, as we mentioned earlier, with a higher degree of

[8] For a detailed report see McIvor (2005).

disintegration, more control and coordination effort is needed and thus transaction costs increase. Since the function of a manager is to find the most efficient production structure, the decision on outsourcing depends on the overall costs of the organizational choice.
The transaction cost theory thus answers the question "When does the firm use the make-option or the buy-option?" by comparing the costs of the different production structures. Notably, only the difference of the transaction costs, which characterizes the relative advantage of an organization, and not the absolute value, is decisive. The transaction costs are influenced by opportunism, asymmetric information and bounded rationality and increases, if transactions are characterized by certain properties. Thus, the properties of the transaction influence the costs and determine the organizational structure. Williamson (1986) categorizes the relevant properties of the transactions in asset specificity, uncertainty and infrequency. If a transaction is characterized by less uncertainty, no specific investments or a high frequency, the activity should be provided by the market, respectively realized by outsourcing. Integrated production, respectively hierarchy, occurs if the opposite characteristics hold.

Industry View

Close to the cost saving argument, this approach also explains outsourcing. It is intuitive that the profit potential of a firm is influenced by structural characteristics of its environment. Porter (1980) identifies entry barriers, threat of substitution, bargaining power of buyers and suppliers and the degree of competiveness in an industry as those structural properties. Therefore, firm's actions are interpreted as defence against these forces to achieve a strong position within an industry. However, this can only be realized if the firm has essential competitive advantages. According to Porter (1985), such advantages can result from cost leadership or differentiation. Both strategies can be pursued by the organizational choice, since integration or outsourcing lead to lower costs and also generate a differentiation feature.

Resource-Based Approach

Within this view, the competitive advantage of a firm in relation to other firms in an industry does not result from cost reduction but the use of free and/or unique resources. Thus, the resource-based theory compares the strength and weakness of

an enterprise and sees outsourcing as a possibility to focus on the core competence by the final good producer. Therefore, only non-strategic relevant activities should be outsourced. The management thus has to identify, if outsourcing of a certain activity influences the competitive advantage of a firm. As we mentioned earlier, after external procurement, the free capacity may be used to concentrate more intensively on core activities or to increase the flexibility and realizing a stronger market position. Beside this advantage, the final good producer additionally profits from important resources, i.e. the know-how, of the specialized intermediate good supplier and can improve its competitive advantage and thus its market position through higher quality. Following this argumentation, the resourced-based approach explains why firms differ in the production structure, since outsourcing creates a substantial advantage by focusing on the different core activities of the firms.

Relational View

This approach explains the competitive advantages of inter-organizational relationships. If different firms are able to combine their resources in a unique way, they are able to generate relational rents and to gain competitive advantages over firms that are unable to do so. Therefore, this approach focuses on the mentioned possibility of using the know-how of the outsourcing partner by outsourcing. Due to the new knowledge, the performance can be improved and thus a stronger market position by the alliance of these firms can be realized. An important property of relational rents is that they cannot be created by one firm alone. Thus, an alliance is crucial for the creation of this advantage. Sources which promote the existence of such profits are for instance i) inter-firm specific assets, where in a long-term relationship the partners account for the special production needs, ii) inter-firm knowledge sharing routines, where knowledge will be exchanged between the firms or iii) complementary resource endowments.

In practice, one reason alone cannot explain the outsourcing decision, but the interplay of the different approaches. However, the above paragraph should only give a short overview concerning driving forces of the different approaches and incorporate the mentioned advantages and disadvantages in a wider context to justify outsourcing.

1.2 Aim of the Analysis

As we mentioned, in a global world a firm reallocates its relatively inefficient parts of production stages and increases the average productivity. This increasing productivity affects the domestic labour market outcome in two ways. Given a constant output level, an increase in productivity reduces employment. However, due to the possibility of reducing production costs as a main factor of the outsourcing decision (see Holl, 2008), the output price falls and induces a higher demand. This scale effect may increase labour demand. Thus, the net effect is a priori ambiguous.

The impacts of outsourcing on labour market outcomes are analysed in a growing empirical research. Most of these studies conclude that wages and employment of low-skilled workers decline, but on the other hand, high-skilled workers benefit from outsourcing at least in the short-run.[9] This is intuitive, since taking up a new job requires some time for the search and application process. In long-run analyses, such as Amiti and Wei (2005, 2006) or Olsen et al. (2004), it is shown that the negative short-run effect can be dampened or offset by a labour demanding effect in other sectors.[10]

Nevertheless, in the focus of the public debate, outsourcing is seen as a short-run phenomenon and, thus, media, social organisation as labour unions and politics focus on the involved job losses and wage decline that cause social and economic problems. From such a political point of view government interactions are justified.

In our analysis, we adopt this short-run argumentation and analyse different interactions with regard to their effect on outsourcing, wage and employment.

In the first part, which includes Chapter 2 and 3, we assume that the interests of political and labour market institutions, such as trade unions are to secure existing jobs and realize an adequate wage level. To achieve the employment aim, due to the underlying cost reduction motive of outsourcing, the domestic wage level has to fall. However, this is contrary to the aim of an adequate wage. Therefore, an instrument is needed that helps to decrease domestic wages without lowering the workers' income or alternatively, for a given domestic wage level, increases the productivity of integrated production.

Profit sharing may be such an instrument. Since the workers participate in the firm's profit, their motivation increases and they have an incentive to increase effort and

9 See Geishecker (2006) or Görg and Hanley (2005). A survey is presented by Knabe and Koebel (2006).

10 An introduction in the theoretical analysis is done by Bhagwhati et al. (2004).

thus increase productivity for a given wage level.[11] On the other hand, this type of compensation scheme also affects wage negotiations and, consequently, the wage level. Due to the introduction of profit sharing, a part of the income is independent from the wage, which may lead to a lower wage level without losing any income. Therefore, this instrument may meet the employment goal without losing any income.
Since profit sharing can be granted to high-skilled or low-skilled workers, we distinguish between these two cases. The central questions concerning the implementation of a profit sharing scheme in a partial equilibrium model, where the low-skilled wage is set by the trade union, are:

1. Can profit sharing increase the workers' productivity?
2. How does profit sharing affect the number of outsourced activities?
3. In which way do profit sharing and outsourcing costs influence the domestic wage level?
4. What are the effects on employment in a firm?
5. What are the consequences for the wage gap in a firm?

Answering these questions should help the government decide whether or not to abolish profit sharing, which can also be interpreted as bonus payments, or to set incentives for promoting the implementation of such compensation schemes for the different types of labour in the individual firms.

In line with the industry view, the second part of the analysis, Chapter 4 and 5, sees outsourcing as in instrument to achieve a strong market position for a firm in its branch. Therefore, in conformity with this approach and the long-term character of the organizational choice, outsourcing is an instrument for strategic interactions between companies. Thus, the decisions of a firm are affected by structural market characteristics, such as the degree of competitiveness, and the decisions of its competitors. However, also governmental interventions, such as taxes and subsidies, can influence the organizational choice and therefore the market outcome. Concerning the analysis of the strategic effects of outsourcing in oligopolistic output markets with market interaction by the government, the central questions are:

1. How does the organizational choice affect each other?

[11] A solution for the underlying moral hazard problem is presented in the relevant chapter.

2. Which effects on outsourcing and employment result from governmental interactions?
3. What is the role of the motivation of outsourcing?
4. What are the welfare effects of the certain production strategies?

Answering these questions, we can evaluate different policies and identify situations, in which the government increases employment by influencing the production choice.

The next sections will give a briefly summary of the chapters.

1.3 The Role of Profit Sharing in a Dual Labour Market with Flexible Outsourcing

The discussion above has pointed out that employee participation in firm's profit due to a profit sharing scheme can positively influence individual motivation and thus increase effort and productivity for a given wage level. This effect, in turn, increases profit and may promote an integrated production.
However, since every single worker decides independently on his/her effort provision, there may be a moral hazard problem, arising from the incentive to shirk. This may be solved by paying the profit share to the whole group, since this provides an incentive to observe each other. By creating this kind of peer pressure, the provision of the optimal individual effort becomes a social norm and thus helps to avoid shirking.
In this part, we assume that only high-skilled workers participate in such a remuneration scheme. If profit sharing increases effort, the demand for this type of labour rises accordingly. This high-skilled labour augmenting effect, however, affects the low-skilled outcome. If higher effort of skilled workers provides higher productivity, the firm's profit raises. This opens the opportunity for the trade union to pick up a higher share of this profit by demanding a higher wage for its member. Thus, there could be the possibility to realize an adequate wage income for low-skilled workers and lower wage dispersion in the firm. Since low-skilled labour and outsourcing are assumed to be substitutes, the participation of high-skilled worker in firm's profit creates an indirectly positive effect on the outsourcing demand. Thus profit sharing increases marginal costs and will dampen the advantage of domestic production and increases outsourcing activities.

From this framework, we can also describe the employment effects for both types of labour. For the low-skilled labour demand, there will be a negative impact based on the wage increase. However, the implementation of a profit sharing scheme increases the effort of the high-skilled worker and, due to the complementary relationship, the demand for the low-skilled typ. Thus, the effect on low-skilled employment is a priori ambiguous. For the high-skilled, too, the employment effect is also a priori ambiguous, since there is also a labour enhancing effect through higher effort, respectively productivity, but also a lower labour demand induced by the increase of the low-skilled wage. As an implication, we can conclude that a profit sharing scheme for managers helps to realize an adequate wage level for low-skilled workers, but could be accompanied by job losses for this type of labour. However, it is also possible that despite of the low-skilled wage increase and higher outsourcing demand, also the low-skilled employment increases.

1.4 Can Committed Profit Sharing Lower Flexible Outsourcing?

In contrast to Chapter 2, in this section, low-skilled labour participates in a firm's success via profit sharing. Also effort is interpreted differently. In this framework, it is seen as a working condition which positively influences the productivity. A standard example is the speed of the production line. Another difference results from interpreting effort as a working condition, since now effort can be part of the wage formation process, which means that not only the wage level is decided, but also the effort level, respectively the productivity. Thus, the aim in this chapter is to present the effects of a profit sharing system on productivity and wage level, if both result from a centralized wage formation process.

Our analysis shows that, despite the mutual determination of wage and effort, a profit sharing scheme can lead to a wage moderation effect due to the substitution of wage income by profit income and therefore induces a lower outsourcing demand. But the main result of this analysis is that the effort level is unaffected by profit sharing. This has an important impact on the effectiveness of the participation scheme. Since there is no productivity increasing effect, due to the centralized determination, a firm will optimally desist from implementing a profit sharing scheme. To be more specific, no worker will provide more effort than set by the wage formation process and therefore, a profit sharing scheme only leads to a contribution of profit to the workers without any positive effect on the profit. Although there is a wage moderation effect of profit sharing, this effect will not have any influence on this decision, from which one can conclude that the profit

effect of a wage reduction is too small to compensate the firm's owner for sharing the profit.
Following the above, we derive an important policy implication. Using profit sharing to moderate the low-skilled wage will only be possible if it is not unilaterally set be the firm, which means that it has to become part of the wage formation process or should be determine by an individual decision.

1.5 Outsourcing Motives, Competitiveness and Taxation

Following the industry view, a stronger position in the market can only created by a comparative advantage. For realizing this, firms have to pursue a cost leadership strategy. Therefore, the cost saving argument as the motivation for outsourcing can be characterized in two ways. First, outsourcing saves fixed production costs, however, the price for the outsourced input is higher than domestic marginal costs, while in the second way outsourcing leads to lower marginal costs, but is also associated with higher fixed costs than the integrated production. Since outsourcing can in both of the above mentioned trade-offs decrease the average cost it can lead to cost leadership.
Due to the choice of the production structure, the costs of a firm and the output price, as well as the profit of the competitor are influenced. Thus, the market positions of the firms are affected and strategic interactions may occur. To analyse these interactions, we model a simple Cournot-oligopoly with homogenous goods. Here, we assume that every output unit requires more than one input, where the firms decide about the share of inputs that are either produced internally or outsourced. Therefore, we can focus on partial outsourcing and derive the strategic interactions of outsourcing decisions.
In the first part of our analysis we see outsourcing as an investment preventing intensive fixed costs. Under this motivation, we show that the outsourcing decisions are strategic substitutes, which follows from our assumed trade-off between investment cost savings and additional marginal cost payments by outsourcing. If one firm decreases its proportion of outsourcing due to lower marginal costs, it will increase the intensity of competition, which reduces the market share and output of its competitor. The other firm will react to the new situation by adjusting its production mode. Since the integrated production is associated with fixed costs, it becomes more difficult to bear these costs and the firm will thus produce with a higher share of outsourcing to avoid the fixed costs.

After analyzing the strategic interaction, the effect of competition on the equilibrium outsourcing proportion can be examined. Here, we find that there is a positive correlation between the number of firms and the equilibrium share of externally procured inputs. Due to the fact that a stronger competition lowers the individual output, our former argumentation can be used to explain this finding. Also the impact of different policies will be analysed. Our focus is on the effect of changing domestic characteristics, such as the domestic production costs or the tax system. Since for a given number of competitors, the relation of marginal and fixed costs drives the outsourcing decision, lower domestic marginal and/or fixed costs will promote integrated production and thus lead to less outsourcing and more domestic employment. Tax reforms are also suitable for influencing the production choice. Taxing the output decreases the demand and thus the output per firm, which increases the incentive for more outsourcing to avoid fixed costs.
Assuming the reversed trade-off, so that outsourcing is motivated by a marginal cost advantage, we also analyse the strategic interaction, impact of competition and taxation. While the strategic property is unchanged, the effect of competition and taxation is the opposite of the former analysis. In both cases, there is a decreasing output. However, now outsourcing requires fixed costs, lower revenues are used for financing these fixed costs and profit will decline. Therefore, the motivation of outsourcing is decisive for the effects of changes in market characteristics. Thus, higher competition and taxation increases the incentive to produce more integrated.
Due to the opposite results, our analysis allows us to postulate a policy statement concerning the domestic tax policy. If the aim is to lower the incentive of outsourcing the taxation has to account for the outsourcing motivation and therefore on can derive a justification for a differentiated taxation.

1.6 Welfare Effects of Strategic Outsourcing in a Duopolistic Market

In this chapter the previous framework will be generalized, by concentrating only on one input component. To analyse the interactions, we model a simple Cournot-duopoly with homogenous goods, where the firms can choose between an integrated production and outsourcing of the input component. Deciding on the production mode, every firm faces the trade-off between lower fixed costs and higher marginal costs due to outsourcing. Since the firms face the choice between a completely integrated production or complete outsourcing, there are three different market constellations, i) both firms produce integrated (in-house), ii) both firms use external procurement (outsourcing) or iii) the firms operate with different production modes

(one firm produces integrated, while the other firm outsources). Because in this setting the relationship of fixed and marginal costs is decisive, we show that existence of one of these constellations depends on the cost relation. If the marginal cost disadvantage is sufficiently low (high) or the fixed cost saving sufficiently high (low), both firms will outsource the input production (produce integrated), while an asymmetric constellation results from medium cost levels.
Since the cost relations determine the market outcome, both, consumers and producers are affected by the production mode decision. Therefore, in the second part of this chapter, we compare the welfare in the different market constellation, using the sum of the profits and the consumer rent as the welfare measure. From this comparative static, we conclude if a resulting constellation is pareto inferior or superior to another constellation of production modes. Here we find that a situation with different production strategies is superior to symmetric production modes. Thus, for unchanged cost, if the firms decide on asymmetric choices, neither a constellation with bilateral integrated production nor a constellation with bilateral outsourcing yields higher welfare. Furthermore, we find that if the market situation is characterized by bilateral outsourcing, welfare cannot increase through bilateral in-house production. However, at given fixed costs and a sufficiently high marginal cost disadvantage of outsourcing, a constellation with asymmetric production strategies can increase the welfare level. We find a similar result, in a symmetric constellation with bilateral in-house production. If both firms choose the integrated production, for unchanged costs, welfare cannot increase by producing with bilateral outsourcing, while under certain cost conditions an asymmetric structure increases the welfare. Thus, the profit maximizing behaviour of the firms does not necessarily correspond with a superior welfare outcome. Therefore, our analysis shows that there is a scope for a benevolent planner to interact and influence the decisions concerning the production mode.

1.7 Preliminary Conclusion

As empirical studies show, at least in the short-run, outsourcing is associated with lower domestic employment. If the policy wants to achieve a high employment level, especially of low-skilled workers, the domestic production has to become more attractive. One way to achieve this is to lower domestic production costs by reducing the wage level or increasing productivity. Profit sharing is considered an instrument that may realize both.

Since high-skilled and low-skilled workers can participate in the firm's success, in this thesis we analyse the effects of profit sharing on wages and thus on outsourcing and employment if both groups get a profit income. The result obtained from analysing profit sharing for high-skilled employment is not as bad as public opinion believes. Profit sharing increases productivity and the labour demand for high-skilled workers, which opens scope for realizing higher wages for low-skilled employment. Although this leads to a lower labour demand of low-skilled workers and higher outsourcing, the increasing productivity effect may offset this decrease. Therefore, bonus payments for high-skilled workers must not lead to lower employment of low-skilled workers.

However, in the case a profit share is paid to the low-skilled, the firm will desist from profit sharing if the low-skilled trade union sets the wage and determines the effort. Therefore, we conclude that profit sharing for low-skilled employment should be part of the wage negotiation and not be set unilaterally by the firm.

Other ways to lower domestic costs are fixed cost assistance and/or lower indirect labour costs. As the second part of this thesis shows, both instruments reduce outsourcing and increase employment in a single industry, if the domestic production is associated with lower marginal costs but higher fixed cost than the external procurement. Therefore, we can conclude that political instruments are appropriate measures to achieve higher employment. However, the government can also influence the outsourcing decision via taxation. By reducing the output in a market, it works to intensify the competition. But here, the motivation for outsourcing becomes relevant, i.e. it becomes harder to bear the fixed costs of the production and thus the production mode with the higher fixed costs becomes less attractive.

Since we also show under the assumption that firms behave rational the resulting production structure is not necessarily pareto superior, there is also from the welfare point of view a leeway for market interferences by the government.

PART II: OUTSOURCING IF LABOUR MARKETS ARE IMPERFECT

This part deals with the often formulated postulation of employee involvement due to the practice of bonus payments, respectively profit sharing. Thereby, we distinguish two cases. In the first case only high-skilled workers such as managers receive these payments, where in the case only low-skilled participate on firm's profit via profit sharing. Here we are interested on the effects of this additional remuneration on the low-skill employment, low-skilled wage and outsourcing, if the low-skilled are represented by a trade union.

Chapter 2

The Role of Profit Sharing in a Dual Labour Market with Flexible Outsourcing*

Abstract

In this chapter, we analyse the following question associated with flexible outsourcing under partly imperfect dual domestic labour markets, where skilled workers participate in a firm's success via profit sharing: How does the implementation of profit sharing influence flexible outsourcing and low-skilled wage and thus how does it affect employment? We show that profit sharing has a positive effect on the bargained low-skilled wage and thus an outsourcing enhancing character. Also higher outsourcing costs will increase the low-skilled wage, so that higher costs for external procurement and profit sharing will decrease the wage dispersion in a firm. On the other hand, the employment effect of profit sharing is ambiguous, since there is an employment reducing effect due to higher wage for the low-skilled worker, which can be offset by the employment increasing effect of higher effort.

JEL Classification: E24, J33, J51, J82
Keywords: flexible outsourcing, profit sharing, dual labour market, employee effort

* This chapter is a joint work with Erkki Koskela from the University of Helsinki and based on Koskela and König (2009a).

2.1 Introduction

In an integrated world, marginal cost differences are the driving force for the reallocation of production parts (offshoring) and for the make-or-buy decision (outsourcing). Especially for Western European countries, the wage and labour cost differences constitute a central explanation for the increasing business practice of offshoring and international outsourcing to Eastern European or Asian countries.[12] Reasons for the wage gap are, amongst others, differences in labour market institutions and the process of wage determination. In most Western European countries, wages are determined by bilateral bargaining between firms or employer federations and trade unions. In opposite, unions in Eastern European or Asian countries are much weaker or wages are determined by market forces. Typically low-skilled workers in Western Europe are unionized so that labour unions are able to push for their relatively high wages at the costs of a higher unemployment in continental Europe than in the United States (see e.g. Freeman and Schettkat, 2001). Since Western European firms have the opportunity to buy foreign intermediate goods after knowing the domestic wage levels and so the marginal production costs, this knowledge affects the domestic wage formation process for the low-skilled and high-skilled workers, since the firm can use outsourcing to build up the fear of substitution. Thus, the threat of flexible outsourcing as a reaction to high domestic marginal production costs will dampen the opportunity of the trade union to realize a high wage level especially for low-skilled workers. To induce Western European firms to abstain from external procurement of intermediate goods, they need lower marginal costs. Since the wages for skilled and unskilled workers affect the domestic marginal production costs, there are two components to realize that. However, not in all cases lower wages are possible and another way has to be found for avoiding outsourcing. Since the choice of the firm is driven by the comparison of costs and productivity of the production structures, despite the higher marginal costs, domestic production can be beneficial if its productivity rises. One channel to increase the productivity of domestic production is to stimulate workers' effort. For this, the firm may introduce a profit sharing scheme that lets workers participate in the firm's success. Due to the profit participation a worker can increase its income with higher firm's profit and thus, the implementation of such a compensation scheme induces the incentive to increase effort and thus productivity for given wage levels. Empirical studies show that profit sharing is an important phenomenon in

[12] See Amiti and Wei (2005) and Rishi and Saxena (2004), who emphasize the big difference in labour costs as the main explanation for the strong increase in outsourcing of manufacturing and services to countries with low labour costs.

many OECD countries.[13] However, high-skilled workers, such as managers, often realize profit sharing as part of their income. The conclusion of the political debate about this procedure is that the participation of manager on firm's profit set wrong incentives, where politicians argue that due to the dependence of the income on the profit, the manager purely pursuit the strategy of highest short-run profit, which is one reason for the increasing practice of domestic jobs relocation.

But politics ignore other aspects of profit sharing. The idea behind a profit sharing scheme is to stimulate motivation and identification and thus productivity of the workforce due to the participation on firm's success, which is positively influenced by their effort. Although, only high-skilled workers often realize profit sharing as a part of their income, profit sharing will also affect the wage for high and low-skilled workers. An intuitively explanation for the influence on the high-skilled wage is the opportunity to substitute the wage income by profit income. Thus, the high-skilled wage level can decrease with an implementation of a profit sharing scheme. Also the wage for low-skilled workers, which is determined in a bargaining round, is affected. Since higher effort of skilled workers provides higher productivity and thus raises the firm's profit, this opens the opportunity for the labour union to pick up a higher share of this profit by demanding a higher wage for low-skilled workers. However, on the other hand, this will increase the costs of using for the low-skilled worker and thus profit sharing will dampen the advantage of domestic production and increases outsourcing activities.

As profit sharing becomes more in focus of firms, unions and the political discussion, the implications of bonus payments if firms are only profit orientated has to be analysed from a theoretical point of view by analysing the different effects and support or confute the public opinion.

Concerning the analysis of the effects of outsourcing on compensation schemes under wage bargaining, there are two focuses in the literature: the case of committed and flexible outsourcing. While in the committed case, outsourcing takes place before wage bargaining[14], in the flexible case outsourcing is decided after wage bargaining. Our focus in this chapter is to assume that outsourcing is flexible, i.e. determined simultaneously with domestic labour demand, but after wage formation for low-skilled workers. To our knowledge, the first, who study the effects of

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13 See Pendleton et al. (2001) for an overview, where recent and detailed data of the financial employee participation in 14 EU countries is presented. For further analysis of profit sharing see also Wadhwani and Wall (1990), Cahuc and Dormont (1997), Estrin et al. (1997) and Conyon and Freeman (2004).

14 See e.g. Perry (1997) for an overview about the relationship between outsourcing and wage bargaining.

flexible outsourcing on wage setting, is Skaksen (2004). He has analysed the implications of outsourcing, in terms of potential (non-realized) and realized international outsourcing, for wage level and employment under imperfectly competitive homogeneous labour markets. By assuming that output is produced by combining two intermediate activities, where one activity can be perfectly substituted by outsourcing, he shows that the wage level depends positively on outsourcing costs. To be more precisely, he characterizes three cases of the relationship of domestic wage level and outsourcing costs. First, if the costs of external procurement are under a lower bound, the domestic union will desist from wage dumping to avoid outsourcing. Second, when the costs are over a critical value, then there is no outsourcing and the union can set a relative high wage level. For cost levels between these limits, the third case, external procurement can be prevented by setting the domestic wage level equal to the outsourcing costs. Braun and Scheffel (2007b) have developed a simple two-stage game between a monopoly union and a firm by assuming that the labour union sets wage before the firm decides on the degree of outsourcing. In their model the costs of outsourcing have an ambiguous effect on the wage. However, in the mentioned papers the authors have abstracted from the analysis of profit sharing as a part of the compensation scheme or heterogeneity of labour force, which is our focus.[15] Also the effects of profit sharing are studied in the literature. For instance, the wage effect of both committed and flexible profit sharing is analysed by Koskela and Stenbacka (2006).[16]
By combining outsourcing and profit sharing in a dual labour market we provide answers to the following question: How does the implementation of profit sharing for high-skilled workers influence the low-skilled wage level and thus outsourcing activities and employment? By analysing our main question, we thus also answer: How do the costs of outsourcing influence the wage for low-skilled workers?
We analyse these questions in a partial equilibrium model in which we assume a time sequence of the profit sharing decision, where firms commit to profit sharing

[15] For an introduction into the debate on dual labour markets, see Saint-Paul (1996). Koskela and Stenbacka (2010) analyse strategic outsourcing in a dual labour market in the presence of wage solidarity by the labour union. They find that outsourcing promotes the wage dispersion between high-skilled and low-skilled workers while the labour union's solidaristic wage policy will dampen this tendency. Moreover, they find that outsourcing will reduce equilibrium unemployment if the proportion of high-skilled workers is sufficiently low. Also Davidson et al. (2007, 2008) analyse the effects of outsourcing when labour is heterogeneous. However, they concentrate on labour market frictions that arise with search, while we focus on the role of labour unions in the case of unskilled wage formation.

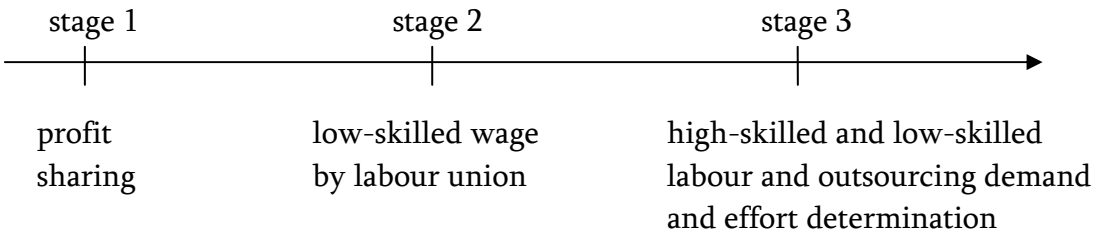
[16] There are some studies that analyse the wage effect of profit sharing. See also Weitzman (1987) and Holmlund (1990).

before the base wage formation and decide flexible about the amount of outsourcing after knowing the domestic production costs. We find that the profit participation has an individual effort augmenting effect for high-skilled workers, which increases the labour demand. Due to the complementary relationship of labour types, this increases the low-skilled wage, so that for a constant high-skilled wage, bonus payments lead to lower wage dispersion in a firm, where a profit sharing scheme is implemented. However, the employment effect of profit sharing for both types of labour is ambiguous. On the one hand, there is a labour augmenting effect via higher effort, but on the other hand there is a labour reducing effect via the induced wage increase for low-skilled workers. Since in our framework, outsourcing and low-skilled labour are substitutes and profit sharing increases the low-skilled wage, it has an enhancing effect on outsourcing activities. Furthermore, we find that higher outsourcing costs lead to an increasing wage for low-skilled workers and also lower the wage dispersion.
We proceed as follows. Section 2.2 presents the basic structure of theoretical framework. Labour and outsourcing demand and employee effort are presented in Section 2.3 whilst Section 2.4 investigates the low-skilled wage formation and employment effects. Finally, we present our conclusions in Section 2.5.

2.2 Basic Framework

We analyse in a model with heterogeneous domestic workers, i.e. a dual domestic labour market, flexible international outsourcing and committed profit sharing. The production combines effective high-skilled worker services and low-skilled worker services. Effective high-skilled employment is a combination of absolute high-skilled employment and the effort by high-skilled workers, i.e. their productivity. Following empirical studies (see e.g. Görg and Hanley, 2005, and Munch and Skaksen, 2009), we assume that low-skilled workers and outsourcing activities are substitutes, so that low-skilled labour services can be provided either by the firm's own workers, or obtained from abroad through international outsourcing. Furthermore, we assume that the firm is flexible enough to decide upon the amount of external procurement after the wage for low-skilled workers is set by the monopoly labour union. Therefore, flexible outsourcing acts as a threat in domestic wage bargaining and work against high domestic marginal production costs, respectively low-skilled wage.
The analysed timing sequence of the decisions is summarized in Figure 2.1.

Figure 2.1: sequence of events



In this timing structure profit sharing is assumed to be committed at stage 1 and at stage 2 conditional on profit sharing, the labour union determines the wage for low-skilled workers by taking into account how this affects the demand for labour and outsourcing by the firm. At stage 3, the representative firm decides on domestic employment and international outsourcing. The wage of the high-skilled labour is adjusted to the constant world market level and given for the firm. Moreover, the representative skilled worker decides on effort provision given this wage level and the profit share and thus, knowing the earning components.
The decisions at each stage are analysed by using backward induction.

2.3 Labour Demand, Outsourcing Decision and Employee Effort

2.3.1 Labour Demand and Outsourcing

At the last stage, the representative high-skilled worker decides the individual effort e_i and the representative firm decides the skilled labour demand H, the low-skilled labour demand L, and outsourcing M.
The firm decides domestic labour demand and outsourcing to maximize the profit function

$$\max_{H;L;M}(1-\tau)\cdot\pi = (1-\tau)\left[F(\bar{e}H, L, M) - w_H H - w_L L - g(M)\right], \qquad (2.1)$$

by taking the average high-skilled worker's effort $\bar{e}$, the low-skilled and high-skilled wages, w_L and w_H, as well as profit share τ, as given. The average effort is

defined as $\bar{e} = \frac{1}{H}\sum_{i=1}^{H} e_i$, so that the impact of provision of an additional unit of effort by a single worker is $\frac{\partial \bar{e}}{\partial e_i} = \frac{1}{H}$.[17]

In order to obtain M units of outsourced low-skilled labour input, we assume that firms have to spend $f(M) = 0{,}5cM^2$ with $f'(M) > 0$ and $f''(M) > 0$. This cost formulation reveals that there are some other costs associated with outsourcing such as the price the intermediate goods. Such costs could be costs for quality proofing or transport, which are exponential increasing with higher outsourcing. To allow for an exponential cost increase, we model a quadratic cost function.

We assume a Cobb-Douglas-type production function with decreasing returns to scale according to three inputs, i.e. $F(\bar{e}H, L, M) = (\bar{e}H)^{\alpha}(L+M)^{\beta}$, where the parameters α and β are assumed to satisfy the assumptions $\alpha, \beta > 0$ and $1-\alpha-\beta > 0$.[18] From the production function, we can derive the marginal products of high-skilled labour, low-skilled labour and outsourcing: $F_H = \alpha \frac{F(\bar{e}H, L, M)}{H} > 0$ and $F_L = \beta \frac{F(\bar{e}H, L, M)}{L+M} = F_M > 0$. The outsourced low-skilled labour input affects the marginal products of the domestic high-skilled and low-skilled labour inputs as follows

$$F_{HM} = \alpha \cdot \beta \cdot \frac{F(\bar{e}H, L, M)}{H \cdot (L+M)} > 0 \text{ and } F_{LM} = -(1-\beta) \cdot \beta \cdot \frac{F(\bar{e}H, L, M)}{(L+M)^2} < 0.$$

Taking these derivatives, we can conclude that for our type of production function the domestic high-skilled labour input and the outsourced low-skilled labour input are complements, whereas the low-skilled domestic labour input and the outsourced input are substitutes in terms of the marginal product effects. Also, one can calculate from the production function that domestic high-skilled and low-skilled labours are complements, i.e. $F_{HL} = F_{HM} > 0$. Using the marginal products we can calculate the

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17 A specification, which is also common in the literature, describes effort as the fraction of working hours that the worker actually works. Since the number of working hours is normalized to 1, the choice of an individual is $e_i \in (0;1)$ and thus $(1-e_i)$ characterizes the fraction of time spent shirking. Following this $\bar{e}H$ is the whole actual working time.

18 Koskela and Schöb (2010) use a similar formulation of the relationship between domestic labor and outsourcing. However, they abstract from high-skilled employment and focus on the effects of labour taxation on strategic and flexible outsourcing if firms are unionized.

first-order conditions characterizing the domestic skilled and unskilled labour demand and outsourcing activities as[19]

$$\pi_H = \frac{\alpha}{H} F - w_H = 0 \tag{2.2a}$$

$$\pi_L = \frac{\beta}{(L+M)} F - w_L = 0 \tag{2.2b}$$

$$\pi_M = \frac{\beta}{(L+M)} F - cM = 0\,. \tag{2.2c}$$

The first-order conditions (2.2a) and (2.2b) imply the relationship between the high-skilled (H) and the low-skilled labour, inclusive of outsourcing $(L+M)$, as follows

$$H = \frac{w_L}{w_H} \frac{\alpha}{\beta} (L+M). \tag{2.3}$$

Using (2.2b) and (2.2c) we get the demand for outsourcing as

$$M = \frac{w_L}{c}, \tag{2.4}$$

where $-\frac{M_c\, c}{M} = 1 = \frac{M_{w_L} w_L}{M}$. According to equation (2.4) higher low-skilled domestic wage rate and lower outsourcing costs will increase outsourcing. Substituting (2.3) into the production function in equation (2.2b) gives the low-skilled labour demand, which can be expressed as

$$L = m w_L^{-\delta} w_H^{-\varepsilon} \bar{e}^{\varepsilon} - M = m w_L^{-\delta} w_H^{-\varepsilon} \bar{e}^{\varepsilon} - \left(\frac{w_L}{c}\right), \tag{2.5}$$

where $m = \alpha^{\varepsilon} \cdot \beta^{\delta} > 0$, $\delta = \frac{1-\alpha}{1-\alpha-\beta} > 1$ and $\varepsilon = \frac{\alpha}{1-\alpha-\beta} > 0$. According to (2.5), a more extensive outsourcing activity will decrease the low-skilled labour demand, which shows the substitutability of low-skilled labour and international

[19] Note, that the profit of the firm owner is $(1-\tau)\cdot\pi$. However, due to our modeling of committed profit participation, profit sharing works as a profit tax. Since this kind of tax is characterized by neutrality, the domestic labour demand is independent of profit sharing.

outsourcing. As we can see, higher own wage and cross wage and lower high-skilled effort will negatively affect the low-skilled labour demand. The direct own wage and cross wage elasticities of low-skilled labour and the effort elasticity of the low-skilled labour can be written as

$$\eta_L = -\frac{\partial L}{\partial w_L}\frac{w_L}{L} = \delta + (1+\delta)\frac{M}{L} = \delta + (1+\delta)\frac{w_L}{cL} \tag{2.6a}$$

$$\eta_H = \eta_{\bar{e}} = -\frac{\partial L}{\partial w_H}\frac{w_H}{L} = \frac{\partial L}{\partial \bar{e}}\frac{\bar{e}}{L} = \varepsilon \cdot \left(1 + \frac{M}{L}\right). \tag{2.6b}$$

Note, that in the absence of outsourcing both the wage and effort elasticity are constant and smaller, i.e. $\eta_L\big|_{M=0} = \delta$ and $\eta_{\bar{e}}\big|_{M=0} = \varepsilon$.

Finally, substituting equation (2.5) into equation (2.3) gives the high-skilled labour demand

$$H = \frac{m\alpha}{\beta} w_H^{-(1+\varepsilon)} w_L^{1-\delta} \bar{e}^{\varepsilon}, \tag{2.7}$$

where $(1+\varepsilon) = -\frac{H_{w_H} w_H}{H} > 1$ and $(1-\delta) = -\frac{H_{w_L} w_L}{H} < 0$. These elasticities are higher with weaker decreasing returns to scale, but unlike in the case with low-skilled labour, the own wage and cross wage labour demand elasticities of high-skilled labour are independent of outsourcing.

Using the equations (2.4), (2.5) and (2.7) and plug into the profit function (2.1) we can write the indirect profit function as follows

$$\pi^* = \frac{(1-\alpha-\beta)\cdot m}{\beta} \cdot w_H^{-\varepsilon} \cdot \bar{e}^{\varepsilon} \cdot w_L^{1-\delta} + \frac{1}{2}\frac{w_L^2}{c}. \tag{2.8}$$

2.3.2 Effort Formation and Direct Employment Effects for High-Skilled Workers

Effort Determination of High-Skilled Workers

In line with the literature of efficiency wage models, we assume that for the employed high-skilled worker the utility function is additively separable in income and effort, while the utility depends positively on wage and profit income and

negatively on the disutility of effort. Following this specification, the employed skilled worker receives an income of I, which includes the wage w_H and the profit income $\tau \cdot \frac{\pi^*}{H}$ so that the overall remuneration can be written as $I = w_H + \tau \cdot \frac{\pi^*}{H}$. The idea behind this is that high-skilled workers are assumed to be a team. The whole team gets the profit income $\tau \cdot \pi^*$, which is distributed equally among the members. However, to get the profit income, it causes effort provision of a worker. Since the worker dislikes effort provision, it is associated with a disutility, which can be described by $g(e_i)$, where $g(e_i) = \gamma \cdot e_i^{1/\gamma}$ is assumed to be a convex function with $0 < \gamma < 1$ so that $g'(e_i) > 0$ and $g''(e_i) > 0$.

For being simple we assume a small firm so that the wage the firm pays is the market wage for a high-skilled worker, and therefore they get anywhere the same wage w_H. A result of this assumption is that there will be no unemployment for this type of workers. However, the high-skilled jobs will be different with respect to their job characteristics due to the existence of a profit sharing system.

Notice, that every skilled worker in a firm, which implements a profit sharing system, gets the same per capita profit income, but the worker realizes the individual disutility for providing a certain effort level. Thus, there is space for free-rider behaviour by the single worker, which means that there is an incentive for shirking. The biggest problem of a firm's owner is to solve this moral hazard problem and to verify the individual effort.[20] However, in the discussion of the free-rider problem, interactions of the group member and peer pressure are often neglected. Due to the implementation of profit sharing there are incentives in the group to internalize the externalities of free-riding and avoiding shirking, since it sets some incentives to observe each other and interact.[21] Thus, observations can build up peer pressure to provide the individual effort resulting from individual utility maximization and eliminate the moral hazard problem concerning free-rider behaviour.

Following Kandel and Lazear (1992), we motivate this peer pressure as a group norm. Due to the observation, the individual feels shame or guilt if the individual

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[20] In the literature of efficiency wage models this is solved with paying a higher wage than the competitive level, see Salop (1979), Shapiro and Stiglitz (1984) and the book edited by Akerlof and Yellen (1986), which includes the standard efficiency wage models, i.e. shirking models, labour turnover models, adverse selection models and sociological models.

[21] See the analysis by FitzRoy and Kraft (1986), Holmstrom (1982), Holmstrom and Milgrom (1990) and Varian (1990). Radner (1986) shows, that in repeated games under certain conditions the free-rider problem can be eliminated even if the players cannot observe other players' actions or information, but can only observe the resulting consequences.

effort is below this norm, i.e. if the individual shirks, since it lowers the income for each team member. Due to this shame, the individual realizes a loss of utility. However, an effort above the norm will also decrease the individual utility, since now the other team member will feel shame. Thus, any deviation from the norm will lead to a utility loss and can be interpreted as a punishment. Since any deviation from the group norm decreases the individual utility, we model the peer pressure function as a quadratic function, which can in a simple form be written as $P(e_i) = (\tilde{e} - e_i)^2$, where $\tilde{e}$ is the social norm and defined as the average effort of all other workers than i.[22]

Using all our assumptions, we can formalize the utility function for an employed worker in a profit sharing firm in (2.9a) and (2.9b) in a firm, where is no profit sharing

$$v = w_H + \tau \cdot \frac{\pi^*}{H} - \gamma e_i^{1/\gamma} - (\tilde{e} - e_i)^2, \tag{2.9a}$$

$$\bar{v} = w_H, \tag{2.9b}$$

where π^* is the representative firm's profit and H describes the employment or the team size of this firm.

A worker's problem is to choose the level of individual effort to maximize its utility. For simplifying the analysis, we assume that the observation of a team member is costless and that the group norm is not affected by the individual effort, i.e. $\frac{\partial \tilde{e}}{\partial e_i} = 0$.[23] Thus, the optimal individual provided effort level results from individual utility maximization of (2.9a) with respect to effort, which yields the first-order condition[24]

$$v_e = \frac{\tau}{H}\pi_e^* - e^{(1/\gamma)-1} + 2(\tilde{e} - e) = 0. \tag{2.10}$$

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22 Within this framework, we assume that every group member can verify the effort of the others, but the firm owner cannot do this. It should also be emphasized, that the shirking or over motivated members are punished. However, this punishment is a utility loss and not an income loss, where the utility loss can be interpreted as mental harassment or social exclusion.

23 In our framework we assume Nash-behaviour, where every worker chooses his/her effort taking the effort of others as given. So there is no effect of effort provision by the other workers and thus no effect on the social norm. See also Lin et al. (2002).

24 The index i has been dropped for notational convenience.

Notice, that we focus on individual effort determination and thus the effect on employment will be not taken into account. Therefore, $\pi_e^* = F_e$ holds. Using the specification of the production function, the definition $\bar{e} = \frac{1}{H}\sum_{i=1}^{H} e_i$, which leads to $\frac{\partial \bar{e}}{\partial e_i} = \frac{1}{H}$, we obtain $F_e = F_{\bar{e}} \cdot \bar{e}_e = \alpha(\bar{e}H)^{\alpha-1}(L+M)^{\beta}$. Inserting the labour demand for low-skilled and high-skilled workers, i.e. equations (2.5) and (2.7), we find for the individual effect on profit $\pi_e^* = w_H / \bar{e}$.

Remember, that the group norm is defined as the observable average effort of all other team members. Assuming Nash-behaviour, where every worker takes the effort of the others as given, in the equilibrium, the individual chosen effort level equals the group norm, which corresponds to the average effort level of all other group members. Thus, we have $e = \tilde{e}$. Since this is true for every single worker for identical workers, the individual effort also equals the average effort level and effort level which would be chosen without any peer pressure. Using this, we get from solving equation (2.10)

$$e = \bar{e} = \tilde{e} = \left(\frac{\tau \cdot w_H}{H}\right)^{\gamma}. \tag{2.11}$$

As equation (2.11) shows, the optimal effort by the representative high-skilled worker is influenced by the income parts, but outsourcing will have no direct effect. From (2.11) it is easy to see that for $\tau = 0$ no effort will provided so that concerning our production function, this means that output falls to zero. Therefore, we assume that the committed profit share is set according to $0 < \tau < 1$.

Since changes in low-skilled wage and profit income affect all high-skilled workers, each of them will adjust its effort and thus the average effort will change. These effects we derive by taking the differential of the effort function (2.11). Here, we find $\frac{d\bar{e}}{dw_L} > 0$ and $\frac{d\bar{e}}{d\tau} > 0$ (see Appendix A), so that the low-skilled wage and profit sharing enhance productivity by increasing effort provision and positively affect labour demand indirectly, which lies in conformity with empirics.[25] As a result of a higher low-skilled wage the low-skilled labour demand falls and due to the complementary relationship of the two types of labour, the high-skilled labour demand also decreases. However, decreasing high-skilled employment raises the

[25] See e.g. Bhargava and Jenkinson (1995), Booth and Frank (1999), Cable and Wilson (1990), Kruse (1992) and Lynn Hannan (2005).

effort provision of an employed high-skilled worker, since the influence of an individual worker on profit increases and he/she provides more effort. We can summarize our findings as follows:

Proposition 2.1:

Profit sharing and the low-skilled wage have an individual effort augmenting effect and thus increase productivity.

Important for the next analysis is the effort elasticity of low-skilled wage. In our framework we find $\varphi = \frac{d\bar{e}}{dw_L}\frac{w_L}{\bar{e}} = \frac{(\delta - 1)\cdot\gamma}{1+\gamma\cdot\varepsilon}$, where $0 < \varphi < 1$ (see Appendix A). This condition has to be met, since it ensures, that the low-skilled wage setting by the labour union is binding.

Direct Employment Effects for High-Skilled Workers

Since we assume a constant skilled wage w_H, the employment of high-skilled workers is described by equation (2.7). Thus, we can determine for this type of labour the direct employment effects of low-skilled wage and profit sharing by taking into account the effects of effort provision.
The low-skilled wage affects the high-skilled labour demand in a direct way and also in an indirect way via the effort provision. The direct effect shows the complementarity between both labour types, since a higher low-skilled wage decreases the high-skilled labour demand. The indirect effect effort works in the opposite direction, because higher low-skilled wage raises effort and higher effort increases high-skilled labour demand. Formally, the influence of the low-skilled wage on the employment of the high-skilled workers can be presented as follows

$$\frac{dH}{dw_L} = \frac{\partial H}{\partial w_L} + \frac{\partial H}{\partial \bar{e}}\cdot\frac{d\bar{e}}{dw_L} = \frac{H}{w_L}\cdot\left[\frac{\partial H}{\partial w_L}\frac{w_L}{H} + \frac{\partial H}{\partial \bar{e}}\frac{\bar{e}}{H}\cdot\frac{d\bar{e}}{dw_L}\frac{w_L}{\bar{e}}\right].$$

By using $\frac{\partial H}{\partial w_L}\frac{w_L}{H} = 1-\delta$, $\frac{\partial H}{\partial \bar{e}}\frac{\bar{e}}{H} = \varepsilon$ and $\frac{d\bar{e}}{dw_L}\frac{w_L}{\bar{e}} = \varphi$ we can simplify the high-skilled employment effect of the low-skilled wage to (for the sign see Appendix A)

$$\frac{dH}{dw_L} = \frac{H}{w_L}\cdot\left[1-\delta+\varepsilon\cdot\varphi\right] < 0\,, \tag{2.12}$$

so that there is a negative relationship between the low-skilled wage and the employment of the high-skilled workers and the direct complementary effect dominates the indirect effort effect.
Profit sharing affects the high-skilled labour demand only via the provided effort. Since higher profit sharing enhances effort provision and higher effort increases high-skilled labour demand, there is a positive indirect relationship between high-skilled employment and profit sharing. Differentiating (2.7) with respect to profit sharing and taking into account the effort effect gives

$$\frac{dH}{d\tau} = \frac{H}{\tau} \cdot \left[\frac{\partial H}{\partial \bar{e}} \frac{\bar{e}}{H} \cdot \frac{d\bar{e}}{d\tau} \frac{\tau}{\bar{e}} \right] = \frac{H}{\tau} \cdot \varepsilon\gamma > 0 . \tag{2.13}$$

We can summarize our findings regarding the properties of the high-skilled employment in the presence of outsourcing as follows:

Proposition 2.2:

In the presence of flexible outsourcing

a) *the wage for low-skilled workers affects a firm's demand for high-skilled workers in two ways, directly due to the complementarity of inputs and indirectly due to the induced higher effort, where the direct effect dominates, so that higher low-skilled wage reduces skilled employment and*
b) *profit sharing affects the skilled worker demand of a firm only indirectly due to the effort channel, where the induced positive effort effect of profit sharing increases the high-skilled labour employment.*

These results are intuitive in our setting. Higher low-skilled wage will affect the high-skilled labour demand via two channels. The first is the negative direct wage effect, which leads to a lower high-skilled employment due to the complementary relationship between the types of labour. However, a lower high-skilled team size will increase the individual effort, which increases the firm's high-skilled labour demand. This channel describes the second working mechanism, which is a positive indirect effect. As we showed in our analysis, the direct effect dominates and thus higher low-skilled wage will reduce the high-skilled employment.
The positive direct effect of profit sharing can be explained as follows. Higher profit sharing will increase the effort, which leads for given wage level to a higher productivity, which increases the high-skilled labour demand.

2.4 Low-Skilled Wage Formation and Employment Effects

Now we analyse the wage formation of low-skilled workers, which takes place in anticipation of the decisions by the firm. For simplicity, we model the wage formation by a monopoly labour union (see also Cahuc and Zylberberg, 2004, p. 401-403 concerning the monopoly union specification), which determines the wage for low-skilled workers in anticipation of optimal in-house low-skilled labour demand, of flexible outsourcing and of high-skilled employment.[26]

Wage Formation by a Monopoly Labour Union

The objective function of the labour union of low-skilled workers is assumed to be $V = (w_L - b_L) \cdot L + b_L \cdot N$, where b_L is the (exogenous) outside option available for low-skilled workers and N is the number of labour union members. The monopoly labour union sets the wage for the low-skilled workers so as to maximize the surplus according to

$$\max_{w_L} \; V = (w_L - b_L) \cdot L + b_L \cdot N \tag{2.14}$$
$$\text{s.t. } L = m w_L^{-\delta} w_H^{-\varepsilon} \bar{e}^{\varepsilon} - M = m w_L^{-\delta} w_H^{-\varepsilon} \bar{e}^{\varepsilon} - \left(\frac{w_L}{c} \right).$$

The first-order condition associated with (2.14) is

$$V_{w_L} = \frac{L}{w_L} \left[w_L + (w_L - b_L) \frac{w_L}{L} \frac{dL}{dw_L} \right] = 0, \tag{2.15}$$

where the total unskilled wage elasticity of unskilled labour demand in this model is $\bar{\eta} = -\frac{dL}{dw_L} \frac{w_L}{L} = -\frac{\partial L}{\partial w_L} \frac{w_L}{L} - \frac{\partial L}{\partial \bar{e}} \frac{\bar{e}}{L} \cdot \frac{d\bar{e}}{dw_L} \frac{w_L}{\bar{e}}$. Simplifying the first-order condition (2.15) we get

$$w_L(c, w_H, b_L, \bar{e}, \tau) = \left(\frac{\bar{\eta}}{\bar{\eta} - 1} \right) b_L, \tag{2.16}$$

[26] In Western European countries, which we like to focus on, labour market institutions can be characterized by this setting (see e.g. Freeman, 2008).

where $\overline{\eta}$ can, by using our former results, be rewritten to $\overline{\eta} = \eta_L - \varphi \cdot \eta_{\bar{e}}$, where η_L is the own wage elasticity of low-skilled labour demand, $\eta_{\bar{e}}$ is the effort elasticity of low-skilled labour demand and $0 < \varphi < 1$ is the effort elasticity with respect to the low-skilled wage. As one can see from the previous analysis, these low-skilled labour demand elasticities are not constant because the low-skilled labour demand depends negatively on the high-skilled wage and the low-skilled wage but positively on the high-skilled worker's effort and the costs of outsourcing and thus equation (2.16) is an implicit formulation of the low-skilled wage. However, in our framework the effort elasticity is constant. Because $\overline{\eta} = \eta_L - \varphi \cdot \eta_{\bar{e}} = \delta - \varphi\varepsilon + (1 + \delta - \varphi\varepsilon)\frac{M}{L} > 1$ (see Appendix B), the mark-up is above one, i.e. $\overline{\eta}/(\overline{\eta} - 1) > 1$.

In order to answer the mentioned research questions and characterize the effect of profit sharing and outsourcing costs on the low-skilled wage formation, we therefore apply the implicit differentiation (for the details see Appendix B). Differentiating the wage equation (2.16) with respect to the profit share and the low-skilled wage gives

$$\frac{dw_L}{d\tau} = -\frac{\frac{d\overline{\eta}}{d\tau}\frac{w_L}{\overline{\eta}}}{\overline{\eta} - 1 + \frac{d\overline{\eta}}{dw_L}\frac{w_L}{\overline{\eta}}} > 0, \tag{2.17}$$

and differentiating (2.16) with respect to the outsourcing costs and the low-skilled wage gives

$$\frac{dw_L}{dc} = -\frac{\frac{d\overline{\eta}}{dc}\frac{w_L}{\overline{\eta}_L}}{\overline{\eta} - 1 + \frac{d\overline{\eta}}{dw_L}\frac{w_L}{\overline{\eta}}} > 0, \tag{2.18}$$

where $\frac{d\overline{\eta}}{dw_L} > 0$, $\frac{d\overline{\eta}}{d\tau} < 0$ and $\frac{d\overline{\eta}}{dc} < 0$. Therefore, a higher low-skilled wage will increase the total wage elasticity of domestic low-skilled labour demand and higher profit share and outsourcing costs will decrease the total wage elasticity of domestic low-skilled labour demand.[27] Finally, we can conclude that due to a less elastic low-

[27] See e.g. Hasan et al. (2007), Slaughter (2001) and Senses (2010), who provide empirical evidence according to which international trade has increased the wage elasticity of low-skilled labour demand.

skilled labour demand the wage mark-up rises and thus profit sharing and outsourcing costs will increase the low-skilled wage.
Knowing this, we are able to find an answer to our main research question: How does the implementation of profit sharing for high-skilled workers influence outsourcing activities?
Differentiating (2.4) in terms of profit sharing gives

$$\frac{dM}{d\tau} = \frac{1}{c}\underbrace{\frac{dw_L}{d\tau}}_{+} > 0 \tag{2.19}$$

so that the effect of outsourcing activities is driven by the effect on low-skilled wage, which is positive. We can summarize our findings concerning the effects of profit sharing and outsourcing costs on the low-skilled wage, which also determines the effect of profit sharing on outsourcing as follows:

Proposition 2.3:

In the presence of flexible outsourcing

a) *higher profit sharing for the high-skilled workers has a positive effect on the wage for low-skilled labour, whereas*
b) *higher profit sharing for the high-skilled workers has an enhancing effect on outsourcing activities and*
c) *lower costs of outsourcing decreases the wage for low-skilled workers.*

Higher profit sharing increases the high-skilled labour demand and since the labour inputs are assumed to be complements, the low-skilled labour demand raises. Thus, a higher low-skilled wage will have a smaller loss for the trade union via less dismissals and the union can set a higher wage. Since higher profit sharing increases the firm's profit, the labour union gets a higher share of this due to a higher low-skilled wage. But the wage enhancing effect will also induce a higher outsourcing demand, which can be explained by the substitutability of domestic low-skilled labour services and foreign intermediate goods.
The positive relationship between low-skilled wage and outsourcing costs can be motivated in a similar way. Lower outsourcing costs mean for a given low-skilled wage level a higher outsourcing demand and a more elastic low-skilled labour demand. Thus the opportunity for the labour union to set a higher wage falls, since the firm will react with more dismissals. To avoid outsourcing and the dismissals by

making the integrated production more attractive, the trade union reacts with a decreasing low-skilled wage.[28]
Knowing the low-skilled wage effect of profit sharing, we can also look at the relationship of the wage levels and thus on the impact of profit sharing on the wage dispersion in a firm. Since it is reasonable to assume that $w_H > w_L$, where w_H characterizes in our framework the world market wage levl for the high-skilled worker and thus it is given and constant from a single firm's view, we can conclude:

Corollary 2.1:

Profit sharing for high-skilled workers decreases duo to a higher wage sets by the low-skilled labour union the wage dispersion in a firm.

Our analysis shows that, introducing profit sharing increases the wage for low-skilled workers, since the union can act more aggressive due to the labour augmenting effort effect. Because we assume a single firm and a given wage for high-skilled workers, thus profit sharing leads to a lower wage gap in that single firm.

Overall Employment Effects

Up to now we have only analyzed the direct effect of profit sharing on the high-skilled employment. For the sake of completeness, in this paragraph the overall effects of profit sharing for both employment types will be demonstrated.
The effect of profit sharing on low-skilled employment by using equation (2.5), (2.11) and (2.17), can be characterized as

$$\frac{\Delta L}{\Delta \tau} = \underbrace{\underbrace{\frac{\partial L}{\partial \bar{e}}}_{+}\underbrace{\frac{d\bar{e}}{d\tau}}_{+}}_{+} + \underbrace{\underbrace{\frac{dL}{dw_L}}_{-}\underbrace{\frac{dw_L}{d\tau}}_{+}}_{-} = ?\,, \tag{2.20}$$

with $\frac{dL}{dw_L} = -\bar{\eta} \cdot \frac{L}{w_L} < 0$ as the effort including overall effect of the low-skilled wage on low-skilled labour demand.

[28] This lies in conformity with empirics, see evidence from various countries, e.g. Feenstra and Hanson (1999), Hijzen et al. (2005), Egger and Egger (2006), Braun and Scheffel (2007a) or Geishecker and Görg (2008).

The first term in equation (2.20) describes the direct effort effect of profit sharing. We showed that higher profit sharing induces higher effort provision by the high-skilled worker, which leads at a given wage level to an increase productivity and thus in high-skilled labour employment. Since in our framework the labour inputs are complements the low-skilled labour demand also increases. Therefore we have a positive effect on low-skilled employment through the implementation of a profit sharing scheme. However, the increase of low-skilled labour demand opens the opportunity for the labour union to set a higher wage for the low-skilled worker. Due to the assumption that low-skilled labour and outsourcing are substitutes, the firm will react to the increase in low-skilled labour cost by engaging in more outsourcing and demanding less low-skilled labour. This indirect effect is characterized by the second term in (2.20). As one can see, this is a negative effect, since higher profit sharing leads to a lower labour demand and. Thus we have two oppose low-skilled labour effects of a profit sharing scheme for high-skilled workers, where the overall effect is a priori ambiguous. From this we can conclude, that it is under certain circumstances possible to observe more outsourcing and higher low-skilled employment if the low-skilled wage increases due to profit sharing, i.e. the labour demand augmenting effort effect dominates the labour demand reducing wage effect.

Similarly, we can also determine the overall high-skilled employment effect. From equation (2.7) by using the results presented in (2.12), (2.13) and (2.17), we can express the overall effect of profit sharing on high-skilled employment as

$$\frac{\Delta H}{\Delta \tau} = \underbrace{\frac{dH}{d\tau}}_{+} + \underbrace{\underbrace{\frac{dH}{dw_L}}_{-}\underbrace{\frac{dw_L}{d\tau}}_{+}}_{-} = ? . \tag{2.21}$$

From equation (2.21) we see that higher profit sharing has also an ambiguous overall effect on the high-skilled employment. As in the analysis of the effect on the low-skilled employment, the first term in (2.21) describes the well known positive effort effect, since profit sharing increases effort and thus productivity. This in turn increases the high-skilled labour demand and therefore, the first term describes an enhancing high-skilled employment effect. On the other hand there is a negative effect via the increasing effect on the low-skilled wage. This indirect effect results, since with higher effort the opportunity of the low-skilled labour union to set a higher wage increases, which induces a decrease in the low-skilled labour demand and, due to the complementarity of the inputs, also a decrease on the high-skilled

labour demand. Thus, the high-skilled employment effect also consists of two opposed effects, where the overall effect is a priori ambiguous.

Proposition 2.4:

In the presence of flexible outsourcing profit sharing affects a firm's demand for high-skilled and low-skilled workers via two opposed effects. The first is the direct effort effect, which enhances the labour demand, whereas the indirect low-skilled wage effect as the second working channel decreases the labour demand.

As our last results pointed out, it is possible that implementing a profit sharing scheme for high-skilled workers decreases the wage gap in a firm without losing low-skilled employment, if the labour increasing productivity effect offset the labour decreasing wage effect. Since bonus payments for high-skilled workers must not lead in any case to lower employment of low-skilled workers, such a compensation scheme is not as bad as it is seen in the public opinion.

2.5 Concluding Remarks

In this chapter we have tried to describe a realistic framework of flexible outsourcing in a partly unionized dual labour market by using reasonable assumptions. In Western Europe we often observe that, unlike low-skilled workers, who are often organized in labour unions, high-skilled wages are mostly determined competitively. However, high-skilled workers could also directly participate in the firm's success via profit sharing, which also affects the wage determination of low-skilled labour and also the outsourcing demand. Thereby, our main question is: How does the implementation of profit sharing for high-skilled workers influence the wage for low-skilled and thus the outsourcing activities? By analysing these impacts, we can also look on the labour demand effects for both the high-skilled and low-skilled worker.

In the above analyses we could show that the wage of the low-skilled workers will be positively affected by profit sharing for high-skilled workers and outsourcing costs. Since the high-skilled wage is to be assumed constant from the firm's point of view and higher than the low-skilled wage, thus higher profit sharing and outsourcing costs reduce the wage dispersion in a single firm. Also, we could conclude that the effect of profit sharing on outsourcing activities is indirect negatively via the effort effect on the low-skilled wage. Finally, we characterized

the employment effects of profit sharing. Here we find that profit sharing induces higher low-skilled and high-skilled labour demand via increased effort, but on the other hand decreases the labour demand for both types via the higher low-skilled wage, so that the employment effects are a priori ambiguous. Thus, under certain circumstances, profit sharing or bonus payments for high-skilled worker helps to realize the aims of adequate wage and high employment level for low-skilled workers in a single firm. Therefore, not in any case the restriction or the prohibition of such compensation schemes is advisable.

Since we see the high-skilled worker as a member of a group, in contrast to the above analysis, one can also assume that the group size is constant but the high-skilled wage will be flexible determined from equality of labour demand and a constant supply, which is equivalent to the group size. In this approach, thus there is no high-skilled employment effect but a high-skilled wage effect. Using this framework, comparative statics show that due to the assumptions there is a direct positive relationship between profit sharing and the high-skilled wage and low-skilled wage. However, the overall effect of profit sharing on high-skilled wage is ambiguous, since there is due to the complementary relationship between the two types of labour also the known decreasing indirect working channel via the low-skilled wage. Thus in the case of flexible high-skilled wage, profit sharing can have a supplementary or compensatory character for high-skilled labour. [29] Finally we can summarize that our results concerning the wage effects for low-skilled worker and thus the amount of outsourcing do not depend on the assumption of modelling the wage process for high-skilled workers.

Appendices

Appendix A: Comparative Statics of Effort Effects

Differentiating the effort function (2.11) with respect to effort and low-skilled wage gives

$$\left[1+\gamma\cdot\frac{\bar{e}}{H}\cdot H_{\bar{e}}\right]d\bar{e}=\left[-\gamma\cdot\frac{\bar{e}}{H}\cdot H_{w_L}\right]dw_L. \tag{A.2.1}$$

[29] These properties are going confirm with empirical evidence as Black and Lynch (2004) where profit sharing results in lower regular pay or Hart and Hubler (1991) and Kraft and Ugarkovic (2005) where the authors find a supplementary character.

By using equation (2.7) we have $H_{\bar{e}} = \frac{\varepsilon}{\bar{e}} \cdot H$ and $H_{w_L} = (1-\delta)\frac{H}{w_L}$, so that (A.2.1) can be simplified to

$$\frac{d\bar{e}}{dw_L} = \frac{(\delta-1)\cdot\gamma}{1+\gamma\cdot\varepsilon} \cdot \frac{\bar{e}}{w_L} > 0, \tag{A.2.2}$$

where $\delta = \frac{1-\alpha}{1-\alpha-\beta} > 1$.

For the effort elasticity with respect to the low-skilled wage we have $0 < \varphi = \frac{(\delta-1)\gamma}{1-\alpha-\beta} < 1$. This holds, since we can rewrite this term to $\varphi = \frac{\beta\gamma}{1-\alpha-\beta+\alpha\gamma}$. Because our assumptions $1-\alpha-\beta > 0$, $\alpha;\beta > 0$ and $\gamma \in (0;1)$ we have $\varphi \in (0;1)$. For the high-skilled employment effect of higher low-skilled wage, we need the sign of $1-\delta+\varepsilon\cdot\varphi$. Using our results for φ we can rewrite this term to $-(\delta-1)+(\delta-1)\frac{\gamma\cdot\varepsilon}{1+\gamma\cdot\varepsilon}$, which leads to $-\frac{(\delta-1)}{1+\gamma\cdot\varepsilon} < 0$.

Appendix B: Effects of Parameters on Low-Skilled Wage

The total wage elasticity of low-skilled labour demand is $\bar{\eta} = \eta_L - \varphi\cdot\eta_{\bar{e}} = \delta - \varphi\varepsilon + (1+\delta-\varphi\varepsilon)\frac{M}{L} > 1$, where $\delta > \varphi\varepsilon$ and $1+\delta-\varphi\varepsilon > 0$.

Since the wage effects are driven by the effects on the total wage elasticity, we have to differentiate $\bar{\eta}$ with respect to low skilled wage w_L, outsourcing cost c and profit sharing τ.

Using the formulation above, we find that $\frac{d\bar{\eta}}{dw_L} = \frac{d\eta_L}{dw_L} - \varphi\cdot\frac{d\eta_{\bar{e}}}{dw_L}$, where $\frac{d\eta_L}{dw_L} = \frac{(1+\delta)}{w_L}\frac{M}{L}(1+\bar{\eta}) > 0$ and $\frac{d\eta_{\bar{e}}}{dw_L} = \frac{\varepsilon}{w_L}\frac{M}{L}(1+\bar{\eta}) > 0$. Simplifying gives

$$\frac{d\bar{\eta}}{dw_L} = \frac{M}{L\cdot w_L}(1+\bar{\eta})\left[1+\delta-\frac{\varepsilon\gamma(\delta-1)}{1+\varepsilon\gamma}\right] > 0, \tag{B.2.1}$$

since $1+\delta-\varepsilon\varphi = 1+\delta-\frac{\varepsilon\gamma(\delta-1)}{1+\varepsilon\gamma} = \frac{1+\delta+2\varepsilon\gamma}{1+\varepsilon\gamma} > 0$.

As the effect of outsourcing costs, we find $\frac{d\bar{\eta}}{dc} = \frac{d\eta_L}{dc} - \varphi \cdot \frac{d\eta_{\bar{e}}}{dc}$, with $\frac{d\eta_L}{dc} = -\frac{(1+\delta)}{c}\frac{M}{L}\left(1+\frac{M}{L}\right) < 0$ and $\frac{d\eta_{\bar{e}}}{dc} = -\frac{\varepsilon}{c}\frac{M}{L}\left(1+\frac{M}{L}\right) < 0$, which lead to

$$\frac{d\bar{\eta}}{dc} = -\frac{M}{L\cdot c}\left(1+\frac{M}{L}\right)\left[1+\delta-\frac{\varepsilon\gamma(\delta-1)}{1+\varepsilon\gamma}\right] < 0. \qquad \text{(B.2.2)}$$

For $\frac{d\bar{\eta}}{d\tau} = \frac{d\eta_L}{d\tau} - \varphi \cdot \frac{d\eta_{\bar{e}}}{d\tau}$ with $\frac{d\eta_L}{d\tau} = -\frac{(1+\delta)}{\tau}\frac{M}{L}\left(1+\frac{M}{L}\right)\frac{\varepsilon\gamma}{1+\varepsilon\gamma} < 0$ and $\frac{d\eta_{\bar{e}}}{d\tau} = -\frac{\varepsilon}{\tau}\frac{M}{L}\left(1+\frac{M}{L}\right)\frac{\varepsilon\gamma}{1+\varepsilon\gamma} < 0$, we have

$$\frac{d\bar{\eta}}{d\tau} = -\frac{\varepsilon\gamma}{1+\varepsilon\gamma}\left(1+\frac{M}{L}\right)\left[1+\delta-\frac{\varepsilon\gamma(\delta-1)}{1+\varepsilon\gamma}\right] < 0. \qquad \text{(B.2.3)}$$

Differentiating the implicit wage formation (2.16) with respect to the profit share and the low-skilled wage gives

$$\left(1-\frac{\left[(\bar{\eta}-1)\frac{d\bar{\eta}}{dw_L}-\bar{\eta}\frac{d\bar{\eta}}{dw_L}\right]}{(\bar{\eta}-1)^2}b_L\right)\cdot dw_L = \frac{\left[(\bar{\eta}-1)\frac{d\bar{\eta}}{d\tau}-\bar{\eta}\frac{d\bar{\eta}}{d\tau}\right]}{(\bar{\eta}-1)^2}b_L\cdot d\tau, \qquad \text{(B.2.4)}$$

which, by using $b_L = \frac{w_L\cdot(\bar{\eta}-1)}{\bar{\eta}}$, can be expressed as equation (2.17). In a similar way, by differentiating the implicit wage formation (2.16) with respect to the outsourcing costs and the low-skilled wage, we can deviate the relationship of the outsourcing costs and the low-skilled wage, i.e. equation (2.18).

Chapter 3

Can Committed Profit Sharing Lower Flexible Outsourcing?*

Abstract

We analyse the following question associated with flexible outsourcing under an imperfect domestic labour market: How does the implementation of profit sharing for low-skilled workers influences flexible outsourcing? We show that in general, the implementation of a profit sharing scheme leads to a substitution effect which results in a low-skilled wage. Since outsourcing and the domestic wage level are negative correlated, profit sharing has an outsourcing decreasing character. However, the labour union determination of effort leads to a constant effort level, in which case a firm's optimal choice of profit sharing is zero.

JEL Classification: E24, J33, J51
Keywords: flexible outsourcing, profit sharing, wage bargaining, employee effort

* This chapter is a joint work with Erkki Koskela from the University of Helsinki and based on Koskela and König (2009b).

3.1 Introduction

As detailed mentioned above, marginal cost differences are the main argument on a firm's decision for or against outsourcing. It is without controversy that high wage and labour costs, especially in Western European countries, are the driving forces for this marginal cost disadvantage. Therefore the wage differences are the central explanation for the growing business practice of offshoring and international outsourcing to Eastern European or Asian countries. One reason for the observed wage gap is the difference in the process of wage determination. While in most Western European countries wages are determined by bilateral bargaining between firms or employer federations and trade unions, in Eastern European or Asian countries wages are determined by market forces, because unions here are much weaker (see e.g. Du Caju et al., 2008).

As seen above, there are two focuses in the literature concerning the relationship between domestic wage bargaining and international outsourcing. Following the previous analysis, in this chapter we assume that outsourcing is flexible, which means that it is determined after the domestic wage formation. Therefore we are in line with Skaksen (2004), who analyses potential (non-realized) and realized international outsourcing. He distinguishes three cases: First, if the outsourcing costs are very low, the union will desist from wage dumping to avoid outsourcing. Second, the firm will desist from outsourcing if costs are very high. In this case, the union can set a relatively high wage without the fear of substitution of domestic employment by external procurement. Third, for an intermediate cost level, the union can avoid outsourcing if the wage is equal to the outsourcing costs. Thus, the wage level depends positively on the outsourcing costs. In contrast to that, Braun and Scheffel (2007b) find that the costs of outsourcing have an ambiguous effect on wage sets by the labour union.

Due to the threat of flexible outsourcing, the opportunity of the trade union to realize a high wage level will be dampen. However, the trade union wants to realize a high income for its members and therefore lower wages are not possible. To solve this puzzle an instrument has to be implemented that realizes a high work income and lower the incentive for outsourcing by decreasing the wage. Such an instrument can be profit sharing, which can substitute wage income by profit income, without losing total remunerations. Thus, there can be an incentive for a lower base wage and domestic labour becomes advantageously, without losses for the union or worker.

From the firms point of view the marginal costs are determined by the base wage. Therefore profit sharing will decrease outsourcing. However, due to the profit

participation another advantage for the firm can be created. This advantage can be a productivity effect, since the profit participation setting incentives to increase worker's effort, while improving the working atmosphere or the worker's motivation.[30] On the other hand, if profit sharing is used to increase the individual effort, there is a moral hazard or free-riding problem. This problem can be solved, if effort is interpreted as working conditions such as the speed of the production line, and therefore it can be part of wage negotiations. For that case, the literature mainly focuses on comparing the effort level set by a union and the effort level in a competitive market or analysis the effect of bargaining power on effort level and efficiency properties.[31] Also, the implementation of profit sharing schemes is analysed with collective bargaining. Pohjola (1987) and Anderson and Devereux (1989) show that an efficient but unenforceable bargaining outcome, since direct negotiation on the total employment is precluded, can be made enforceable by introducing bargaining over wages and profit share. Additionally, Anderson and Devereux (1989) show that for efficient bargaining over wages and employment, implementing profit sharing has no effect on wages, employment and profit, if profit sharing is exogenously increased by the legislator or if it is a part of the optimal contract.

In this chapter we use the approach where the union sets the wage and the effort, while the firm sets the profit share, and analyse: How does profit sharing influence flexible outsourcing? Based on this, due to comparative statics, we further show how outsourcing costs influence the wage level. The analysis shows that the union sets an effort level, which is unaffected by the wage and profit sharing. However, profit sharing can decrease the wage and thus outsourcing. For the optimal profit share we find that the firm will not implement any profit sharing scheme. For our minor question we find that in the presence of outsourcing, due to a more elastic labour demand, the base wage is lower than in the absence of outsourcing.

We proceed as follows. The basic structure of the theoretical framework is briefly presented in Section 3.2. In Section 3.3, we derivate the optimal labour and

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30 Introducing a profit sharing scheme can increase the motivation of a worker and thus effort, see Cable and FitzRoy (1980). On the other hand Jones and Pliskin (1991) and Kruse (1993) find negative productivity effects of profit sharing.

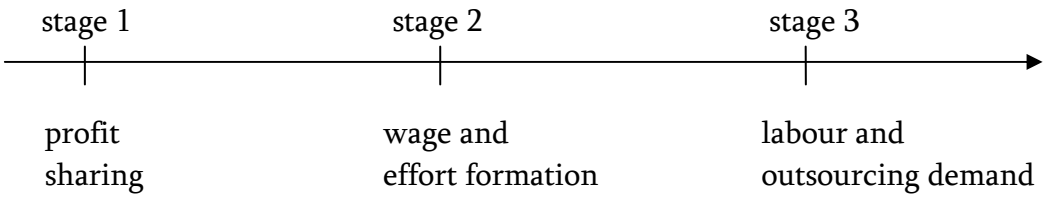
31 Bulkley (1992) shows that a monopoly union will reduce the specified effort level below that which would be demanded by the firm in its absence. Moreover, Bulkley and Myles (1996) showed that the popular wisdom that unions reduce effort is generally false. The effect of bargaining power if effort is negotiable has also been analysed by Sampson (1993) and Bulkley and Myles (1997). They show that in a generalized Nash bargaining between a trade union and a firm over employment and effort, the higher bargaining power of the firm can increase the effort level.

outsourcing demand. Section 3.4 investigates the effort and wage formation by the monopoly trade union. Finally, we sum up our conclusions in Section 3.5.

3.2 Basic Framework

We assume that output depends not only on domestic labour and international outsourcing, but also on the average effort by workers, i.e. the worker's productivity. This lies in conformity with the efficiency wage hypothesis form (see Akerlof and Yellen, 1986). The timing captures the idea that the representative firm is flexible in deciding about the amount of outsourcing simultaneously with domestic labour demand, but commits to profit sharing before wage and effort determination. After the firm has made its decision on profit sharing, the monopoly trade union sets the wage and effort with respect to the profit share level. Knowing the base wage, the representative firm determines outsourcing and employment. The timing of events is depicted as in Figure 3.1.

Figure 3.1: sequence of events



The decisions at each stage are analysed by using backward induction.

3.3 Optimal Outsourcing and Labour Demand

In this section, we characterize the optimal labour demand and outsourcing by the representative firm by taking profit sharing, wage and effort as given. The revenue function is presented as

$$R(L,M) = (\bar{e}L + M)^{\alpha}, \text{ with } 0 < \alpha < 1, \tag{3.1}$$

where the price of the output is normalized to unity, L is the amount of domestic labour, $\bar{e}$ characterizes the average effort level and M is the firm's labour input acquired from external suppliers through outsourcing.[32] The parameter $0 < \alpha < 1$ indicates decreasing returns to scale, which means that the production function is an increasing and concave function of both inputs.[33] As one can see from (3.1), we follow Munch and Skaksen (2009), which find that there is empirical evidence for substitutability between domestic labour and outsourcing.The firm decides on domestic labour and outsourcing to maximize the profit function

$$\max_{L;M} (1-\tau)\cdot\pi = (1-\tau)\left[(\bar{e}L + M)^{\alpha} - w_L \cdot L - \frac{1}{2} cM^2 \right], \tag{3.2}$$

by taking the negotiated effort $\bar{e}$, wage w_L and the profit share τ as given. Furthermore, we assume that the costs of outsourcing $f(M) = 0{,}5cM^2$ are convex, so that the marginal costs of outsourcing increases in the scope of outsourcing activities. To be simple, we assume a quadratic cost function.[34] The first-order conditions $\pi_L = \bar{e} \cdot (\bar{e}L + M)^{-(1-\alpha)} - w_L = 0$ and $\pi_M = (\bar{e}L + M)^{-(1-\alpha)} - cM = 0$ can be expressed as[35]

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32 As mentioned in footnote 18, a similar formulation of the relationship between domestic labour and outsourcing can be found by Koskela and Schöb (2010). Furthermore, we follow the efficiency wage literature and assume that effort is labour augmenting. Consequently, $\bar{e}L$ can be interpreted as effective domestic labour.

33 This analysis does not focus on the simultaneous presence of imperfections in labour and product markets, so that in this model the wage moderating effect of outsourcing is independent of potential market structure change in the product market. Lommerud et al. (2006) demonstrate how international mergers might curb the market power of unions, giving socially excessive incentives for international mergers, unless products are close substitutes. A somewhat related wage moderating effect of foreign investments is developed in Eckel and Egger (2006). They focus on duopoly competition within a framework where the firms can produce either in one or both of two identical countries. Within such a framework foreign market penetration induces a wage moderating effect in a unionized economy, because it improves the firm's outside option relevant for the wage negotiations.

34 This formulation captures the idea that beside the price for external procurement there are other costs associated with outsourcing. Such costs are transport and communication costs or costs for monitoring and quality control. Especially in the case of transport costs, not only proportionally increasing costs but also exponentially increasing costs are imaginable.

35 As mentioned in footnote 19, due to our modeling of profit participation, the commitment of profit sharing works as a profit tax and thus the domestic labor demand and outsourcing are independent of profit sharing.

$$L = \alpha^{\frac{1}{1-\alpha}} \cdot w_L^{-\frac{1}{1-\alpha}} \cdot \bar{e}^{\frac{\alpha}{1-\alpha}} - \frac{M}{\bar{e}}, \tag{3.3a}$$

$$M = \frac{w_L}{c \cdot \bar{e}}. \tag{3.3b}$$

As one can see, domestic labour demand is a negative function of wage and the amount of outsourcing and a positive function of outsourcing costs and effort. Thus, higher outsourcing will decrease domestic labour demand, which lies in conformity with empirics as shown by e.g. Görg and Hanley (2005). However, labour demand does not directly depend on profit sharing, which is in line with empirical studies as Wadwani and Wall (1990) and Cahuc and Dormont (1997). For outsourcing, we find that external procurement is a positive function of domestic wage rate and a negative function of outsourcing costs and effort.
The wage elasticity of labour demand, which becomes important later on, can be expressed as

$$\eta_L \equiv -\frac{L_{w_L} w_L}{L} = \frac{1}{1-\alpha} + \left(\frac{1}{1-\alpha} + 1\right) \cdot \frac{M}{\bar{e}L}. \tag{3.4}$$

The wage elasticity depends on parameter α and also on wage rate and outsourcing costs via M and L. In the absence of outsourcing, the wage elasticity is constant and smaller, i.e. $\eta_L\big|_{M=0} = \frac{1}{1-\alpha} < \eta_L$.

3.4 Wage and Effort Formation by a Monopoly Labour Union

As we mentioned in the introduction, effort can be interpreted as a working condition, which can be determined in bargaining rounds between trade unions and firms. In this paragraph we assume a simultaneous setting of wage and effort by the employee federation.

3.4.1 Wage and Effort Determination

The individual utility function for the employed worker is (3.5a) and for the unemployed worker (3.5b)

$$v = w_L + \frac{\tau}{L}\pi^* - g(\bar{e}), \tag{3.5a}$$

$$\bar{v} = b_L, \tag{3.5b}$$

so that utility is assumed to be linear in income, where $\pi^* = \alpha^{\frac{\alpha}{1-\alpha}} \cdot w_L^{-\frac{\alpha}{1-\alpha}} \cdot \bar{e}^{\frac{\alpha}{1-\alpha}}(1-\alpha) + \frac{1}{2}\frac{w_L^2}{c \cdot \bar{e}^2}$ characterizes the indirect profit function. In addition we assume that provision of effort is associated with a disutility for the worker, which is assumed to satisfy the convex function $g(\bar{e}) = \gamma\, \bar{e}^{1/\gamma}$ with $0 < \gamma < 1$, i.e. $g'(\bar{e}), g''(\bar{e}) > 0$.

Following the standard literature, we assume a monopoly trade union, which is interested in the income of its members, so that the objective function is $V = vL + (N - L)\bar{v}$. Therefore, we can rewrite the union utility as

$$\max_{w_L;\bar{e}} V = (w_L - b_L)L + \tau\, \pi^* - g(\bar{e})L + b_L \cdot N \text{ s.t. } \pi_L = \pi_M = 0, \tag{3.6}$$

where b_L captures the exogenous minimum income for labour union members N.

Maximizing in terms of the base wage and effort subject to labour demand and outsourcing gives

$$V_{w_L} = L + L_{w_L}(w_L - b_L) + \tau\, \pi^*_{w_L} - g(\bar{e})L_{w_L} = 0, \tag{3.7}$$

which by using $\pi^*_{w_L} = -L$ can be solved as $w_L \cdot [\eta_L - (1-\tau)] = \eta_L (b_L + g)$, so that we have

$$w_L = \left[\frac{\eta_L}{\eta_L + \tau - 1}\right](b_L + g). \tag{3.8}$$

This is an implicit form concerning wage formation, because the numerator and denominator of the mark-up depend in a non-linear way on the wage rate according to equation (3.4).

The first-order condition for the optimal effort level is

$$V_{\bar{e}} = L_{\bar{e}}(w_L - b_L) + \tau\, \pi^*_{\bar{e}} - g(\bar{e})L_{\bar{e}} - Lg'(\bar{e}) = 0. \tag{3.9}$$

By using $\pi^{*}_{\bar{e}} = \frac{w_L}{\bar{e}} \cdot L$ and $\frac{L_{\bar{e}}\bar{e}}{L} = \eta_{\bar{e}} = \eta_L - 1$, the first-order condition (3.9) can be expressed as

$$w_L = \left[\frac{\eta_L - 1}{\eta_L + \tau - 1}\right](b_L + g) + \frac{\bar{e}^{1/\gamma}}{\eta_L + \tau - 1}. \tag{3.10}$$

A simultaneous solution of (3.8) and (3.10) gives the optimal effort

$$\bar{e} = \left[\frac{b_L}{1-\gamma}\right]^{\gamma}. \tag{3.11}$$

Our analysis shows that the optimal effort level, decided by the monopoly trade union, is independent of the profit share or the base wage. Thus, we see that profit sharing does not affect effort provision and, therefore, does not increase productivity. This result is plausible in our framework for two reasons. The first is that higher effort provision leads to higher disutility for the worker, which can be avoided by a constant effort. Of course, one may argue that this will negatively affect the worker's income, since higher effort leads to higher profit and thus increases worker's income. But the trade union has a second instrument to influence a firm's profit and thus the worker's income. Therefore, the second reason is that the trade union can affect the worker's income by its wage setting. Knowing that effort is unaffected by profit sharing, we can show in which way the wage is influenced by the profit participation for worker, which helps us to answer our research question. To verify the mentioned wage moderation effect of profit sharing, we can take a look at the equations above. The equations (3.8) and (3.11) show that profit sharing has only a direct effect on the wage level, which can be seen in the denominator. We call this effect the substitution effect, since it decreases the base wage, meaning that a former part of the base wage is substituted by profit income. Analytically, this can be shown by using the total differential of (3.8)

$$\frac{dw_L}{d\tau} = -\frac{w_L}{\eta_L + \tau - 1 + (1-\tau)\frac{\partial \eta_L}{\partial w_L} \cdot \frac{w_L}{\eta_L}} < 0, \tag{3.12}$$

with $\frac{\partial \eta_L}{\partial w_L} = \left(\frac{1}{1-\alpha} + 1\right) \cdot \frac{M}{w_L \cdot \bar{e}L}(1 + \eta_L) > 0$.

The wage effect of profit sharing can be explained by the union's marginal costs of an increasing wage. However, we only focus on the part of the marginal costs that are affected by profit sharing. This means, we are only interested in the impact of wages on the total profit (see 3.7). Since a higher wage will decrease profit and thus proft income, a higher profit share increases this utility loss. Due to this increasing effect on the union's marginal costs, higher profit sharing will induce a less aggressive wage setting.[36] Thus, in our framework, profit sharing has a complementary character for the base wage.[37]

In the absence of outsourcing we have $\left.\frac{\partial \eta_L}{\partial w_L}\right|_{M=0} = 0$, so that base wage does not affect the wage elasticity of labour demand. In that case, we get qualitatively the same result $\left.\frac{dw_L}{d\tau}\right|_{M=0} = -\frac{w_L|_{M=0}}{\tau + \alpha/(1-\alpha)} < 0$.

In a similar way we can also look at the wage reaction concerning changes in outsourcing costs. The reaction of the wage elasticity is described by $\frac{\partial \eta_L}{\partial c} = -\left(\frac{1}{1-\alpha}+1\right)\cdot\frac{M}{c\bar{e}L}\left(1+\frac{M}{\bar{e}L}\right) < 0$. This effect can be explained as follows. Higher outsourcing costs reduce the demand for outsourcing and, due to the substitutability of inputs, domestic labour demand increases and thus, the labour demand becomes more inelastic[38], which open the opportunity for the union to set a higher wage. Algebraically the wage effect of changing outsourcing costs is given by

$$\frac{dw_L}{dc} = -\frac{(1-\tau)\frac{\partial \eta_L}{\partial c}\frac{w_L}{\eta_L}}{\eta_L - 1 + \tau + (1-\tau)\frac{\partial \eta_L}{\partial w_L}\frac{w_L}{\eta_L}} > 0, \tag{3.13}$$

so that in the presence of flexible outsourcing, lower outsourcing costs will decrease the wage.

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36 See also Weitzman (1987), Jackman (1988), Wadhwani (1988), Fung (1989) and Holmlund (1990).

37 However, in the empirical literature there is also evidence for a supplementary property of profit sharing. By using US data, Black and Lynch (2004) show that profit sharing results in lower regular pay for workers, which implies a compensatory character, but in Wadhwani and Wall (1990) by using UK data and also in Kraft and Ugarkovic (2005) by using German panel data, it is shown that introducing profit sharing does not reduce the wage, which implies a supplementary character.

38 See e.g. Slaughter (2001), Hasan et al. (2007) and Senses (2010).

This holds, as lower outsourcing costs induce higher outsourcing demand, so that the labour demand elasticity becomes more elastic and the wage has to fall accordingly to avoid higher outsourcing with lower in-house costs and make integrated production more attractive. We can summarize our findings as follows:

***Proposition 3.1**:*

In the presence of flexible outsourcing,

a) *the effort level, set by the union, is unaffected by base wage and profit sharing, and*
b) *profit sharing has a complementary character, and*
c) *lower outsourcing costs will lower the wage.*

We now analyse the effect of profit sharing in a firm that engages in outsourcing. The working channel of committed profit sharing on the amount of outsourcing can be derived from the outsourcing demand (3.3b) in combination with (3.12). Inserting the different expression and simplifying yields

$$\frac{dM}{d\tau} = \frac{\partial M}{\partial w_L} \cdot \frac{dw_L}{d\tau} = \frac{1}{c\bar{e}} \cdot \underbrace{\frac{dw_L}{d\tau}}_{<0} < 0\,, \tag{3.14}$$

so that the effect of implementing profit sharing is negative.

Proposition 3.2:

Profit sharing decreases marginal costs, so that outsourcing activities becomes less attractive and decrease.

As we know from (3.3b), the outsourcing demand depends on the outsourcing costs, effort and wage level. However, the outsourcing costs and the effort level are constant, so that only wage changes affect the outsourcing demand. Since profit sharing leads to a lower wage level, this reduction alone induces less outsourcing activities. The reason for this is intuitive. Due to a lower wage level, the domestic marginal costs fall, thereby increasing the advantage of integrated production and inducing a higher domestic labour demand.

Although it is known that lower domestic marginal costs work in favour of domestic production and that profit sharing lowers the wage level, to our knowledge, ours is

the first analysis which incorporates outsourcing, wage bargaining and direct worker participation in a firm's success via profit sharing.[39]

3.4.2 Committed Profit Sharing

In the previous analysis, we have come to know the effects of profit sharing. Since, in our framework, profit sharing is a commitment by the firm, we have to analyse the grounds on which a firm will introduce it or not. Therefore, in this section, we concentrate on the optimal profit share.
The representative firm commits to profit sharing to maximize its profit subject to labour demand (3.3a), outsourcing (3.3b), wage formation (3.8) and effort determination (3.11), so that

$$\begin{aligned} &\max_{\tau} \bar{\pi} = (1-\tau)\cdot\pi^{*} \\ &\text{s.t. } \pi_{L}^{*} = \pi_{M}^{*} = 0 \\ &\bar{e} = \left(\frac{b}{1-\gamma}\right)^{\gamma} \\ &w_{L} = \frac{\eta_{L}}{\eta_{L}-1+\tau}\left(b_{L} + g(\bar{e})\right). \end{aligned} \tag{3.15}$$

The first-order condition is $-\pi^{*} + (1-\tau)\pi_{\tau}^{*} = 0$, where π^{*} is the indirect profit. Using this, we can solve the optimal committed profit sharing set by the firm by the rewritten first order condition to

$$1-\tau = \frac{\pi^{*}}{\pi_{\tau}^{*}}. \tag{3.16}$$

Since $\pi^{*} > 0$ and $\pi_{\tau}^{*} = \pi_{w_L}^{*} \cdot \frac{dw_L}{d\tau} = -\frac{dw_L}{d\tau} \cdot L > 0$, we can conclude that the left hand side of (3.16) has to be positive and therefore the share, which is deviated to

[39] Empirically, Budd et al. (2005), show that affiliate wages also depend positively on the profit of the parent firm. This can be understood as profit sharing within a multinational firm and explains partly why a multinational affiliate pays higher wages than a purely domestic firm. In other studies as Antras (2003, 2005) or Grossman et al. (2005) profit sharing is incorporated, too. However, their focus is on bargaining between the outsourcing partners to distribute the rent, which is created from the contractual relationship.

the workforce fulfils $\tau < 1$. It is intuitive that the profit share fulfils $0 \leq \tau < 1$. This means that the workforce gets either only the wage or the wage plus a share of the profit. Thus, we have to check if the firm will implement a profit sharing scheme.
At first we will solve (3.16) for the optimal profit share in the absence of outsourcing. Using $\pi^*\big|_{M=0} = \frac{(1-\alpha)}{\alpha} \cdot L \cdot w_L\big|_{M=0}$ and $\left.\frac{dw_L}{d\tau}\right|_{M=0} = -\frac{w_L\big|_{M=0}}{\tau + \alpha/(1-\alpha)}$ we can rewrite (3.16) to $\frac{1-\tau}{\tau + \alpha/(1-\alpha)} = \frac{1-\alpha}{\alpha}$. Solving this expression leads to $\tau\big|_{M=0} = 0$, which shows that the firm will desist from a profit sharing scheme in the absence of outsourcing.
In the presence of outsourcing, the optimal profit share expression is more complicated, but in Appendix A it is shown that $\tau < 0$ results and we yield in the presence of outsourcing the corner solution of a zero profit share, too. We can summarize our main finding and formulate it as:

Proposition 3.3:

If the labour union sets the effort level, the firm desists from profit sharing.

To give an explanation for this result, we have to look back on our findings. Concerning the effort level, we demonstrate that it is independent of profit sharing, since for an exogenous profit share the trade union can negotiate the wage level to realize an adequate income. For a given wage level, through the unchanged decision about effort provision, even if the firm sets some incentives by introducing profit sharing, the firm only contributes part of its profit to the workers. Thus, it is beneficial for the firm to avoid profit sharing. Notice that this argumentation ignores the wage decreasing effect obtained from profit sharing. Although the profit increases with the implementation of such a compensation scheme, the firm has to share the overall profit with the workforce. As we show, the firm will abandon this instrument despite the wage reducing effect. For a profit maximizing firm, this can only be explained by the fact that the profit the firm owner gets without a profit sharing scheme is always higher than the share of profits he gets in the presence of such a remuneration system. Therefore, the wage decreasing effect, respectively profit increase of any positive profit share is too small and does not compensate the firm owner for the loss of profit by implementing a sharing system. This means that the loss due to sharing is for any positive profit sharing higher than the gain due to the wage decrease and thus the wage reduction realized by the union is lower than the needed wage reduction by the firm.

We can therefore answer our main research question as follows: If the union sets the effort level, there is a wage moderation effect due to profit sharing, which leads to a lower outsourcing demand. Despite the existence of this effect, a profit maximizing firm will abstain from profit sharing, since it creates no enhancing productivity effect and the wage decreasing effect is too small and cannot increase the profit the firm gets.
From our findings we can derive an important policy implication. If the firm has the power to unilaterally set the profit share, there will be no sharing system. If the union sets the effort level, using a profit sharing system to induce wage moderation and prevent outsourcing can only be realized if profit sharing is also a part of the wage negotiation. Alternatively the effort can also be individually determined, where profit sharing creates a positive effect on effort provision and thus an increase in productivity can be realized as shown by Koskela and Stenbacka (2006). However, in that case the mentioned moral hazard and free-riding problem has to be solved.
Knowing the optimal effort level, relying on comparative statics, we can give a statement about the wage effect of outsourcing. Since in the absence and presence of outsourcing the effort level is the same, we only focus on the mark-up $A = \frac{\eta_L}{\eta_L - 1}$, with $\eta_L = \frac{1}{1-\alpha} + \left(\frac{1}{1-\alpha} + 1\right)\frac{M}{\bar{e}L}$ and $\eta_L\big|_{M=0} = \frac{1}{1-\alpha} < \eta_L$. Since the mark-up is decreasing with higher labour demand elasticity it follows that $w_L < w_L\big|_{M=0}$. We can sum this up in:

Proposition 3.4:

Outsourcing has a wage decreasing effect.

This holds, since higher outsourcing demand results from lower outsourcing costs. As we have shown in (3.13) this reduces the base wage due to a more elastic labour demand. Thus, setting a high wage increases the loss for the union and leads to a less aggressive union behaviour, resulting in a lower wage, whereby the union can avoid outsourcing and makes integrated production more attractive.

3.5 Concluding Remarks

We have focused on the question: How does profit sharing influence flexible outsourcing? In our framework we show that the union fixed effort level is

independent of profit sharing. This is due to the fact that effort provision is connected with a disutility, which can be avoided. Also, the loss of income via this constant effort level can be neglected, since with its second instrument, the wage, the trade union can affect the income. Therefore, no productivity effect, only a wage moderation effect may occur by implementing a profit sharing scheme. Due to the possibility of substitution between outsourcing and domestic labour, this wage effect affects the outsourcing demand. Since the amount of outsourcing depends positively on the domestic wage, in general, profit sharing can lead to lower outsourcing due to decreasing domestic marginal costs. However, we demonstrate that the optimal committed profit share is zero. Ignoring the wage effect, this can be explained by the constant effort level. By introducing profit sharing, the firm only redistributes profit from itself to the workforce, without any profit increasing incentives on productivity. Since despite the wage moderation, the firm does not implement a profit sharing scheme, we can conclude that the wage reduction is too small to compensate the firm's owner for sharing part of the profit with the workforce. Thus, our analysis shows that there has to be not only a wage moderating but also an additional positive effort effect of profit sharing. In combination of the mentioned unclear empirical impact of profit sharing on effort and the problem of monitoring the effort provision of workers, we show that it is not profitable for the firm to implement such a compensation scheme. From this finding, we give an explanation why only few of these remuneration packages for non-managers will be observed.
Moreover, we also find that lower outsourcing costs or higher outsourcing will decrease the base wage. This follows, since we assume that outsourcing and domestic labour are substitutes.

Appendix

Appendix A: Optimal Profit Sharing in the Presence of Outsourcing

From equation (3.16), we can solve for the optimal profit share. Since there could be a distribution of none or a part of the profit to the workers, the optimal profit share has to fulfil $0 \leq \tau < 1$.

To check this condition, we can rewrite (3.16) to $-(1-\tau)\cdot\frac{dw_L}{d\tau}\cdot L = \pi^*$, where the right side is positive. Thus, to fulfil this equation, the left-hand side has to be positive, too. Due to the knowledge of $\frac{dw_L}{d\tau} < 0$, this only holds for $\tau < 1$.

Since we know that there will be no full profit distribution, we have to check whether there is none or a partial participation of the workers in the firm's success. For this analysis we use (3.12) and rewrite (3.16) to

$$\frac{(1-\tau)\cdot w_L \cdot L}{\eta_L - (1-\tau)\left(1 - \frac{\partial \eta_L}{\partial w_L}\frac{w_L}{\eta_L}\right)} = \pi^*. \tag{A.3.1}$$

Implementing $\pi^* = w_L \cdot L\left[\frac{1-\alpha}{\alpha} + \frac{M}{\bar{e}L}\left(\frac{1-\alpha}{\alpha} + \frac{1}{2}\right)\right]$ and rearranging (A.3.1), we obtain

$$(1-\tau)\cdot A = B, \tag{A.3.2}$$

where $A = \left[1 + \frac{B}{\eta_L}\left(1 - \frac{\partial \eta_L}{\partial w_L}\frac{w_L}{\eta_L}\right)\right]$ and $B = \eta_L \cdot \left[\frac{1-\alpha}{\alpha} + \frac{M}{\bar{e}L}\left(\frac{1-\alpha}{\alpha} + \frac{1}{2}\right)\right]$.

Comparing these expressions, we find that $B > 0$ and $B > A$ if $L; M > 0$.

With the knowledge of $\tau < 1$ and $B > A$ in the presence of outsourcing, we can from (A.3.2) identify the sign of the term A and also the optimal profit share.

Since $\tau < 1$ holds, the term $1-\tau$ will be positive. With $B > 0$ this gives us the sign of the term A. As one can see from (A.3.2), $A > 0$ holds under the derived conditions.

Thus, to fulfil (A.3.2) under the finding $B > A > 0$, we can conclude that $0 < \tau < 1$ does not hold. Therefore, under $B > A > 0$, equation (A.3.2) holds only for $\tau < 0$. Since implementing a negative profit share is impossible, we obtain a corner solution, where the firm desists from profit sharing.

PART III: OUTSOURCING IN OLIGOPOLISTIC MARKETS

In this part we see outsourcing as a long-term decision, which is motivated by saving fixed costs and thus has a strategic character in imperfect output markets. Therefore, we follow the industry view, where outsourcing is an instrument to achieve a strong position in the market. In this part, we are interested in explaining when certain production structures in an industry are observed and which outsourcing effects resulting from competition and taxation. In addition, we focus on the impact of motivation, since the motivation of outsourcing can differentiate between sectors.

Chapter 4

Outsourcing Motives, Competitiveness and Taxation

Abstract

This chapter shows the strategic aspects of international outsourcing in an oligopolistic market, while we distinguish two outsourcing motives. First, outsourcing is attractive because of fixed cost savings and second, outsourcing is associated with lower marginal costs than the domestic production. We show that outsourcing decisions are strategic substitutes, independently of the underlying motive. Additionally, we analyse how competition and taxation affect the equilibrium level of outsourcing and employment. Here, we demonstrate for the fix costs saving motive that intensified competition leads to more outsourcing. Concerning the impact of taxation, we find that a lower consumption tax on output decreases outsourcing and thus increases employment. In case of a reversed outsourcing motivation, where outsourcing is associated with lower marginal costs, we show that the opposite effects concerning competition and taxation on outsourcing occur, while the employment effect of taxation is ambiguous.

JEL classification: D20, L13, L22, L23, L24
Keywords: outsourcing, cost structure, Cournot-competition, taxation

4.1 Introduction

It is without controversy that outsourcing has become a central topic in the political debate and in firms' management to reorganize the production mode. In addition, in the economic literature, especially in the theory of industrial organization, outsourcing has been discussed in depth. The analyses of outsourcing as a firm's organization decision started with Coase (1937). Focusing on the question, why a firm covers all steps of the production chain, although some could be realized by other manufactures, respectively the market, he developed a theory of vertical integration, which in fact, is a theory of outsourcing.[40] The driving force behind integration and less outsourcing are transaction costs, such as costs of quality control, information and communication. As pointed out by Harris (1993), these kinds of costs have been falling over recent decades due to technical developments, and thus favouring outsourcing.[41] To decide on the production mode, thus the management of the firm compares the in-house production costs with the costs of external procurement, which includes price and transaction costs. If the costs of outsourcing are lower due to decreasing transactions costs, then the firm decides to outsource. However, the transaction cost thesis (see Williamson 1975, 1986) is just one way to explain outsourcing. The most frequently used argument for outsourcing is the difference of marginal costs, such as wages, where transaction costs play only an inferior part. Besides marginal costs, fixed costs or investment costs are also part of a firm's calculus and thus, also affect the choice of the organizational structure. Since outsourcing can be used to avoid fixed costs, the organizational choice can be interpreted as an investment decision, where outsourcing stands for a long-term externalization of certain production parts. Especially in the automobile industry and aircraft sector, which are characterized by high investment costs, this view takes on an important role. Sinn (2005) shows that 88% of the production volume of the Porsche Cayenne is procured externally. The study of the Fraunhofer-Institute and Mercer (2004) conclude that by the year 2015 up to 80% of the development and production in the automobile industry, i.e. the production stages with the highest fixed costs, will be sub-contracted. Thus, the input suppliers bear the major investment burden and compete directly with the in-house input production of the car manufacturer.

Therefore, cost differences as the motivation for outsourcing can be characterized in two ways. First, outsourcing saves fixed production costs, however, the price for the

40 For an overview of vertical integration, see Perry (1989) or Williamson (1996).

41 Empirical studies like Hummels et al. (1998, 2001) or Yeats (2001) show the increase of imported intermediate goods over the last 30 years.

outsourced input is higher than domestic marginal costs, while in the second way, outsourcing leads to lower marginal costs, but is associated with higher fixed costs than the integrated production.

Due to the cost saving argument, outsourcing becomes an instrument for the firm to defend itself against competitive forces and to establish a strong market position. Porter (1985) argues that a strong market position relative to the competitors can only be derived by having a comparative advantage. For realizing this, firms have to pursue either a cost leadership or a differentiation strategy. Since outsourcing can in both of the mentioned trade-offs decrease the average costs, it can lead to the cost leadership. However, it can also be used as a differentiation criterion. One example for the production mode as a differentiation criterion is the product label "In cooperation with in ….", which can be understood as a quality standard, since the notice stands for a collaboration with a well known firm. If the cooperation partner is specialized in producing a certain input good, the cooperation can be interpreted as outsourcing. The uniqueness of the collaboration signals a high quality standard by using the know-how of the partner and can therefore improve the reputation of a firm. Thus, outsourcing can lead to a higher demand and can increase the competitiveness of a firm.

In reality, most markets are characterized by more than one firm, each entrepreneur has an incentive to differentiate and thus, the organization choice becomes an instrument of strategic interaction between the participants in an industry. However, this strategic incentive and therefore the extent of outsourcing is affected by the intensity of competition in an industry.

In this chapter we focus on two aims. First, we analyse the strategic interactions between companies in a Cournot-oligopoly, where the production of the output requires different components. Here, we characterize the optimal share of outsourced inputs depending on the production costs and the number of competitors. The second goal deals with the fear of reducing employment as a result of outsourcing.[42] Among other aims, governments and politicians are mostly interested in saving domestic jobs due to lower outsourcing and thus, they interact in the market. Understanding the different motives of outsourcing and the impact of different variables, the government can then use its knowledge and implement goal-oriented (specific) policies to lower outsourcing activities.

Since in our model the relationship of fixed and marginal costs is decisive, we analyse in the first instance the effects of government interactions, which lower

[42] For an overview concerning the debate on employment effects due to outsourcing, see Freeman (1995) and Bhagwati et al. (2004).

domestic production costs. Therefore, we look at the changes of investment and marginal costs. To make domestic production attractive due to lower investment costs, exploitation costs are taking over public investments in the infrastructure are often implemented. Lowering marginal costs can be realized by lower social insurance contributions by the employer.

However, the government can also affect organizational choice in an indirect way by changes in the demand for goods. These changes can occur through taxation. As a result of the tax, producer price decreases and consumer price increases and thus the total output declines. Since taxation influences the market outcome, it will generate an adaption of the cost and production structure and thus the outsourcing decision will be affected.[43]

We thus answer the questions: What is the strategic relationship of the outsourcing decisions? Which impact concerning the strategic property of the decisions results from different outsourcing motives, respectively trade-offs? What is the influence of policy instruments, such as the degree of competition and taxation under the different motives?

In the first part of our analysis we see outsourcing as an investment preventing fixed costs. On the other hand, it entails higher marginal costs than in-house production and thus, the company faces a trade-off between investment costs savings and additional marginal cost payments. We show that the numbers of externally procured inputs are strategic substitutes. We also find that due to the fixed cost saving argument, higher competition in the market leads to more outsourcing. Regarding of the second goal, we demonstrate that decreasing marginal and fixed costs favours integrated production and leads to a higher employment level. Concerning taxation, we show that higher output taxation increases the proportion of outsourcing and employment level by reducing the total amount of output.

We also analyse the strategic interactions, impact of competition and taxation for the reversed outsourcing motivation, where outsourcing is attractive due to lower marginal costs, but on the other hand is associated with additional fixed costs. Here, we find the amounts of outsourced inputs are also strategic substitutes. Therefore, the strategic relationship does not depend on the motivation of outsourcing. However, this statement does not hold for the impact of competition and taxation. In both cases there is a decreasing output, lower revenues are used for financing the fixed costs. Since now outsourcing requires fixed costs, higher competition and

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[43] Notice that the primary target of taxation is not to avoid outsourcing, but a tax can affect the production structure and therefore, it can be an instrument that favours external procurement or dampens the incentive for outsourcing. However, our central aim is to demonstrate only the impact of taxation on outsourcing.

taxation increases the incentive to produce more integrated. This result shows that the motivation of outsourcing is decisive in relation to the effects of changes in market characteristics.
Our analysis is organized as follows. Section 4.2 integrates the analysis with the existing literature. Section 4.3 presents the basic framework if outsourcing is attractive because of fixed cost savings. Following this, Section 4.4 concentrates on the influence of government interactions concerning the proportion of outsourcing and employment level. In Section 4.5, we analyse the effect of competition and taxation under the reversed motivation, where outsourcing saves marginal costs. The last Section 4.6 concludes.

4.2 Related Literature

Although there is a growing literature relating to outsourcing and its effects on wages and employment[44], only few studies focus on the strategic aspects, where the price structure and thus the intensity of competition is affected by the organizational choice. In a Cournot-duopoly, Nickerson and Vanden Bergh (1999) derive conditions for the production structure in the different possible Nash-Cournot-equilibria: i) both use outsourcing, ii) both have integrated production or iii) the firms use different strategies. In this framework, the resulting equilibrium depends on the trade-off between fixed costs saving against marginal cost increase due to outsourcing. In addition, Shy and Stenbacka (2003) in a Hotelling model depict the organizational decision in imperfect output markets with the identical trade-off. Since in both analysis outsourcing leads to lower fixed costs but higher marginal production costs, in the case of relatively high (low) fixed cost and/or low (high) marginal cost differences, the firms will outsource (produce integrated). If the fixed cost level and/or the marginal cost difference have a medium level, a different production structure will result. Assuming the same trade-off as the above mentioned papers, also Buehler and Haucap (2006) analyse the strategic aspects of outsourcing. However, they differ in two ways. First they model a sequential decision process of the firms. Thus, the choice of the first firm influences the second participant's behaviour and the competition via the costs. The second difference is the outsourcing price reaction. In the first two papers, the price of external procurement is constant, but in Buehler and Haucap (2006), it rises with increased

[44] For a survey of the empirical literature see Knabe and Koebel (2006), Geishecker (2008) or Geishecker and Görg (2008) and their references. Examples of theoretical analyses are Zhao (1995), Lommerud et al. (2009) and Koskela and Stenbacka (2009).

outsourcing. Since one firm can influence the behaviour of its competitor, it will soften the competition with its organizational choice. The authors identify the three known types of equilibria, but in the case of different strategies, the first firm will produce integrated to increase the marginal costs of the second firm, which will produce via outsourcing. Eberfeld (2001) assumes the same trade-off and shows that due to the externality of the integration decision of one firm on other firms, different production modes can exist in equilibrium. This holds since integrated firms produce with lower marginal costs, which decrease the market price. As a result, the demand grows and other firms lose the incentive to integrate, since this increase the fixed costs. He also finds that higher fixed costs associated with integrated production decrease the advantage of integration and thus, reduce the number of firms with integrated production. Also the effect of a higher degree of competition in the input market can be explained intuitively. Since stronger competition lowers the price for the input good, outsourcing becomes more attractive and the number of integrated firms in the final good market decreases. However, all of these papers concentrate on complete outsourcing, where the firm has only the choice of complete outsourcing or no outsourcing.

Only partial outsourcing is the focus in Shy and Stenbacka (2005). In a Cournot-model, they find that higher competition stimulates outsourcing. In contrast to the studies above, the trade-off is reversed, such that integrated production has higher marginal costs due to a lower degree of specialization or less efficiency. On the other hand, outsourcing is associated with fixed costs for search frictions, contractual imperfections and monitoring. The case of partial outsourcing can also interpret as bi-sourcing. In bi-sourcing, parts of a firm's input goods are produced independently, though company-owned branches (insourcing) and parts of the input goods are procured externally (outsourcing). Thus it can be understood as a make-and-buy decision. Du et al. (2005, 2006) as well as Beladi and Mukherjee (2008) show that due to the strategic impact of this type of production organization the price for external procurement falls and thus the hold-up problem between input supply and input demand is minimized.

In the case of horizontal outsourcing the production choice serves as a strategic instrument, since the influence is directly on a competitor.[45] Here, using a Bertrand-

[45] Vertical outsourcing is characterized by the fact that an input producer specializes on intermediate good production. In contrast, horizontal outsourcing describes the fact that firms compete in the output market, i.e. eye-to-eye, while they produce also parts for the rival firm. Practical examples are among others are the automobile and aircraft industry, e.g. Mazda not only built its own sports car but also provided parts for a Ford model. The US aircraft manufacturer Lockheed also produced parts for Boeing (Spiegel, 1993).

duopoly with an auction approach, Kamien et al. (1989) analyse the strategic aspect of outsourcing on bids, output price and thus on the competition. Spiegel (1993) shows that in a Cournot-model with horizontal outsourcing, production can be efficiently divided among the companies. However, the effect on aggregate output and price is ambiguous, and thus, only in the case of growing market output the welfare will definitively increase. Comparing the welfare in Bertrand- and Cournot-competition with horizontal outsourcing, Arya et al. (2008) find that the welfare level in Bertrand-competition is smaller than in Cournot- competition. The reason for this result is that the costs of the input producer increase and this firm will lose some of its aggressiveness on the Bertrand-market. Therefore, the output price is higher as in Cournot-competition.[46]

Although we adapt the framework by Shy and Stenbacka (2005), the differences should be emphasized. The first difference is that we have the reverse outsourcing motivation in the first part of our analysis. Here, we model the trade-off of fixed costs saving against higher marginal costs due to outsourcing, while they model a cost structure, where outsourcing is associated with a marginal cost advantage, but has a disadvantage in the form of transaction costs, which increase with the number of outsourced inputs. Secondly, we assume constant marginal costs, where Shy and Stenbacka (2005) adopt increasing marginal costs. This difference will also exist in the second part of our analysis, where we assume the same motivation of outsourcing as Shy and Stenbacka (2005). Therefore, we can answer the similar question to which Shy and Stenbacka (2005) responded, but we extend the analysis by showing the impact of taxation.

4.3 Basic Model

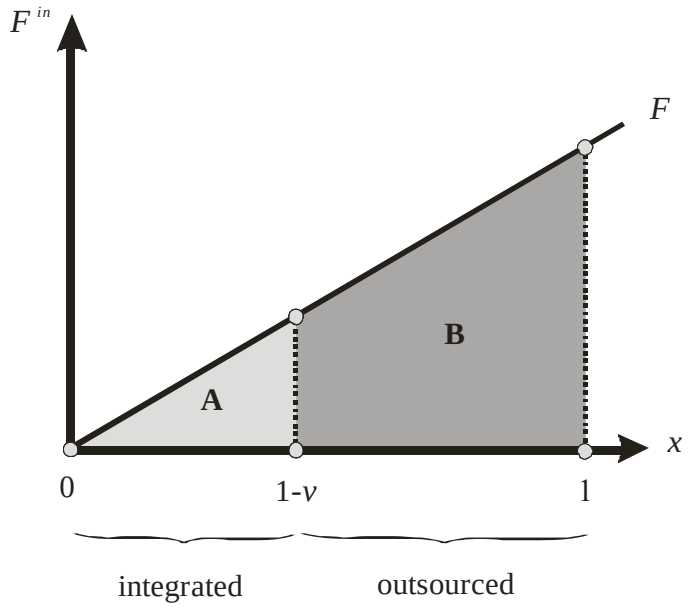
Following Shy and Stenbacka (2005), we assume that the production of one unit of the final good y requires a continuum of inputs x indexed by $x \in [0;1]$. The firm faces a make-or-buy decision, since each input can be produced in-house at the firm's plant or can be outsourced to an independent supplier.

The firm can produce one unit of any input integrated at constant marginal costs m. Additionally there are fixed costs F of in-house production. These costs can be saved by outsourcing, in which case, any of the inputs can be bought at a constant

[46] Similar to horizontal subcontracting and the resulting welfare effects, the welfare effects of cross-supplies, where firms in an industry due to existing fixed costs, sell the final good to each other, is studied in the literature. Baake et al. (1999) show that cross-supplies always increase welfare compared to the normal Cournot-outcome.

price q.[47] For being simple, we abstract from any kind of fixed costs associated with outsourcing.[48] The case $q < m$ characterizes outsourcing as the strictly dominant production mode, since it saves marginal and fixed costs. Therefore, we focus on the case, where the price of buying one input unit from a foreign supplier is bigger than the marginal costs of the integrated production, i.e. $q > m$[49], where the marginal cost disadvantage of outsourcing can be interpreted as an premium payment to the intermediate good supplier. For the fixed costs, we assume that they will vary with the type of the input x and increase over the interval $[0;1]$. Due to the indexation of the inputs and the assumption on linear increasing fixed costs, we can conclude that the final producer will only produce the cheapest inputs in an integrated way. Let $v \in (0;1)$ be the amount (respective share) of outsourced inputs, then the fixed costs for the remaining integrated produced inputs can be described by $F = \int_0^{1-v} x\,dx$. We can illustrate the fixed cost assumption in Figure 4.1.

Figure 4.1: fixed cost illustration



47 This means that we assume linear pricing for any intermediate good.

48 Following this, we abstract from costs like expenditure to find an appropriate external supplier, severance package or costs for supervising the quality of the intermediate good. We therefore assume that there is no hold-up problem in the relationship between the final good and the intermediate good producer.

49 This is reasonable, if we assume that the domestic firms have technological advantages.

Starting from a fully integrated input production, the fixed costs are described by the light grey area A and the grey area B. If v inputs are outsourced, the firm will reduce its fixed costs by B. This describes the fixed cost saving argument, since there are only fixed costs (area A) for the residual integrated production $1-v$. By using our assumption for the fixed costs, we implicitly model quadratic fixed costs, i.e. $F=\frac{(1-v_i)^2}{2}$.[50]

In the basic framework, there are $i=1...N$ firms, where y_i captures the output of a single firm. We can use this notation to specify the total costs of firm i as

$$TC_i=\left[(1-v_i)\cdot m+v_i\cdot q\right]\cdot y_i+F\,. \tag{4.1}$$

The framework of the model can be described as a two-stage game with the following sequence of events:

(I) Each firm i $(i=1...N)$ chooses the inputs $v_i\in(0;1)$, which will be outsourced, i.e. will be bought from an independent input supplier, and decides the set of inputs $(1-v_i)$, which will be internally procured.

(II) Each firm takes the outsourcing and output decision of the other firms as given, and chooses its production level to maximize its profit.

These stages are analysed by using backward induction.

4.3.1 Stage II: Cournot-Equilibrium

In line with the former discussion, we assume that all firms engage in a Cournot-competition in homogeneous goods, where the linear market demand for the final good is described by $p=1-Y=1-\sum_{i=1}^{N}y_i$, with $i=1...N\geq 2$ as the index of firms and p as the market price.

[50] Notice that a quadratic fixed cost function guarantees that the outsourcing advantage decrease with an increasing amount of external procurement. This is true, since the marginal cost difference is the same for all numbers, but the fixed costs saving will decrease. Additionally, this leads to the necessary condition of a negative second order condition of the profit function.

At this stage we characterize the production decision of the firm for a given output choice of the other firms. Each firm chooses the output level y_i to solve its maximization problem

$$\max_{y_i} \Pi_i = \left[1 - m - y_i - Y_{-i} - v_i \cdot (q - m)\right] \cdot y_i - F, \tag{4.2}$$

with $Y_{-i} = \sum_{j \neq i} y_j$ as the output of all competitors except i. The first derivative of the profit function yields the reaction function $y_i = \frac{1}{2}\left[1 - m - Y_{-i} - (q - m) \cdot v_i\right]$ of a single firm $i = 1,...,N$, which characterizes the best response function for the given output level of all the other firms. Since there are N firms, we get a system of N reaction functions. The solution of these equation system yields the Cournot-equilibrium output level as a function of the outsourcing decisions. To solve this equation system, we have to use repeated substitutions. Here, we find that the output of a firm depends on its own share of outsourcing and the outsourcing decision of all the other competitors. For the individual output we obtain

$$y_i = \frac{1}{(N+1)}\left[1 - m + (q - m) \cdot \left(\left(\sum v_{-i}\right) - N \cdot v_i\right)\right], \tag{4.3}$$

with $\sum v_{-i}$ as the sum of the outsourced inputs of all firms except i. For the industry output and market price we get

$$Y = \frac{1}{(N+1)}\left[N(1 - m) - (q - m) \cdot \sum_{i=1}^{N} v_i\right] \tag{4.3a}$$

and

$$p = \frac{1}{N+1} + \frac{N \cdot m}{N+1} + \frac{q - m}{N+1} \cdot \sum_{i=1}^{N} v_i \,. \tag{4.3b}$$

Equation (4.3) shows that the output of a firm depends negatively on the amount of the firm's outsourced inputs v_i, i.e. $\frac{\partial y_i}{\partial v_i} < 0$. Due to the marginal cost disadvantage of outsourcing, $q > m$, higher external procurement (higher v_i) increases the output price, and thus demand and production decrease.

The impact of the production mode of all other firms, $\sum v_{-i}$, can be similarly described. If the number of outsourced inputs of all other firms increases, the marginal costs of these firms increase and thus the demand will decrease. Due to the property of homogenous goods, this increases the demand of firm i, i.e. $\frac{\partial y_i}{\partial\left(\sum v_{-i}\right)} > 0$.

Since the price has to be lower as consumer's maximal willingness to pay, the condition $p < 1$ has to be fulfilled. In connection with our assumption $q > m$, this is given for $1 > q > m$. The term q characterizes the unit production costs of one piece of output, if all components are externally procured and thus the term describes the maximal marginal production costs of one unit of the final good. To be sure that the market price exceeds the marginal production costs in any case of the production mode, we assume that maximum willingness to pay is bigger than the maximum unit of production costs for one piece of the final good. Thus, we can formulate our assumption concerning the maximal willingness to pay.

Assumption 4.1: non-negative output

We assume that $1 > q > m > 0$ *holds.*

Assumption 4.1 secures that there is a positive market outcome for any organizational choice and thus we avoid a corner solution.

4.3.2 Stage I: Optimal Production Mode

After characterizing the results on stage II, we can look at stage I to determine the optimal amount of procured inputs of a firm as a function of the number of competitors, the domestic marginal costs and outsourcing price. If we use our former results and insert these into the profit function, we can specify the object function (4.2) on stage I for firm $i = 1,\ldots,N$ as

$$\max_{v_i} \Pi_i = \frac{\left[(1-m)+(q-m)\cdot\left(\left(\sum v_{-i}\right)-N\cdot v_i\right)\right]^2}{(N+1)^2} - \frac{(1-v_i)^2}{2}. \qquad (4.4)$$

Since the firm decides directly about the amount of externally procured inputs v_i there are only fixed costs for each of the residual integrated produced inputs, so that

the firm has to pay fixed costs of $\frac{(1-v_i)^2}{2}$. Consequently, there is a fixed cost saving of $v_i\left(1-\frac{v_i}{2}\right)$ for the external procured inputs in comparison to a situation with no outsourcing.[51] As the first order condition of the maximizing problem (4.4) we obtain

$$\frac{\partial \Pi_i}{\partial v_i} = \frac{-2 \cdot N(q-m)}{(N+1)^2}\left[(1-m)+(q-m)\left(\left(\sum v_{-i}\right)-N \cdot v_i\right)\right]+(1-v_i)=0 .$$

Solving the first order condition we obtain the reaction function of a firm, defined as the best response of i to the disintegration choice of all rival firms, i.e. $v_i = v_i\left(\sum v_{-i}\right)$. The decision of a single firm can be expressed as

$$v_i = \frac{(N+1)^2 - 2N \cdot (q-m) \cdot \left[(1-m)+(q-m) \cdot \sum v_{-i}\right]}{(N+1)^2 - 2N^2 (q-m)^2}. \tag{4.5}$$

If we use the symmetry property $v_1 = ... = v_N = v$ we can simplify the individual reaction function and obtain the equilibrium proportion of outsourcing

$$v^* = \frac{(N+1)^2 - 2N \cdot (q-m) \cdot (1-m)}{(N+1)^2 - 2N \cdot (q-m)^2}. \tag{4.6}$$

Before we analyse the effects of intensified competition and domestic costs, we have to show that several conditions are fulfilled.

At first we have to ensure, that (4.6) describes a profit maximum. Therefore, the second order condition has to be negative. For an N -firm Cournot-oligopoly with homogenous goods, from (4.4) we obtain as the second order condition, $\frac{\partial^2 \Pi_i}{\partial v_i^2} = \frac{2N^2 \cdot (q-m)^2}{(N+1)^2} - 1$. To guarantee that (4.6) constitutes a profit maximizing equilibrium with positive profits, the condition $q - m < \frac{N+1}{N \cdot \sqrt{2}}$ has to be fulfilled.

In addition we have to guarantee that the individual and industry output in the equilibrium is positive, so that the output price is lower than consumer's maximal willingness to pay, i.e. $p < 1$. Inserting the optimal outsourcing proportion in the

[51] This term correspondents to area B in Figure 4.1.

output equation, we find that a positive individual and industry output in the equilibrium is obtained, if $q - m < \frac{N+1}{\sqrt{2} \cdot N}$. Thus, we have the conditions that can be checked to identify, which of them is binding. Comparing the last expression with the second order condition, we find that $\frac{(N+1)}{N \cdot \sqrt{2}} < \frac{(N+1)}{\sqrt{2N}}$ for $N > 1$. Due to our assumption that at least two firms compete in the market, we have $p < 1$ for a valid second order condition.

However, $p > 0$ also has to be fulfilled. Here we find that a positive market price will result for $(q-m)^2 < \frac{(N+1)^2}{2N} - \frac{(1-q)(N+1)}{2}$. In addition, this expression has to be compared with the second order condition to derive the necessary binding condition. If $\frac{(N+1)^2}{2N^2} < \frac{(N+1)^2}{2N} - \frac{(1-q)(N+1)}{2}$ holds, the second order condition is the binding constraint, but this is only given for $q > \frac{1}{N^2}$. Assuming that this is given, we can identify an interval for the marginal cost difference, in which the model leads to an internal solution.

Assumption 4.2: internal solution

For a given market size the marginal cost difference fulfils $\frac{1}{N^2} - m < q - m < \frac{N+1}{N\sqrt{2}}$.

Since our interest is partial outsourcing we have to show, that $v^* \in]0;1[$ will be generated from profit maximization. For $v^* < 1$ we find that this will hold, if $q < 1$, which is our Assumption 4.1. Therefore, $v^* < 1$ is given. For the absence of full outsourcing an intuitive explanation from our cost structure can be derived. Figure 4.1 shows the fixed costs for every needed input. It can be seen for the first unit of input goods, that there are no fixed costs. However, the domestic marginal costs m and the price for external procurement q, with $q > m$, are the same for all inputs. Therefore, for the first unit, there is only a disadvantage of outsourcing, which means that this unit will not be outsourced. Thus, for the assumed cost structure, we will never observe full outsourcing, because at least the first marginal unit of input goods will be produced in an integrated way.

Now we have only to check that $v^* > 0$ holds. Under Assumption 4.2, the denominator of (4.6) is positive and a positive numerator is guaranteed by

$q-m<\frac{(N+1)^2}{2N(1-m)}$. Comparing this expression with Assumption 4.2, we find that $\frac{N+1}{N\cdot\sqrt{2}}<\frac{(N+1)^2}{2N(1-m)}$ holds, if $(N+1)>(1-m)\cdot\sqrt{2}$. Due to our assumptions $1>m>0$ and $N\geq 2$, this is always true and thus, the numerator is positive too. Therefore, equation (4.6) is an internal solution, with $0<v^*<1$.

Assuming there is no difference in marginal costs, $q=m$, we can see from (4.6) that in this case the whole input production will be outsourced, i.e. $v^*\big|_{q=m}=1$. This is intuitive, since in that case, the external procurement has no disadvantage, but does have the advantage of fixed cost saving.

After checking the necessary conditions, we can analyse the impact of the number of competitors and the domestic marginal costs. For the impact of the intensity of competition we find

$$\frac{\partial v^*}{\partial N}=\frac{2\cdot\left(N^2-1\right)\cdot(q-m)\cdot(1-q)}{\left[(N+1)^2-2N\cdot(q-m)^2\right]^2}>0. \tag{4.7}$$

Equation (4.7) shows that higher competition increases the amount of outsourced inputs, which can be explained as follows. If the number of competitors increases, the market share and the output of a single firm will fall. Since also the mark-up on the output price decreases, consequently, the profit of the firm will decline. To react to this loss, the firm adjusts its number of externally procured components to influence its costs. However, the number of outsourced inputs affects the costs of a firm in two ways, due to the fixed costs and due to the marginal production costs. Since a more integrated production process will increase the intensity of competition, due to lower marginal costs, and raise the fixed costs, the firm has no incentive to produce in a more integrated way. Therefore, the lower market share and resulting lower individual output increases the incentives to reduce the fixed costs and intensity of competition, since the realized revenues are too low for bearing the fixed costs for an unchanged production mode. In our framework, this can be done by reducing the number of integrated produced inputs respectively by increasing the number of outsourced inputs.

In a similar way, we find for the impact of the domestic marginal costs

$$\frac{\partial v^*}{\partial m}=\frac{2N(1-q)\left[(N+1)^2+2N\cdot(q-m)^2\right]}{\left[(N+1)^2-2N\cdot(q-m)^2\right]^2}>0. \tag{4.8}$$

This result is intuitive. If domestic marginal costs are increasing, ceteris paribus, the marginal cost advantage of the integrated production decreases, and thus outsourcing will be more profitable. To make it more clear: the advantage of outsourcing due to the fixed cost saving will be unaffected and the marginal cost disadvantage of outsourcing will be smaller, which implies that buying the input becomes more attractive and the proportion of external procurement increases. Therefore, we can sum in:

Proposition 4.1:

For homogenous final goods

a) increasing competition and

b) higher domestic marginal costs leads to more outsourcing.

To examine the strategic relationship of outsourcing choices, we restrict our model in the size of producing firms by focusing on the duopoly case. Therefore, the reaction function (4.5) can be rewritten as

$$v_i = \frac{9 - 4 \cdot (q - m) \cdot \left[(1 - m) + (q - m) \cdot v_j \right]}{9 - 8 \cdot (q - m)^2}, \tag{4.9}$$

Where the indices i and j characterize the two firms. From equation (4.9) the strategic relationship of the outsourcing decisions, $\frac{\partial v_i}{\partial v_j}$ and $\frac{\partial v_j}{\partial v_i}$, can be derived. The first derivative yields under Assumption 4.1

$$\frac{\partial v_i}{\partial v_j} = \frac{\partial v_j}{\partial v_i} = \frac{-4 \cdot (q - m)^2}{9 - 8 \cdot (q - m)^2} < 0. \tag{4.10}$$

Thus, we have downward sloping reaction curves for the outsourcing decision. This means, that an increase of outsourced inputs in one firm decreases the number of outsourced inputs in the other firm, so that the numbers of externally procured inputs are strategic substitutes.[52] Therefore, each firm has an incentive to increase their own amount of externally procured inputs as a response to a reduction of the

[52] The term "strategic" describes the property of the production mode. Due to the choice of outsourcing proportion, the price, as well as the profit of the competitor is influenced. Thus, the market position is affected and the choice of the production organization has a strategic component.

outsourcing activities by the other firm. Due to the assumption of higher marginal costs of outsourcing, lower outsourcing of firm j decreases the price of the output good. This, in turn, decreases the demand for the output of i and the firm faces a disadvantage, since its output and profit decreases. This can also be seen from the first order condition $\frac{\partial \Pi_i}{\partial v_i}$. The first term characterizes the marginal revenue, including marginal costs and the second term is the associated fixed costs. Due to lower outsourcing of firm j, the marginal revenue decreases, however, the fixed costs are unchanged and firm i realizes a loss. To react to this loss, firm i has to adapt its production organization, which can be done by reducing or enlarging its outsourcing activities. As equation (4.10) pointed out, the firm will increase its share of outsourcing. Since the market share of firm i decreases, the output and revenue are too small for bearing the associated fixed costs and the firm has a higher incentive to outsource and to avoid the fixed costs. Additionally, firm i will decrease the intensity of competition, since the price is affected by the marginal costs of all firms. The firm can achieve lower fixed costs and less intensity of competition by increasing the share of components, which are bought by a higher price from outside the firm. Following this, the marginal cost disadvantage will be compensated by lower fixed costs and weaker competition associated with higher outsourcing.[53] We can summarize our finding as follows:

Proposition 4.2:

The numbers of externally procured inputs are strategic substitutes.

This finding can also be interpreted in line with Proposition 4.1, where the outsourcing proportion increases with the higher intensity of competition. The argument suggests that the market share of a single firm is too low for bearing fixed costs and thus more outsourcing is observed. Additionally, due to the increased intensity of competition also the market price declines. However, adjusting the production mode in favour of outsourcing reduces the fixed costs and partly absorbs the reduction in market price, since the marginal costs of all firms affect the market price. The incentive to lower the intensity of competition also occurs when there is a decrease in outsourcing activities of firm j, since, in both cases, the price will decline. To react against this price decline, a single firm can lower the intensity of

[53] Also, Eberfeld (2001) finds that lower output due to a lower demand will lead to more outsourcing in order to avoid the associated fixed costs.

competition and fight against this fall by increasing its marginal production costs via outsourcing.

4.4 Government Interaction

Since high unemployment can be partly explained by higher outsourcing, policy instruments, which are helpful to increase the employment level, should favour domestic production. Before we analyse those instruments, we have to introduce labour as a production factor. To be simple, we assume that each integrated produced input requires one unit of labour. Thus $L = \left(1 - v^*\right) \cdot Y$ describes the equilibrium employment level in the industry.

As we showed, a lower proportion of outsourcing is achieved by a lower intensity of competition, i.e. $\frac{\partial v^*}{\partial N} > 0$. Therefore, the government can avoid an increase of competition by preventing new firms entering the market, which can be done by building up some entry barriers, such as bureaucratic restrictions. However, as one can see, also an output effect of competition, $\frac{\partial Y}{\partial N} > 0$, influences the employment level. Since both effects are working in opposite directions, the overall employment effect of competition is a priori ambiguous.

Of course, there are also other channels that can influence a firm's decision, which are less bureaucratic and restrictive. For example subsidies can lower production costs and therefore, affect a firm's choice in favour of integrated production. In our framework, two subsidies are possible. The first one is a subsidy relating to domestic marginal costs and the second is a fixed cost subsidy. However, in the EU the implementation of a subsidy is limited, or partly forbidden, by law[54], but there are some flaws and alternatives that can be found.

To lower domestic marginal production costs, non-wage labour costs like the social insurance contribution for the employer have to decrease. A German example of a fixed cost subsidy is the payments made by the government of the German state Nordrhein-Westfalen to the mobile phone producer Nokia. These payments lower investment costs and makes it easier to settle in Germany and create a certain number of jobs. This subsidy can be understood as investment assistance, such as

[54] For example, a subsidy that distorts the competition and trade between countries is forbidden. However, subsidies that assist the development of certain industries and regions get the acceptance of the commission of the EU and can be implemented, if they do not distort the competition (Europäische Gemeinschaft, 1997, § 87 EG-Vertrag).

developing real estate, or for the development of infrastructure, which can also include the provision of adequate production opportunities.
Also, with tax reforms, the government can influence the production mode, since changes in tax rates affect prices and therefore, affect the demand for output and input goods. To respond to this impact, firms can adopt their production mode.
In this chapter we analyse these influences by separating government interactions into two categories. The first is the production cost effect and the second is the taxation effect. As mentioned above, under the production cost affect, we analyse changes in domestic marginal and fixed costs. This reflects the public debate, regarding the reduction of non-wage labour costs for the employer, which relates to the reduction of marginal costs and the implementation of investment assistance for reducing fixed costs. Paragraph 4.4.2 focuses on the tax system. Here, we analyse the effect of a consumption tax. Using comparative statics, we demonstrate the effects on outsourcing proportion and employment. By doing this we concentrate on a short-term perspective, where the number of firms is unaffected and thus unchanged in the different scenarios. Therefore, we exclude market entry and market exit.
Please note: this is a positive analysis only, where we show the general impact of existing policies on outsourcing in oligopolistic markets. Thus, we ignore the financing of subsidies or lower social insurance contribution made by employers, by other taxes and the resulting impacts. Due to this partial framework, from our analysis it cannot be concluded that the different policies are adequate instruments to avoid outsourcing, however, we can demonstrate, in which way they can affect the organizational choice.

4.4.1 Production Costs Effect

As mentioned above, domestic costs are influenced by marginal and fixed costs. Thus, there are two components that are affected by different government policies.

Marginal Costs Influence

By interpreting the marginal costs as gross labour costs, the government can lower them to decrease outsourcing and thus promote higher employment. This can be done by reducing indirect labour costs such as social insurance contributions, which are borne by the employer. To show this effect, we interpret the marginal costs m as gross labour costs. As usual in Germany, these costs consist of two parts, the gross

wage $\tilde{m}$ and the social insurance contributions of the employer, i.e. $m = (1+t)\cdot\tilde{m}$, where t characterizes the social contribution rate for the employer. For simplicity, we assume that the gross wage is fixed by an administrative minimum wage or is given to the industry through a wage agreement between an employer federation and trade union.

From equation (4.6) we can derive the effect of the non-wage labour costs by taking the first derivative with respect to the social insurance contribution. Here we obtain $\frac{\partial v^*}{\partial t} = \underbrace{\frac{\partial v^*}{\partial m}}_{+} \cdot \underbrace{\frac{\partial m}{\partial t}}_{+} > 0$. Therefore, a lower social insurance contribution for the employer reduces the equilibrium outsourcing proportion. This is intuitive, since domestic marginal costs are falling and thus, the advantage of integrated production increases, while the disadvantage is unchanged. Thus, a reduction of these costs leads to a more integrated production and consequently, reduces outsourcing. For determining the overall employment effect, we have to take into account changes in total output.

Following the assumption concerning labour input and using (4.3a) and (4.6), we can write the equilibrium employment as

$$L = \frac{2N^2(1-q)^2(N+1)(q-m)}{\left[(N+1)^2 - 2N(q-m)^2\right]^2}. \tag{4.11}$$

It is easy to see that a lower social insurance contribution for the employer increases the employment level, i.e. $\frac{\partial L}{\partial t} = \underbrace{\frac{\partial L}{\partial m}}_{-} \cdot \underbrace{\frac{\partial m}{\partial t}}_{+} < 0$. Since every output unit will be produced with a higher share of domestic inputs, marginal production costs and therefore, the output price will decrease. This will stimulate demand, which will result in a higher amount of production. Since the integrated produced proportion and total produced output increases, the equilibrium employment level will be higher. Thus, we show the well known postulation: lower non-wage labour costs by reducing the employer payment of social costs leading to less outsourcing and higher employment. Since, the gross wage $\tilde{m}$ affects the gross labour costs in the same way, we obtain the qualitative same results for changes in the gross wage, i.e. $\frac{\partial L}{\partial \tilde{m}} = \underbrace{\frac{\partial L}{\partial m}}_{-} \cdot \underbrace{\frac{\partial m}{\partial \tilde{m}}}_{+} < 0$.

Fixed Costs Influence

To incorporate lower fixed costs, one way would be to offer a subsidy payment, which is orientated on the production fixed costs. This means that, with investment assistance, the firm has to pay only a certain share of the fixed costs. We can interpret these payments as a provision of a better infrastructure or a takeover of industrial real estate development. Following this interpretation, we modify our model so that the firm will only bear the proportion $1-a$ on the associated fixed costs of integrated production, where the parameter a characterizes the proportion of fixed costs, which is now financed by a subsidy. Implementing this assumption, the profit of a firm on stage I is given by

$$\max_{y_i} \Pi_i = \left[1 - m - y_i - Y_{-i} - v_i \cdot (q-m)\right] \cdot y_i - (1-a) \cdot F .$$

Due to the property of the subsidy, we obtain in stage I the same results as in Section 4.3.1. After using these outcomes the problem in stage II becomes[55]

$$\max_{\hat{v}_i} \Pi_i = \frac{\left[(1-m) + (q-m) \cdot \left(\left(\sum \hat{v}_{-i}\right) - N \cdot \hat{v}_i\right)\right]^2}{(N+1)^2} - (1-a)\frac{(1-\hat{v}_i)^2}{2}.$$

Solving this problem, we derive by assuming symmetry

$$\hat{v}^* = \frac{(1-a)(N+1)^2 - 2N \cdot (q-m) \cdot (1-m)}{(1-a)(N+1)^2 - 2N \cdot (q-m)^2}. \tag{4.12}$$

Notice, that now Assumption 4.2 has to be modified to $\frac{1}{N^2} - m < q - m < \frac{N+1}{N\sqrt{2}}\sqrt{1-a}$. This guarantees positive profits and an output price, which lies in the interval $(0;1)$. Since we know that there is no complete outsourcing, i.e. $\hat{v}^* < 1$, from (4.12), one can also see that a fixed cost subsidy set too high can lead to complete integrated input production, i.e. $\hat{v}^* = 0$.
Comparing equations (4.6) and (4.12), we see that $\hat{v}^* < v^*$ and therefore, an investment subsidy, increases the integrated produced proportion of inputs. Similar to the explanation above, this results from the distortion of the costs. For every integrated production, the fixed costs borne by the firm are lower and, the

[55] For a better distinction, all variables in a scenario are characterized by a "^".

disadvantage of the integrated production decreases at a constant marginal cost advantage. Thus, the fixed costs saving due to outsourcing falls and firms produce in a more integrated way.

Due to lower fixed costs and the change of production mode in favour of integration, the total production costs of one unit of output decreases. This in turn decreases the market price and increases the total output. Thus, under the specification for the use of labour as a production input, i.e. $L = (1-v)\cdot Y$, the equilibrium employment level increases, since now, the industry output and the share of integrated input production are higher as in a scenario without an investment cost subsidy. This can also be seen from the employment levels, $\hat{L} = \frac{2N^2(1-q)^2(N+1)(q-m)(1-a)}{\left[(N+1)^2(1-a)-2N(q-m)^2\right]^2}$ and $L = \frac{2N^2(1-q)^2(N+1)(q-m)}{\left[(N+1)^2-2N(q-m)^2\right]^2}$ with $\hat{L} > L$.

The analysis above shows that government interactions, which affect the domestic production costs, can help to realize the aim of a higher employment level by reducing the number of outsourcing activities. We can conclude that a positive distortion in favour of integrated production can be realized by lower production costs. To achieve this, the domestic labour costs and/or the domestic investment costs have to decrease. Therefore, the demands to reduce the non-wage labour costs for employers or gross wage and for public subsidies, interpreted as investment assistance, are useful instruments to realize the employment target. So we have:

Proposition 4.3:

> *The reduction of domestic gross labour costs by lower non-wage labour costs or gross wage and the implementation of an investment cost subsidy will favour domestic production and increase domestic employment.*

These results are intuitive, since both policies distort the trade-off for the firm in favour of integrated production, i.e. a firm has the incentive to produce more integrated. From this point of view (by ignoring the financing of these payments), subsidies are a useful instrument to prevent outsourcing in industries, which are important for the domestic economy. By using this instrument, one has to take into account, that the implementation of a subsidy depends on the acceptance of the EU, and sets incentives for competition in the government budget, since every country will attract firms that are saving or creating jobs through financing some investments.

4.4.2 Taxation Effect

In the previous section, we showed the effect of government interactions that reduce domestic production costs, while this paragraph shows that the government can also influence a firm's decision by the design of the tax system. Here, a government has the power to introduce a consumption tax or to decide, which goods are taxed. The question is: What is the role of consumption taxation in relation to outsourcing?

Notice, that we analyse international outsourcing. Thus, the firm first has to pay the foreign tax, if it buys an input. However, the EU implemented the country-of-destination principle, where this foreign tax will be repaid after the border is crossed, and thus the input good will be taxed with the domestic rate. To keep the analysis simple, we exclude additional taxes or tariffs on such imported goods. This means that the import of an input good from outside the EU is equal to the import from within the EU. Therefore, we ignore the foreign tax rate and focus on domestic consumption tax. Additionally, there is a pre-tax allowance in the EU. In this case, the firm has to pay a purchases tax for the bought input good, which can be declared as a pre-tax, if the firm sells it output.

For simplicity, we model the consumption tax as a unit tax, which the producer has to pay to the tax office. As described in the paragraph above, the imported input and output good will be taxed with the domestic consumption tax rate and there exists a pre-tax allowance. This means that the tax payment on input goods is repaid to the producer and only the consumption of the final good is taxed. Therefore, the tax payment of a single firm can be expressed as $T_i = (\tau + \tau \cdot v_i) \cdot y_i - \tau \cdot v_i \cdot y_i$, where τ denotes the domestic consumption tax rate. The pre-tax allowance is characterized by the second term. Thus, we answer the question, how does the implementation of consumption tax on output influences the firm's choice of production mode.

Since we denote the output consumption tax with τ, the maximization problem of the firm at stage II can by written as[56]

$$\max_{\tilde{y}_i} \Pi_i = \left[1 - m - \tau - \tilde{y}_i - \tilde{Y}_{-i} - v_i \cdot (q - m)\right] \cdot \tilde{y}_i - F .$$

After solving this, we obtain the individual output $\tilde{y}_i = \frac{1}{(N+1)}\left[1 - m - \tau + (q - m) \cdot \left(\left(\sum \tilde{v}_{-i}\right) - N \cdot \tilde{v}_i\right)\right]$. From this equation we find the

[56] For a better distinction, all variables in case of a consumption are characterized by a "~".

intuitive result that for a given outsourcing decision a tax reduces the output of a firm, i.e. $\frac{\partial \tilde{y}_i}{\partial \tau}$, since the tax increases the production costs.
Similar to the former analysis, we can use this result and formulate the problem in stage II. By solving the resulting first order condition, and by using the symmetry property, we obtain

$$\tilde{v}^* = \frac{(N+1)^2 - 2N \cdot (q-m) \cdot (1-m-\tau)}{(N+1)^2 - 2N \cdot (q-m)^2}. \tag{4.13}$$

Notice that Assumption 4.2 is unchanged. However, in Appendix A it is shown that the conditions $0 < \tilde{v}^* < 1$, $\tilde{Y} > 0$ and $0 < \tilde{p} < 1$ are fulfilled, if the tax is sufficiently low, i.e. we exclude any cases of a tax that lead to no production.

Assumption 4.3: positive outcome

The introduced consumption tax is sufficiently low, i.e. $1 > q + \tau$ *holds.*

If Assumption 4.3 does not hold, the industry output is zero and thus, there will be no production, i.e. $\tilde{Y} = 0$. To ensure a positive market outcome, consumer's maximal willingness to pay, which is one under the assumed demand $\tilde{p} = 1 - \tilde{Y}$, has to be bigger than the maximum unit production costs. These are characterized by the outsourcing price plus the tax, i.e. $q + \tau$. Combing both, we obtain Assumption 4.3.
Similarly to the former section we can compare equation (4.13) with equation (4.6), to analyse the effect of the consumption tax on the equilibrium amount of outsourced inputs. Intuitively, we can argue that the tax forces a wedge between consumer and producer price by reducing the revenue per output unit, which leads to a decline in the aggregate output. In these circumstances, the individual output of an entrepreneur is lower, and so producing with the same proportion of integration leads to a loss because of the lower revenue, which finances the fixed costs. As argued in the former analysis, to react against this loss, every firm has to adapt its production mode to decrease its fixed costs. However, in our framework, a fixed cost reduction can only be achieved through less integrated production. So the implementation of a consumption tax increases the incentive for more outsourcing activities. Analytically, this can be shown by comparing $\tilde{v}^*$ and v^*, where we find that ceteris paribus $\tilde{v}^* > v^*$ if $\tau > 0$.
From this argumentation, we can also derive the employment effect of a consumption taxation. Due to the lower proportion of integrated production, every

output unit will be produced with a lower labour intensity. Since we also know that aggregate output will be reduced, the domestic employment level will be lower. This can also be seen easily from the employment level $\tilde{L} = \frac{2N^2(1-q-\tau)^2(N+1)(q-m)}{\left[(N+1)^2 - 2N(q-m)^2\right]^2}$. For $\tau > 0$, the numerator is smaller as in (4.11) and thus, the implementation of a consumption tax decreases the equilibrium employment level, $\tilde{L} < L$. Therefore we can sum in:

Proposition 4.4:

The implementation of a consumption tax will favour outsourcing and reduce domestic employment.

Using our findings, we can postulate a comment on the politics. If the political aim is to avoid or shorten the business practice of outsourcing in fixed cost intensive industries, we deduce that in those industries, where it is easy to implement a vertical production structures, the consumption tax rate should be lower than in other industries where there is no threat of outsourcing. So a differentiate consumption taxation for different goods or industries can be justified. Thus, due to the stimulation of demand, the disadvantage of integrated production can be partly absorbed, since, with higher output, it would be easier to bear the associated fixed costs of integrated production.
Following our analysis, we thus derived a kind of an "optimal" taxation rule for the aim of securing domestic employment due to decreasing the amount of outsourcing. This tax rule becomes especially important, if no subsidies are allowed or there is no scope for reducing the marginal production costs by lower non-wage labour costs or gross wage.

4.5 Reversed Motivation

So far we have studied the impact of competition, the strategic effects of outsourcing and the impact of taxation, if the outsourcing motivation is driven by saving fixed costs. However, as we mentioned earlier, outsourcing can also be used for reducing marginal costs. By allowing for this outsourcing motivation, we can show if different outsourcing motives may lead to qualitatively similar or opposite results.
We will do this by using the same notation, but different assumptions. Due to the change in outsourcing motivation, we now assume that the costs of importing intermediate goods are smaller than costs of integrated production, i.e. $q < m$. In a

similar way to the previous analysis, we also need to identify a disadvantage to outsourcing in order to avoid external procurement becoming a strictly dominant production mode. Therefore, we assume that there are some other costs associated with outsourcing as expenditures to find an appropriate external supplier, severance packaged or costs for supervising the quality of intermediate goods, which can be interpreted as fixed costs of outsourcing. Here, we assume that these costs increase interval $x \in [0;1]$. Since the inputs with the cheapest fixed costs are now externally procured, we can write the fixed cost function as $\Omega = \int_0^{\bar{v}} x\,dx = \frac{1}{2}\bar{v}^2$.[57] To simplify, we abstract from any kind of fixed costs in cases of in-house production.
Since we have the same sequence of events, we shorten the analysis of this outsourcing motivation.
Solving the maximization problem at stage II

$$\max_{\bar{y}_i} \Pi_i = \left[1 - m - \bar{y}_i - \bar{Y}_{-i} + \bar{v}_i \cdot (m - q)\right] \cdot \bar{y}_i - \Omega\,, \tag{4.14}$$

we obtain as the individual output

$$\bar{y}_i = \frac{1}{(N+1)}\left[1 - m - (m - q) \cdot \left(\left(\sum \bar{v}_{-i}\right) - N \cdot \bar{v}_i\right)\right]. \tag{4.15}$$

For the industry output we find $\bar{Y} = \frac{1}{(N+1)}\left[N(1-m) + (m-q) \cdot \sum_{i=1}^{N} \bar{v}_i\right]$ and thus we obtain for the market price and $p = \frac{1}{N+1} + \frac{N \cdot m}{N+1} - \frac{m-q}{N+1} \cdot \sum_{i=1}^{N} \bar{v}_i$.
Similar to Assumption 4.1, we have to secure a positive market outcome. Therefore, the price has to be lower than the maximal willingness to pay, which is normalized to one in our framework. In relation to our assumption $q < m$, this is given for $1 > m > q$.

Assumption 4.1a: non-negative output

We assume that $1 > m > q > 0$ *holds.*

[57] To distinguish the reversed motivation of outsourcing and the former analysis, the variables in the reversed motivation case are characterized by a "—".

If we use our results and insert these into the profit function, we can specify the object function on stage I for firm $i = 1,\ldots,N$ as

$$\max_{\bar{v}_i} \Pi_i = \frac{\left[(1-m)-(m-q)\cdot\left(\left(\sum \bar{v}_{-i}\right)-N\cdot\bar{v}_i\right)\right]^2}{(N+1)^2} - \frac{1}{2}\cdot\bar{v}_i^{\,2}. \tag{4.16}$$

From the first order condition, we can derive the optimal choice of externally procured inputs of firm i as a function of the decisions of all rival firms $\sum \bar{v}_{-i}$,

$$\bar{v}_i = \frac{(N+1)^2 - 2N\cdot(q-m)\cdot\left[(1-m)+(q-m)\cdot\sum \bar{v}_{-i}\right]}{(N+1)^2 - 2N^2(q-m)^2}. \tag{4.17}$$

Using the symmetry property, we obtain the optimal level of outsourcing

$$\bar{v}^* = \frac{2N\cdot(m-q)(1-m)}{(N+1)^2 - 2N\cdot(m-q)^2}. \tag{4.18}$$

From (4.18) we can see that for $m = q$, which corresponds with the case, that outsourcing has no marginal cost advantage, all firms will desist from outsourcing. This result is not surprising, since outsourcing loses its marginal cost advantage, but there are still fixed costs associated with external procurement.
Since we reversed the motivation, we can easily rewrite the assumption for the profit maximization.

Assumption 4.2a: internal solution

For a given market size, the marginal cost difference fulfils $\frac{1}{N^2} - q < m - q < \frac{N+1}{N\sqrt{2}}$.

Assumptions 4.1a and 4.2a ensure that $\bar{v}^* \in \left]0;1\right[$ will be generated from profit maximization and thus, an internal solution is obtained.[58]
Consequently, we can look on the first derivative of equation (4.18) with respect to the number of competitors N to analyse the impact of the market size on production mode. Here we find

[58] For a detailed discussion see Appendix B.

$$\frac{\partial \overline{v}^{*}}{\partial N} = -\frac{2 \cdot \left(N^2 - 1\right) \cdot (m-q) \cdot (1-m)}{\left[(N+1)^2 - 2N \cdot (m-q)^2\right]^2} < 0 . \tag{4.19}$$

Equation (4.19) shows the effect of competition on the amount of externally procured inputs. We know that with increasing numbers of competitors the market share and the output of a single firm falls. Therefore, it becomes more difficult to bear the fixed costs and the production mode has to be adopted. In the case of a reversed motivation, now avoiding fixed costs is associated with less outsourcing.
As we mentioned earlier, analysing outsourcing, motivated by marginal cost saving is also done by Shy and Stenbacka (2005). However, despite the same motivation for outsourcing, they derive an opposing result compared to equation (4.19). In contrast with our analysis, they assume increasing marginal costs of outsourcing and domestic production. Combing this result with the previous findings, we can conclude that for the same marginal cost structure, the impact of competition depends on the outsourcing motive, but for the same motivation, the marginal cost structure seems to be decisive in terms of the influence of competition.

Corollary 4.1:

For an equal marginal cost structure, the effect of competition on outsourcing depends on motivation for outsourcing, respectively for an equal motivation the effect depends on the structure of the marginal production costs.

From the analysis above, we can also derive the strategic property of outsourcing decisions. For this, we restrict the model on a duopoly with $N = 2$ firms. Using this assumption, we can rewrite equation (4.17) as

$$\overline{v}_i = \frac{4 \cdot (m-q)(1-m) - 4 \cdot (m-q)^2 \cdot \overline{v}_j}{9 - 8 \cdot (m-q)^2} .$$

From this reaction function we can derive the strategic relationship of the outsourcing decisions, $\frac{\partial \overline{v}_i}{\partial \overline{v}_j}$ and $\frac{\partial \overline{v}_j}{\partial \overline{v}_i}$. Solving the first derivative under the necessary Assumption 4.2a yields

$$\frac{\partial \overline{v}_i}{\partial \overline{v}_j} = \frac{\partial \overline{v}_j}{\partial \overline{v}_i} = \frac{-4 \cdot (m-q)^2}{9 - 8 \cdot (m-q)^2} < 0 .$$

Therefore, in the case of a reversed motivation of outsourcing, we have also downward sloping reaction curves for the outsourcing decision.
If the final goods are substitutes, each firm has an incentive to decrease their own amount of externally procured inputs as a response to an extension of outsourcing activities by the other firm. Due to the assumption of lower marginal costs of outsourcing, more outsourcing by firm j decreases the price of the output good. This in turn, decreases the market share of firm i and the firm faces a disadvantage. However, at this point, the best response from firm i is not to lower its marginal costs, since a rising degree of outsourcing leads to higher fixed costs and more intensive competition due to the induced price reduction. The firm can avoid both, by lowering the share of components that are bought at a lower price from outside the firm. Following this, the marginal cost disadvantage of integration will be compensated by weaker competition and lower fixed costs associated with higher in-house production.
In line with Shy and Stenbacka (2005), we show that the numbers of outsourced inputs are strategic substitutes, if outsourcing is associated with lower marginal costs. Furthermore, our analysis shows that this is true even for the marginal cost advantage motive and for the fixed cost saving argument. This suggests that different outsourcing motives may lead to qualitatively similar results.

Corollary 4.2:

The strategic link of outsourced inputs does not depend on the motivation for outsourcing or the structure of the production costs.

Additionally, the effect of the consumption case can be illustrated. Using the same notation, where τ characterizes the tax and $\bar{z} = \bar{p} - \tau = 1 - \bar{Y} - \tau$ the inverse demand that the producer faces, we obtain as the optimal outsourcing proportion, if outsourcing is attractive because of marginal cost savings[59]

$$\bar{v}_\tau = \frac{2N \cdot (m-q)(1-m-\tau)}{(N+1)^2 - 2N \cdot (m-q)^2}. \tag{4.20}$$

As we can see, outsourcing will decrease with higher taxation, i.e. $\frac{\partial \bar{v}_\tau}{\partial \tau} < 0$. This result can be explained by the former arguments. Since the tax reduces demand, in equilibrium there is a lower amount of output. The lower output connected with the

[59] For a detailed illustration and the underlying assumptions see Appendix C.

lower producer price leads to a decrease in revenues. If the proportion of outsourcing is unchanged, profit decreases, since lower revenues finance fixed costs. To respond to this loss, every firm has to adopt a production mode that is in favour of integrated production to avoid the associated fixed costs of outsourcing.
In addition, the effect on equilibrium employment can be derived. Using our assumption concerning the use of labour and the previous findings, we obtain

$$\overline{L}_\tau = \frac{(N+1)^2 - 2N(1-q-\tau)(m-q)}{\left[(N+1)^2 - 2N(m-q)^2\right]^2} \cdot (N+1)(1-m-\tau) \cdot N \,. \qquad (4.21)$$

Since the used labour depends on the total output and the number of outsourced inputs, i.e. Thus $\overline{L}_\tau = (1-\overline{v}_\tau) \cdot \overline{Y}_\tau$, there are two opposite effects of taxation. The first one is a labour enhancing effect, since every output unit will be produced with less outsourcing. However, the second is a labour decreasing effect, since taxation reduces the amount of output. In what follows, the employment effect is a priori ambiguous, i.e. $\frac{\partial \overline{L}_\tau}{\partial \tau} = -\underbrace{\frac{\partial \overline{v}_\tau}{\partial \tau}}_{-} \cdot \overline{Y}_\tau + (1-\overline{v}_\tau) \cdot \underbrace{\frac{\partial \overline{Y}_\tau}{\partial \tau}}_{-} = ?$. Thus we can conclude in:

Corollary 4.3:

> *The impact of consumption taxation on outsourcing depends on the motivation for outsourcing, while the employment effect is ambiguous.*

With this result, we can specify our formerly presented policy recommendation. If the policy aims for integrated production in a certain industry, we know that it can set incentives through its taxation policy. Since the impact of taxation depends on the motivation of outsourcing, the motivation is decisive for the differentiation of consumption taxation between a sector with no vertical production and an industry with the opportunity of outsourcing.
As presented above, if outsourcing is used for saving fixed costs, the tax in an industry, where vertical production is easy to implement, should be lower compared to an industry where it is difficult to outsource domestic production parts. The reason for this is that due to a lower tax rate the distortion on the final good market is lower and thus the output is higher, which allows the firms to bear the fixed costs associated with integrated production.
Also in the case of reversed motivation, i.e. if in all sectors the firms can save marginal costs due to outsourcing but there are also fixed costs associated with external procurement, we can derive a rule for differentiate taxation. If there are

sectors, where it is easy to outsource a part of the input production, in this branches the government should implement higher taxes, than in branches, where it is more difficult to use a vertical production structure. As before, the argument is that a higher distortion due to higher tax rates leads to a lower market outcome and it becomes more difficult to bear the fixed costs. Thus, due to a higher tax outsourcing becomes less attractive.
As the previous paragraph shows, the government can affect the outsourcing decision by its taxation policy. To use consumption taxes as an instrument that lowers the incentive of external procurement, the taxation has to account for the motivation of outsourcing. Thus one can derive an argument for a differentiate taxation by implementing a taxation rule depending on the motivation of outsourcing.

4.6 Concluding Remarks

The chapter's aim was to demonstrate the equilibrium proportion of outsourcing and the effect of different policies in an oligopoly with homogeneous goods. In the first part, outsourcing was interpreted as a long-term investment decision, whereby fixed costs could be reduced. On the other hand, the marginal external procurement costs are higher than the marginal costs of in-house production. Consequently, the trade-off between fixed cost savings and a rise in marginal costs influences the company's production choice. It was shown that the share of outsourcing is influenced by marginal cost differences, fixed costs and the number of competitors, whereas domestic marginal costs, fixed costs and the number of firms affects the outsourcing proportion positively. Lower marginal costs increase the advantage of integrated production, while the fixed costs as the disadvantage, are unaffected. Therefore, the firm's production choice changes in favour of integrated production. Similarly holds for lower fixed costs. Since here, the disadvantage of domestic production decreases, while the advantage is unaffected, so lower outsourcing will occur. If the number of competitors increases, there is a more intense competition. As a firm's market power decreases, its production outcome declines. However, with a lower output, the same proportion of integrated production, due to the associated fixed costs, cannot be borne by the firm. Thus, the share of outsourcing increases to reduce the fixed costs. Additional, this lowers the intensity of competition because more outsourcing increases the output price. The incentive for a lower intensity of competition characterizes also the strategic effect of the outsourcing decision. In the special case of a duopoly, we showed that outsourcing choices are strategic substitutes.

Furthermore, we demonstrated how policy interactions affect equilibrium outsourcing proportion and thus industrial employment level. Here we showed that interaction, which lowers the domestic costs favours integrated production and increases employment. As a second government instrument, we focus on taxation, where we find that lower consumption tax lowers outsourcing and increases employment due to a smaller reduction in output.
To extend the argument, we also looked at the strategic interaction of outsourcing decisions, if the motivation for external procurement is the reduction of marginal costs. In this case we showed that, despite reversed motivation, the outsourcing decisions are strategic substitutes. Although the strategic relationship is unchanged, we obtained an opposing result in relation to the impact of competition. In the case of marginal cost saving as the motivation for outsourcing, increasing the number of firms leads to less outsourcing.
In addition, for the effect of consumption tax, we find an opposite result. Therefore, to use taxation as an instrument to increase incentives for integrated production, the motivation for outsourcing is decisive.
Comparing our findings, especially the effect of taxation opens the possibility for a policy recommendation. If the policy pursuit an employment target by reducing international outsourcing, for a given motive, we find an argument for a differentiate taxation between sectors.

Appendices

Appendix A: Taxation Effect

I. $0 < \tilde{v}^* < 1$

Looking separately at the numerator and denominator, it can be shown that $\tilde{v}^* > 0$ is given. From equation (4.13) we derive a positive denominator for

$$\frac{(N+1)}{\sqrt{2N}} > (q-m) \tag{A.4.1}$$

and a positive numerator for

$$\frac{(N+1)}{2N(1-m-\tau)} > (q-m). \tag{A.4.2}$$

Under the second order condition $\frac{N+1}{N\sqrt{2}} > (q-m)$, condition (A.4.1) is fulfilled, because $\frac{N+1}{\sqrt{2N}} > \frac{N+1}{N\sqrt{2}}$. Since the denominator is positive, for $\tilde{v}^* > 0$ also the numerator has to be bigger than zero. Comparing the second order condition and equation (A.4.2) we find that $\frac{N+1}{2N(1-m-\tau)} > \frac{N+1}{N\sqrt{2}}$ if

$$N+1 > (1-m-\tau)\cdot\sqrt{2}\,. \tag{A.4.3}$$

Due to our assumptions, $N \geq 2$, $1-q > \tau$ and $q > m$, which leads to $1-m-\tau > 0$, the left hand side is bigger than two and the right side is lower than two. From this we can conclude that $\frac{N+1}{2N(1-m-\tau)} > \frac{N+1}{N\sqrt{2}}$. Therefore, under the second order condition, i.e. $\frac{N+1}{N\sqrt{2}} > (q-m)$, equation (A.4.2) is also fulfilled, which results in a positive numerator. Since numerator and denominator are positive, $\tilde{v}^* > 0$ follows. Using equation (4.13) we can conclude that $\tilde{v}^* < 1$ if $\tau < 1-q$. Since this is an essential assumption for a positive output, $\tilde{v}^* < 1$ is fulfilled, if Assumption 4.3 holds.

II. $\tilde{Y} > 0$

For the industry output level, we have $\tilde{Y} = \frac{N}{N+1}\left[1-m-\tau-(q-m)\cdot\tilde{v}^*\right]$. Inserting equation (4.13) leads to $\tilde{Y} = \frac{N(N+1)(1-q-\tau)}{(N+1)^2 - 2N(q-m)^2}$. Due to the second order condition, the denominator is positive. Therefore, a positive industry output is achieved, if $1-q > \tau$, which is our Assumption 4.3.

III. $0 < \tilde{z} < \tilde{p} < 1$

Since we know that $\tilde{Y} > 0$ and $\tilde{p} = 1-\tilde{Y}$, it is straightforward to see that the consumer price is below one, i.e. $\tilde{p} < 1$ holds.
For a positive producer price, $\tilde{z} = \tilde{p} - \tau > 0$, we derive the condition $\tilde{p} > \tau$. Inserting $\tilde{p} = \frac{N}{N+1}\cdot(m+\tau) + \frac{1}{N+1} + \frac{N\cdot(q-m)}{N+1}\cdot\tilde{v}^*$ we can simplify this condition to

$$1-\tau > -N\cdot\left[m+(q-m)\cdot\tilde{v}^{*}\right]. \qquad \text{(A.4.4)}$$

Since $1-q>\tau$ and $0<q<1$, we can conclude that $0<\tau<1$. Using this, it is easy to see that the left- hand side of (A.4.4) is positive and the right-hand side is negative. In what follows, (A.4.4) is true and so we have a positive producer price $\tilde{z}>0$. By combining all this, we obtain $0<\tilde{z}<\tilde{p}<1$.

Appendix B: Reversed Motivation

I. $0<\bar{v}^{*}<1$

Assumption 4.2a guarantees a concave profit function concerning the production mode. Under this assumption, the denominator of (4.18) is positive. A positive numerator is guaranteed, if $m<1$ and $m<q$ holds. Since this is our assumption for a positive market outcome, i.e. Assumption 4.1a, $\bar{v}^{*}>0$ is true.
From equation (4.18) we find that $\bar{v}^{*}<1$, if $m-q<\frac{(N+1)^2}{2N(1-q)}$. We can compare this expression with the second order condition. From the comparison we find $\frac{(N+1)^2}{2N(1-q)}>\frac{N+1}{N\sqrt{2}}$ if

$$N+1>(1-q)\cdot\sqrt{2}\,. \qquad \text{(B.4.1)}$$

Due to our assumptions $N\geq 2$ and $1>q>0$, the left-hand side is bigger than two and the right-hand side is lower than two. Therefore, $\frac{(N+1)^2}{2N(1-q)}>\frac{N+1}{N\sqrt{2}}>m-q$ is fulfilled, which results in $\bar{v}^{*}<1$.

II. $\bar{Y}>0$

The industry output level is characterized by $\bar{Y}=\frac{N}{N+1}\left[1-m+(m-q)\cdot\bar{v}^{*}\right]$. Inserting equation (4.18) leads to $\bar{Y}=\frac{N(N+1)(1-m)}{(N+1)^2-2N(m-q)^2}$. As we know from the second order condition, the denominator is positive. Therefore, a positive industry output is achieved, if $1>m$ assumed.

III. $0 < \bar{p} < 1$

From $\bar{Y} > 0$ and $\bar{p} = 1 - \bar{Y}$, it is straightforward to see that the consumer price is below one, i.e. $\bar{p} < 1$ holds.
A positive consumer price $\bar{p} > 0$, is obtained for $\bar{Y} < 1$, which leads to

$$(m-q)^2 < \frac{(N+1)^2}{2N} - \frac{(N+1)(1-m)}{2}. \qquad \text{(B.4.2)}$$

This expression can be compared with the second order condition, where we find that $\frac{(N+1)^2}{2N^2} < \frac{(N+1)^2}{2N} - \frac{(N+1)(1-m)}{2}$, if $\frac{1}{N^2} < m$. If this condition is fulfilled, the second order condition becomes binding and we can solve for Assumption 4.2a, which ensures an internal solution.

Appendix C: Reversed Motivation and Taxation

I. Derivation of the Optimal Outsourcing Share

Solving stage II, i.e. $\max_{\bar{y}_i} \Pi_i = \left[1 - m - \tau - \bar{y}_i - \bar{Y}_{-i} + \bar{v}_i \cdot (m-q)\right] \cdot \bar{y}_i - \Omega$, we obtain as the individual output $\bar{y}_i = \frac{1}{(N+1)}\left[1 - m - \tau - (m-q) \cdot \left(\left(\sum \bar{v}_{-i}\right) - N \cdot \bar{v}_i\right)\right]$. The industry is $\bar{Y}_\tau = \frac{1}{(N+1)}\left[N(1-m-\tau) + (m-q) \cdot \sum_{i=1}^{N} \bar{v}_i \right]$. Using this, the problem on stage I is characterized by $\max_{\bar{v}_i} \Pi_i = \frac{\left[(1-m-\tau) - (m-q) \cdot \left(\left(\sum \bar{v}_{-i}\right) - N \cdot \bar{v}_i\right)\right]^2}{(N+1)^2} - \frac{1}{2} \cdot \bar{v}_i^{\,2}$. Solving this equation and using the symmetry property, we obtain the optimal level of outsourcing, which is characterized in equation (4.20).

II. $0 < \bar{v}_\tau < 1$

Assumption 4.2a guarantees a concave profit function concerning the production mode and a positive denominator of (4.20). A positive numerator is guaranteed, if $1 > m + \tau$ holds. This characterizes the complement to Assumption 4.3, where the maximal willingness to pay exceeds the maximal production costs. Since we exclude

any cases of a tax that lead to no production we focus on the cases where $1 > m + \tau$. Thus, $\bar{v}_\tau > 0$ is given.

From equation (4.20) we find that $\bar{v}_\tau < 1$, if $m - q < \frac{(N+1)^2}{2N(1-q-\tau)}$. As before, we can compare this expression with the second order condition. From the comparison we find that $\frac{(N+1)^2}{2N(1-q-\tau)} > \frac{N+1}{N\sqrt{2}}$ if

$$N + 1 > (1 - q - \tau) \cdot \sqrt{2}\,. \tag{C.4.1}$$

Due to our assumptions $N \geq 2$ and $1 > q > 0$, the left-hand side is bigger than two and the right-hand side is lower than two. Therefore, $\frac{(N+1)^2}{2N(1-q-\tau)} > \frac{N+1}{N\sqrt{2}} > m - q$ is fulfilled, which results in $\bar{v}_\tau < 1$.

III. $\bar{Y}_\tau > 0$

The industry output level is characterized by $\bar{Y}_\tau = \frac{N}{N+1}\left[1 - m - \tau + (m - q) \cdot \bar{v}_\tau\right]$. Inserting equation (4.20) leads to $\bar{Y}_\tau = \frac{N(N+1)(1-m-\tau)}{(N+1)^2 - 2N(m-q)^2}$. Since we know from the second order condition that the denominator is positive, the sign of the numerator is decisive. A positive industry output is achieved, if $1 > m + \tau$, which is assumed for an internal solution (see above and the argumentation to the corresponding Assumption 4.3).

IV. $0 < \bar{z}_\tau < \bar{p}_\tau < 1$

Since $\bar{Y}_\tau > 0$ and $\bar{p}_\tau = 1 - \bar{Y}_\tau$, we know that the consumer price is below one, i.e. $\bar{p}_\tau < 1$. A positive producer price, $\bar{z}_\tau = \bar{p}_\tau - \tau > 0$, implies $\bar{p}_\tau > \tau$. Using $\bar{p}_\tau = \frac{N}{N+1} + \frac{N \cdot (m+\tau)}{N+1} - \frac{m-q}{N+1} \cdot N$, we obtain

$$1 - \tau > -N \cdot \left[m - (m - q) \cdot \bar{v}_\tau\right]. \tag{C.4.2}$$

Since $1 - m > \tau$ and $0 < m < 1$, we can conclude that $0 < \tau < 1$. Using this, the left-hand side of (C.4.2) is positive. To determine the sign of the right-hand side, we

have to analyse the sign of the term in brackets. The expression $m-(m-q)\cdot\bar{v}_\tau$ is positive, if $1>\left(1-\frac{m}{q}\right)\cdot\bar{v}_\tau$. Since $m>q$ and $0<\bar{v}_\tau<1$ we know that the right hand side is negative and thus, this relation is fulfilled. From this we know, that the term in brackets is positive too. Thus, we know: the right-hand side in (C.4.2) is negative and therefore, (C.4.2) is true. Thus, we have a positive producer price $\bar{z}_\tau>0$. By combining all of this, we obtain $0<\bar{z}_\tau<\bar{p}_\tau<1$.

Thus, for the reversed motivation with consumption taxation Assumption 4.2a has to be fulfilled. In addition, for a positive outcome $1>m+\tau$ has to hold. The intuition behind this condition equates the intuition behind Assumption 4.3.

Chapter 5

Welfare Effects of Strategic Outsourcing in a Duopolistic Market

Abstract

This chapter shows the strategic aspects of international outsourcing in a duopolistic market. Due to different costs of integrated production and outsourcing, the choice of a firm influences the strategy of the competitor via the output price. Therefore, the resulting market constellation depends on the fixed costs and the difference between marginal costs. We show that the three market constellations, both firms produce integrated, both use outsourcing and the firms operate with different strategies are possible. Also the welfare effects of the different outcomes are analysed. If the optimal firms decision is characterized by different strategies, this constellations for given costs is pareto superior to a constellation with equal strategies. On the other hand, for given costs, a resulting constellation of equal strategies can be pareto inferior or pareto superior to a constellation with different strategies.

JEL classification: D43, L13, L22, L23, L24
Keywords: strategic outsourcing, oligopoly, welfare effects

5.1 Introduction

Outsourcing, i.e. the acquisition of formerly self-produced inputs from a foreign independent specialized supplier, is often viewed as a possibility to produce in a cheaper way, to cope with increasing competition due to globalization. The increasing tendency towards external procurement in recent years is well documented.[60] The important role of outsourcing can be exemplified by the automobile and mobile communication industry. Nokia, as the leading mobile communications provider outsources 20% of its mobile production (Economist, 2002). For the automobile industry the Fraunhofer Institute and Mercer (2004) estimate that by the year 2015 automobile sub-contractors will be handling up to 80% of the development and production, i.e. the production stages with the highest fixed costs, whereas the manufacturers will focus on the post-production stage, e.g. sales, since investments at that stage mean higher profits with less capital input.

As we mentioned, the main reason for outsourcing is the realization of lower costs. However, this can be done by two ways, lower marginal costs or lower fixed costs. While the first advantages can be set off against transaction costs[61], for the second motive, also higher marginal costs are possible. Similar to the former analysis, in this chapter we assume that outsourcing becomes attractive because of fixed cost saving, but is also associated with higher marginal costs than the domestic production. Thus we see the organizational choice as an investment choice, where outsourcing stands for a long-term externalization of certain production parts. This argument plays an important role in high-investment sectors such as the automobile or aircraft industries, since autonomous input suppliers can divide their fixed costs among various buyers, but an in-house producing company cannot. Since the decision concerning the production mode influences the costs and thus the market price, other participants in an industry are affected. The other firms will react on this effect by adapting the production mode and thus, the organizational choice becomes an instrument of strategic interaction between the participants in an industry.

This chapter analyses these strategic interactions between companies in an industry and the resulting production structures and their welfare implications. The starting point is a Cournot-duopoly with simultaneous organization choices. The following questions will be answered: First, how are production choices affected by the costs? Second, what effects do these choices have on welfare? As outsourcing prevents

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60 See Hummels et al. (1998, 2001) and Yeats (2001).

61 The production choice is therefore made by comparing the in-house production costs with external procurement costs. In this case, outsourcing is explained by the transaction cost thesis (Williamson, 1975 and 1986).

capital intensive fixed costs but also entails higher marginal costs than in-house production, the company is faced with a trade-off between investment costs saving and additional marginal cost payments. We find that relative to the costs, symmetric or asymmetric forms of production organization can emerge. When the marginal cost disadvantage of external procurement is sufficiently low (high), outsourcing (integration) becomes the dominant production structure. A medium level of the marginal costs disadvantage constitutes an asymmetrical constellation. Regarding the second question, we demonstrate via comparative statics, whether the resulting market constellation is to be considered superior or inferior to other constellations for given costs. We find that by decentralized choices, a resulting constellation in different strategies for given costs is always pareto superior to a strategy with equal strategies. On the other hand a resulting constellation of equal strategies can be pareto inferior or superior to a constellation with different strategies. Therefore, profit maximization behaviour by the firms does not lead in any case to the preferred market constellation from the welfare point of view.
The analysis is structured as follows. Section 5.2 integrates the analysis with the existing literature. In Section 5.3 we introduce the basic model, in which the conditions for the production organization are derived. The welfare analysis of the different production structures is undertaken in Section 5.4. Finally, we sum up the results in Section 5.5.

5.2 Related Literature

The literature deals with many different strands the effect of international outsourcing because there are various types (vertical or horizontal) and different definitions (make-or-buy or fragmentation/input trade)[62] of external procurement. Despite the growing significance of outsourcing, the strategic aspect, as a reason for outsourcing has been long ignored. Only in more recent analysis this gap has been closed.
To our knowledge Nickerson und Vanden Bergh (1999) are the first who discuss the strategic implications of organizational choices. Within a Cournot-duopoly in the output market, they derive the conditions for the production structure in the different Nash-Cournot-equilibria from the trade-off of fixed cost savings against

[62] In the case of the make-or-buy choice, transaction costs, as well as non-completed contracts and their effects on a firm's choice, are being considered, see Grossman and Helpmann (2003) and McLaren (2000). However, regarding outsourcing as fragmentation, its effects with regard to trade models are discussed (see Jones, 2000, Jones and Kierzkowski, 2001 and Kohler, 2004).

higher marginal costs in the presence of outsourcing. Using a Hotelling model with differentiating goods and simultaneous production choice procedures, Shy and Stenbacka (2003) also depict the organizational choices. Here, also, the structure is determined by the trade-off between capital intensive fixed costs and the difference in marginal costs. Thus, there are threshold values of the marginal cost difference against the fixed costs, which denote the production organization. Both papers conclude that in the case of relatively high (low) fixed costs and/or low (high) marginal cost differences, the firms will outsource (produce integrated). In the case of a medium fixed cost level and/or a medium marginal cost difference, the market constellation is characterized by different production structures. In contrast to these papers, Buehler and Haucap (2006) assume in their duopoly model a sequential production decision process. Other than in the above mentioned papers, the external procurement price is not constant, but rises with increased outsourcing. Thus, the choice of the first firm is strategic since it can – via the costs – influence the second participant's behaviour and the competition.[63] As these companies are also faced with a trade-off between lower fixed costs and higher variable costs when deciding on outsourcing, the three constellations i) both firms use outsourcing, ii) both firms produce integrated or iii) different market structures occur subject to cost relations. A direct influence on the competitor can also occur through horizontal outsourcing. Kamien et al. (1989) analyses the case of a Bertrand-duopoly, where both final good producers determine via price bidding, which of them can subcontract the production. Since only the party with the lowest bid can realize outsourcing, there is a direct effect on the output price, the bids and on the price competition in the final goods market. In a Cournot-competition with convex and asymmetrical output producer costs, Spiegel (1993) demonstrates that through horizontal outsourcing, production can be efficiently divided among the companies. Outsourcing increases the subcontractor's costs, who thus offer less output, whereas the other company has fewer costs and offers a higher amount of output. However, the effect on the total

63 The mentioned papers look on strategic effects of integration or separation of the input production for a final goods producer. However, this question can also be considered as a decision for the input producer. This forward integration looks on the independence of an input firm. The strategic effects of the integration-separation decision of an input producer in oligopolistic markets is analysed by, e.g. Gal-Or (1990) and Jansen (2003). They are different in the assumption about the competition in the final goods market and for the results they obtain. Gal-Or (1990) assumes a Bertrand-competition in the final market and found that all or no input producer is independent. Thus, there is, from the final goods producer's point of view, no outsourcing or only outsourcing. Jansen (2003), however, assumes a Cournot-competition in the final goods market and showed that integrated and separated input producers exist at the same time.

output and the consumer price is ambiguous, so that when comparing the positive increase in efficiency with the effect on the consumer surplus, a clear welfare statement can only be derived in the case of a rising total output. Using a duopoly with horizontal outsourcing, Arya et al. (2008) compare the equilibria in Bertrand- and Cournot-competition. Since the input producer can set a high price, the outsourcing firm is met with higher costs and loses some of its aggressiveness on the Bertrand-market, which may result in a higher output price and consequently, less welfare than in the Cournot-competition.
In addition, the special case of bi-sourcing (make-and-buy) and its strategic effects is implemented in the existing literature. This strand (see Du et al., 2005, 2006 as well as Beladi and Mukherjee, 2008) shows that the strategic effects of this type of production organization reduces the price for external procurement and minimize the hold-up problem between input supply and demand.[64]
In this chapter we discuss the strategic effects of vertical outsourcing of a duopoly in a Cournot-competition, relating to Nickerson and Vanden Bergh (1999). We will demonstrate the point at which a market constellation is realized. Furthermore, through comparative statics, we will compare the welfare effects in the different market constellations.

5.3 Basic Model

Two identical firms – A and B – compete on the national market. Their competition equals a Cournot-duopoly in homogeneous goods, where the market demand is described by $p = a - b \cdot (y_A + y_B)$, where y_i with $i = A; B$ characterizes the output of one of the players. The following model can be viewed as a simple description of the decision problem in the aircraft industry. Starting from a point up to which the component production is integrated, we model the organization decision for a new product with new components that cannot be manufactured on the existing production line.
In both companies, the production of the output good involves an input component, where one unit of the input good produces one unit of the output good. Due to market integration, the companies can choose between in-house production or

[64] Oladi et al. (2007) analyse the effects of bi-sourcing in an international context, with a rising production volume in each country. Thus, welfare can be positively influenced through trade liberalization, which is aimed at reducing outsourcing costs. Chen et al. (2004) describe the effects that trade liberalization may have on horizontal outsourcing, i.e. a price increase for input and output goods.

outsourcing of the input component to a specialized external supplier. The price for the external procurement of one unit of input is fixed and exogenously given by q. Alternatively, this component may be produced in-house and requires an investment F, which is interpreted as set-up costs. The marginal costs m of the integrated production are constant for each unit of the produced input. Therefore, outsourcing is beneficial, as investment costs F can be saved. To avoid external procurement being the dominant strategy, $q > m$ must be hold. Thus, if a domestic company chooses outsourcing, it pays a bonus to the external supplier for the procurement and bearing of fixed costs. Consequently, the total costs of a company $i = A; B$ are

$$TC_i(y_i) = \begin{cases} m \cdot y_i + F & \text{in-house} \\ q \cdot y_i & \text{outsourcing.} \end{cases} \tag{5.1}$$

The model structure is a two-stage decision problem, where the process can be described as follows:

(I) Each company i $(i = A; B)$ chooses external procurement respectively in-house production, given the competitor's choice.[65]
(II) Given its own and the competitor's production structure choice, the company chooses its profit maximizing output.

The four resulting scenarios are outlined in the following matrix:

Table 5.1: production scenarios

firm A \ firm B	outsourcing	in-house
outsourcing	scenario 1	scenario 2
in-house	scenario 3	scenario 4

[65] Thus, Nash-behaviour is assumed regarding the outsourcing decision.

In scenario 1 and 4, both companies choose the same production structure, whereas in scenario 2 and 3 different strategies are chosen.
By modelling the company's decision, the problem is solved via backwards induction. Here, the individual production structure is illustrated by the superscript indices in for in-house, out for outsourcing and in/out for different strategies.

5.3.1 Stage II: Output Decision

Given the output decision and the organizational choice of the competitor, from a company's profit maximization

$$\begin{aligned} \max_{y_i} \Pi^{in} &= \left[p\left(y_i + y_j\right) - m\right] \cdot y_i - F \\ \max_{y_i} \Pi^{out} &= \left[p\left(y_i + y_j\right) - q\right] \cdot y_i \end{aligned} \tag{5.2}$$

with $i = A;B$ and $i \neq j$, we derive for each scenario the individual reaction functions at the second stage.

Scenario 1: both companies choose external input procurement

$$y_i^{out} = \frac{1}{2b}\left[a - q - by_j^{out}\right],$$

Scenario 4: both companies choose in-house input production

$$y_i^{in} = \frac{1}{2b}\left[a - m - by_j^{in}\right],$$

Scenario 2 and 3: companies choose different strategies

$$\begin{aligned} y_i^{in} &= \frac{1}{2b}\left[a - m - by_j^{out}\right] \\ y_j^{out} &= \frac{1}{2b}\left[a - q - by_i^{in}\right], \end{aligned}$$

with $i, j = A;B$ and $i \neq j$.

Using the reaction functions, for each case the individual output and the total output can be determined.

Scenario 1: both companies choose external input procurement

$$\begin{aligned} y^{out/out} &= \frac{1}{3b}[a-q] \\ Y^{out/out} &= \frac{2}{3b}[a-q], \end{aligned} \tag{5.3}$$

Scenario 4: both companies choose in-house input production

$$\begin{aligned} y^{in/in} &= \frac{1}{3b}[a-m] \\ Y^{in/in} &= \frac{2}{3b}[a-m], \end{aligned} \tag{5.4}$$

Scenario 2 and 3: companies choose different strategies

$$\begin{aligned} y_{in}^{in/out} &= \frac{1}{3b}[a+q-2m] \\ y_{out}^{in/out} &= \frac{1}{3b}[a+m-2q] \\ Y^{in/out} &= \frac{2}{3b}\left[a-\frac{q+m}{2}\right], \end{aligned} \tag{5.5}$$

with $i, j = A; B$ and $i \neq j$, while the subscript in (5.5) characterizes the production mode of the specific firm.

To make sure that both participants stay in the market, negative output levels must be avoided in each market constellation. Thus, we have to calculate the requirements for positive output levels the equations (5.3) to (5.5). Since the marginal outsourcing costs are higher than the domestic marginal costs, i.e. $q > m$, the conditions for realizing positive total and individual output for identical production strategies are $a > q$ and $a > m$. When these requirements are met, the in-house producing participant will in the case of different strategies, also offer a positive output level. The outsourcing firm will offer a positive output if $a - q > q - m$.

Inserting the total output into the market demand, gives the market price for each situation as illustrated in the following table.

Table 5.2: output prices

firm A \ firm B	outsourcing	in-house
outsourcing	$p^{out/out} = \frac{1}{3}[a + 2q]$	$p^{in/out} = \frac{1}{3}[a + (q + m)]$
in-house	$p^{in/out} = \frac{1}{3}[a + (q + m)]$	$p^{in/in} = \frac{1}{3}[a + 2m]$

Table 5.2 shows that the resulting market price is positive in each constellation. Since, due to the linearity of demand, the parameter a represents the maximum willingness-to-pay, in what follows that $0 < p < a$ must apply. Comparing the different price levels with this requirement, it becomes clear that the market price under bilateral outsourcing always stays below the maximum willingness-to-pay if $a > q$, and thereby, positive output for both participants under bilateral outsourcing is guaranteed. Therefore, in that market constellation, both firms will realize positive output and the resulting output price will stay below the maximum price the consumer is willing to pay.

The same applies to a constellation with bilateral in-house production. The requirement for positive output, $a > m$, is met, since $q > m$ and $a > q$ and thus $p^{in/in} < a$. Consequently, in this scenario, both players will offer positive outputs and the output price will stay below the maximum price the consumer is willing to pay. In the case of different production structures, $p^{in/out} < a$ applies, given that $(a - q) > -(a - m)$ holds. As the conditions $a > q$ and $q > m$ are defined, this requirement is always met so that also under different production strategies, the price stays below the maximum price the consumer is prepared to pay.

Assumption 5.1: non-negative output

We assume that $a > q > m$ *and* $a - q > q - m$ *hold.*

Comparing the price levels in the different scenarios shows that in the presence of bilateral outsourcing the price is higher than the price in the case of bilateral in-house input production. The reason is that the external procurement price is made up of the domestic marginal costs plus a positive bonus payment. If different production structures are chosen, a medium price level is realized, since the price level is subject to the average marginal production costs. Thus, we have $p^{out/out} > p^{in/out} > p^{in/in}$.

In the same way, the total output and the individual company's output can be compared for the different scenarios. In the case of bilateral outsourcing, due to the higher output price and the decreasing market demand, the total output is smaller than when both companies produce in-house. When both companies use the same strategy, the firms share total demand in equal parts and thus also the individual output is lower in case of bilateral outsourcing compared to the case of bilateral in-house production. Under different production structures, a medium price level is achieved, which also entails a medium total output level. However, other than in scenario 1 and 4, the individual market shares differ due to the different marginal costs incurred by the organization choice. The market share s of the outsourcing company is $s_{out}^{in/out} = \frac{y_{out}^{in/out}}{Y^{in/out}} = \frac{(a-q)-(q-m)}{(a-q)+(a-m)}$ and the share of the integrated producing firm is $s_{in}^{in/out} = \frac{y_{in}^{in/out}}{Y^{in/out}} = \frac{(a-m)+(q-m)}{(a-q)+(a-m)}$. Thus, the participant who uses in-house production will have a larger market share since he benefits from the marginal cost advantage and is able to offer a higher output at a given market price. Since the market is divided up between the firms, in the case of different production strategies it follows that $s_{out}^{in/out} < \frac{1}{2} < s_{in}^{in/out}$. When the external procurement price rises, the marginal cost difference increases in favour of the in-house producing company, which leads to an increase in its output and market share, while the output and market share of the outsourcing company decreases, i.e. $\partial s_{in}^{in/out} / \partial q > 0$ and $\partial s_{out}^{in/out} / \partial q < 0$. The consequences for the output price and the output sum can be summed up as follows:

Proposition 5.1:

a) *For the prices,* $p^{out/out} > p^{in/out} > p^{in/in}$ *applies and resulting in* $Y^{in/in} > Y^{in/out} > Y^{out/out}$ *for the total output.*
b) *For the individual output, we have* $y_{in}^{in/out} > y^{in/in} > y^{out/out} > y_{out}^{in/out}$.

5.3.2 Stage I: Outsourcing Decision

The strategy, that is chosen by a company depends on the profit to be gained and accordingly, on the difference between the fixed cost savings and the additional marginal costs through the bonus payment to the external supplier. The individual profits to be gained in the various scenarios are shown in Table 5.3.

Table 5.3: profits

<table>
<tr><th>firm A \ firm B</th><th>outsourcing</th><th>in-house</th></tr>
<tr><td>outsourcing</td><td>$\Pi^{out/out} = \frac{1}{9b}(a-q)^2$</td><td>$\Pi_{in}^{in/out} = \frac{1}{9b}(a+q-2m)^2 - F$
$\Pi_{out}^{in/out} = \frac{1}{9b}(a+m-2q)^2$</td></tr>
<tr><td>in-house</td><td>$\Pi_{in}^{in/out} = \frac{1}{9b}(a+q-2m)^2 - F$
$\Pi_{out}^{in/out} = \frac{1}{9b}(a+m-2q)^2$</td><td>$\Pi^{in/in} = \frac{1}{9b}(a-m)^2 - F$</td></tr>
</table>

Comparing the profits of the different scenarios allows us to derive equilibrium conditions, which indicate what market constellations at which point arrive at a Nash-equilibrium. The relations derived indicate the relation between fixed costs F and marginal cost disadvantage $q-m$, i.e. the advantages and disadvantages of an external procurement subject to the demand p.[66]

Lemma 5.1:

a) If the fixed costs are high, respectively, the marginal cost disadvantage is small, so that $\frac{4}{9b}(a-m)(q-m) < F$, in a Nash-equilibrium, both companies will perform via outsourcing.

[66] For details see Appendix A.

b) *If the fixed costs are low, respectively, the marginal cost disadvantage is high, so that* $\frac{4}{9b}(a-q)(q-m) > F$, *in a Nash-equilibrium, both companies will produce in an integrated mode.*
c) *If the fixed costs, respectively, the marginal cost disadvantage is of medium value, so that* $\frac{4}{9b}(a-m)(q-m) > F > \frac{4}{9b}(a-q)(q-m)$, *then we have a Nash-equilibrium with an asymmetrical production structure in which one company has an integrated input production while the other company outsource the input production.*

Solving the first paragraph of Lemma 5.1, we find that both firms will engage in outsourcing for

$$q < q_{crit}^{out/out} = \frac{9b}{4}\frac{F}{(a-m)} + m. \tag{5.6}$$

The critical value for bilateral in-house production is obtained by the solution of the second paragraph of Lemma 5.1. Here, due to the quadratic structure, we obtain two solutions

$$q_{crit}^{in/in} = \frac{(a+m)}{2} \pm \sqrt{\frac{(a-m)^2}{4} - \frac{9b}{4}F}.$$

Both critical values have to fulfilled Assumption 5.1, which means that they have to lie in the interval $(m;a)$ and have to be smaller than $\frac{a+m}{2}$. Comparing our critical values with Assumption 5.1, we see that the bilateral integration can be observed for

$$q > q_{crit}^{in/in} = \frac{a+m}{2} - \sqrt{\frac{(a-m)^2}{4} - \frac{9b}{4}F}. \tag{5.7}$$

Thus, an constellation with different production modes, which is characterized by

$$q_{crit}^{in/in} < q < q_{crit}^{in/in}. \tag{5.8}$$

So far, we have ensured that the individually produced output is positive and that the final market price stays below the maximum price the consumer is willing to

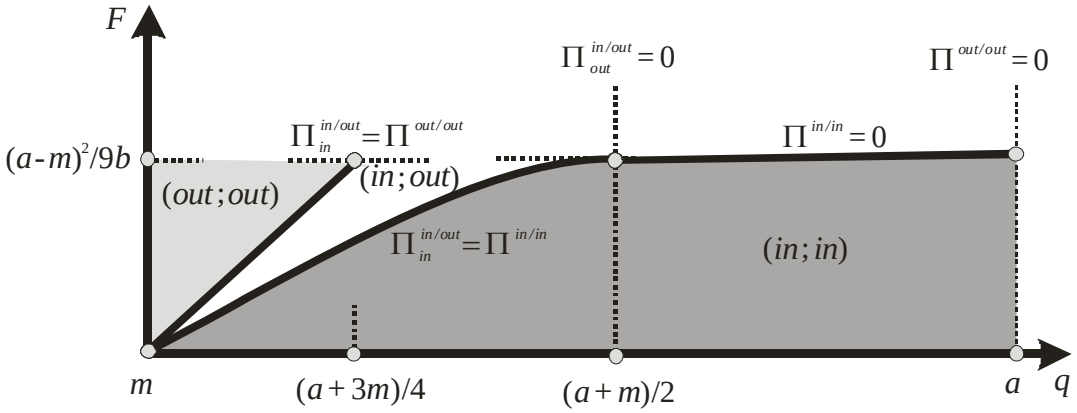
pay. In addition, however, these two requirements also have to ensure that the firm's profit is strictly positive, as this is the criteria for staying in the market.
Considering Table 5.3 and Assumption 5.1, we can see that in an equilibrium with bilateral outsourcing both participants make a positive profit for $a > q$. In the case of different strategies, Assumption 5.1, $(a-q) > (q-m)$, is sufficient to provide the outsourcing participant with positive profits. For the in-house producing company $[(a-m)+(q-m)]^2 > 9bF$ must apply. In a market constellation where both companies produce integrated, in addition to Assumption 5.1, $(a-m)^2 > 9bF$ must hold. By comparing these restrictions, it can be seen that since $q > m$ applies, $(a-m)^2 > 9bF$ suffices.

Assumption 5.2: non-negative profits

In addition to Assumption 5.1, $\frac{(a-m)^2}{9b} \geq F$ *applies.*

Assumptions 5.1 and 5.2 ensure that the three possible market constellations i) both produce via outsourcing, ii) both produce integrated or iii) firms use different production structures occur.
For given domestic marginal costs, the resulting market constellation depending on the relation between domestic fixed costs and outsourcing price can be graphically illustrated. Figure 5.1 illustrates the possible constellations under Assumptions 5.1 and 5.2 as well as under Lemma 5.1. Also the zero profits conditions, which determine the boundary conditions for the validity of the model, are incorporated.

Figure 5.1: market constellations



Here, since the domestic marginal costs are given, only the relation between the outsourcing price and fixed costs determines the constellation. By using Lemma 5.1, the fixed cost/outsourcing cost combinations characterizing the different equilibria can be obtained.

A Nash-equilibrium with bilateral outsourcing, i.e. (out;out), occurs when, given the outsourcing choice by firm B, firm A also chooses external procurement, if $\Pi^{out/out} > \Pi_{in}^{in/out}$ applies from what $\frac{4}{9b}(a-m)(q-m) < F$ follows.[67] For the case where $\frac{(a-m)^2}{9b} = F$, which is illustrated in Figure 5.1, the outsourcing price $q = (a+3m)/4$ can be calculated, where there is an indifference for firm A between choosing outsourcing or in-house production, given the competitor's outsourcing choice. For given fixed costs of $F = \frac{(a-m)^2}{9b}$, due to symmetry, for all $q < (a+3m)/4$, outsourcing becomes more profitable than in-house production for both participants. The reason is that the bonus payment to the external supplier is rather small, which means that the external procurement price is only slightly higher than the marginal costs of in-house production. The fixed cost savings are in that case more significant than the outsourcing disadvantage. Considering Assumption 5.2, in Figure 5.1 the light shaded triangle above the $\Pi^{out/out} = \Pi_{in}^{in/out}$-line and below $\frac{(a-m)^2}{9b} = F$ depicts all fixed costs and outsourcing price combinations of a Nash-equilibrium in which both firms choose outsourcing.

If the external supplier bonus (and thus the difference between in-house marginal and outsourcing price) is sufficiently high so that the fixed cost savings achieved through outsourcing cannot compensate the higher marginal costs, both participants will choose in-house production. A Nash-equilibrium with bilateral in-house production, i.e. (in;in), must fulfil $\Pi^{in/in} > \Pi_{out}^{in/out}$ for firm A, given that firm B chooses the integrated production. This requirement leads to the condition $\frac{4}{9b}(a-q)(q-m) > F$. The graphic illustrates by the $\Pi^{in/in} = \Pi_{out}^{in/out}$-curve the indifference between in-house and outsourcing choice for firm A, given the in-house choice by firm B. However, outsourcing can only be an option as long as firm A realises non-negative profits. Consequently, the $\Pi^{in/in} = \Pi_{out}^{in/out}$-curve is only defined up to $\Pi_{out}^{in/out} = 0$, which corresponds with an outsourcing price of

[67] For symmetry, the same calculus applies for firm B, given the outsourcing choice by firm A. The derived conditions apply to both participants.

$q = (a+m)/2$. In the case of higher external procurement prices, firm A will definitively choose in-house production.[68] Since the $\Pi^{in/in} = \Pi^{in/out}_{out}$-curve stands for all fixed cost/outsourcing price combinations, where firm A, for the given in-house choice by firm B, is indifferent between integrated production and outsourcing. Thus, the area below this curve illustrates all combinations where firm A (and thus both participants) produce in-house. The reason is that, based on the combinations on the $\Pi^{in/in} = \Pi^{in/out}_{out}$-curve, at each outsourcing price $q \in (m;(a+m)/2)$ and given the competitor's in-house choice, firm A will choose the in-house production if fixed costs are decreasing, as this promises higher profits than outsourcing, where the lower fixed costs doesn't affect the profit.

For an external procurement price $q \in ((a+m)/2; a)$, firm A does not choose outsourcing, given the competitor's in-house choice, since here, a loss is realized. This results, if firm A chooses the external procurement only if $q \leq (a+m)/2$ respectively $\Pi^{in/out}_{out} \geq 0$. Thus, for $F \geq \frac{(a-m)^2}{9b}$ and $q \in ((a+m)/2; a)$, both participants will definitively produce in an integrated way. Therefore, the grey area below the $\Pi^{in/in} = \Pi^{in/out}_{out}$-curve and the $\Pi^{in/in} = 0$-line indicates all combinations of fixed costs and outsourcing price for which a Nash-equilibrium with bilateral integrated production, i.e. (in;in), exists.

If $\frac{4}{9b}(a-m)(q-m) > F > \frac{4}{9b}(a-q)(q-m)$ holds, an equilibrium in different strategies, i.e. (in/out) or (out/in), exits. To explain this fact, we can use the former mentioned curves of equal profits as the basis. Since we know, that for $q > (a+m)/2$ both firms choose the integrated production, a constellation with different strategies can only occur in the interval $q \in (m;(a+m)/2)$. If the fixed costs for any external procurement price in that interval is so high that a combination of both lies above the $\Pi^{in/in} = \Pi^{in/out}_{out}$-curve, an equilibrium in differing strategies exists. Here, firm A prefers outsourcing to in-house production, given firm B's in-house choice, due to sufficiently high fixed cost savings and thus $\Pi^{in/out}_{out} > \Pi^{in/in}$ holds. The same occurs when using the $\Pi^{out/out} = \Pi^{in/out}_{in}$-curve as a basis, where firm B's decision to outsource the input production is given. Firm A

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68 Since the profits are identical on the $\Pi^{in/in} = \Pi^{in/out}_{out}$-curve, $\Pi^{in/in} = 0$ also has to apply at $\Pi^{in/out}_{out} = 0$. However, this is only the case if $\frac{(a-m)^2}{9b} = F$ and $q = (a+m)/2$. Consequently, the $\Pi^{in/in} = \Pi^{in/out}_{out}$-curve ends on the intersection of the zero profit conditions $\Pi^{in/out}_{out} = 0$ and $\Pi^{in/in} = 0$, with a maximum at $q = (a+m)/2$.

prefers in-house, if the fixed costs for any external procurement price are sufficiently low. Therefore, all fixed cost/external procurement price combinations with an equilibrium in differing strategies are shown by the white area between the $\Pi^{out/out} = \Pi_{in}^{in/out}$-curve and the $\Pi^{in/in} = \Pi_{out}^{in/out}$-curve, limited by $F = \frac{(a-m)^2}{9b}$.

5.4 Production Choice and Welfare

We know the effects of the production structure on firm's profit, i.e. on the supply side. However, the production choice also affects consumers via the price and the resulting output. To evaluate the effects on all participants in an economy, an indicator must be found that includes supply and demand. In this context, the welfare criterion is often used.
Referring to the previous analysis, the question we focus in this section is: How does the organizational choice affect the economy's welfare, i.e. both sides of the market? To answer this, we will compare the welfare under the different possible market constellations to derive whether one production structure will be pareto superior or inferior to another if firms, for given costs, behave rational, i.e. are profit orientated.

5.4.1 Welfare Indicator

To allow for comparison, an evaluation criterion has to be defined. The welfare indicator used here consists of the sum of the rent, i.e. the producer profits and the consumer rent, where W indicates the welfare and CS the consumer surplus. For a better differentiation, again, the superscripts indicate the different constellation of the used production modes: i.e. in/in, out/out or in/out standing for bilateral in-house production, bilateral outsourcing or different production structures.
Using the known results for the price and output in each scenario, as well as the market demand, we have

Scenario 1: both companies use outsourcing

$$\begin{aligned} CS^{out/out} &= \frac{2}{9b}[a-q]^2 \\ W^{out/out} &= \frac{4}{9b}[a-q]^2, \end{aligned} \tag{5.9}$$

Scenario 4: both companies produce via in-house

$$\begin{aligned} CS^{in/in} &= \frac{2}{9b}[a-m]^2 \\ W^{in/in} &= \frac{4}{9b}[a-m]^2 - 2F, \end{aligned} \tag{5.10}$$

Scenario 2 and 3: the companies use different strategies

$$\begin{aligned} CS^{in/out} &= \frac{2}{9b}\left[a - \frac{q+m}{2}\right]^2 \\ W^{in/out} &= \frac{1}{9b}\left[4(a-m)(a-q) + \frac{11}{2}(q-m)^2\right] - F. \end{aligned} \tag{5.11}$$

Knowing the welfare levels for all constellations, we can compare them to determine whether for given costs another market constellation, other the existing one, is pareto superior and preferable, from the welfare theory point of view.

5.4.2 Welfare Comparison

Similarly, as in Figure 5.1, using equations (5.9) to (5.11), all fixed cost and outsourcing price combinations can be illustrated, which achieve equal welfare levels in the different constellations. By comparing the welfare levels, we determine the three curves $W^{out/out} = W^{in/in}$, $W^{in/out} = W^{in/in}$ and $W^{out/out} = W^{in/out}$, but also the threshold values at which changing the existing choice increases welfare. These values have to meet Assumptions 5.1 and 5.2 and thus have to lie in the interval $(m;a)$. A comparison of these threshold values with the critical values (5.6) to (5.8) shows whether the resulting equilibrium is pareto superior or pareto inferior to other market constellations.

Bilateral Outsourcing Characterizes the Market Constellation

According to (5.6), $q < q_{crit}^{out/out} = \frac{9b}{4}\frac{F}{(a-m)} + m$ defines, for given domestic marginal cost, the upper bound of the external procurement price, in relation to the fixed costs, at which a market constellation with bilateral outsourcing occurs.

Using (5.9) and (5.10) we obtain the outsourcing price, which yields an equal welfare level in a constellation with bilateral outsourcing and bilateral integrated production. Solving $W^{in/in} = W^{out/out}$ we get as the threshold values

$$\tilde{q}_1 = a - \sqrt{(a-m)^2 - \frac{9b}{2}F}$$
$$\tilde{q}_2 = a + \sqrt{(a-m)^2 - \frac{9b}{2}F}.$$

Starting from a point on this curve, we can deduce, that for given domestic marginal and fixed cost a lower outsourcing price leads to $W^{in/in} < W^{out/out}$. This holds, since the outcome in a constellation with bilateral integrated production is unaffected, but in case of bilateral outsourcing lower costs of external procurement increase profits and consumer surplus due to lower market price and higher output and therefore the associated welfare level increases. Thus we can conclude that $W^{out/out} > W^{in/in}$ for $q < \tilde{q}_1$ respectively $q > \tilde{q}_2$ and $W^{in/in} > W^{out/out}$ for $\tilde{q}_1 < q < \tilde{q}_2$.
To derive the binding constraint, these values have to be compared to the Assumptions 5.1 and 5.2. It is obvious that when Assumption 5.2 is met, only $\tilde{q}_1$ lies in the interval $(m;a)$ and has to be included in our analysis. Thus, a constellation with bilateral integrated production leads to higher welfare than a constellation with bilateral outsourcing if

$$q > \tilde{q}_1 = a - \sqrt{(a-m)^2 - \frac{9b}{2}F}. \tag{5.12}$$

To answer the question whether abandoning the optimally bilateral outsourcing in favour of bilateral in-house production leads to higher welfare, the threshold value $\tilde{q}_1$ must be compared to the marginal value $q_{crit}^{out/out}$. Under Assumption 5.2, the comparison of equations (5.6) and (5.12) proves that

$$q_{crit}^{out/out} = \frac{9b}{4}\frac{F}{(a-m)} + m < a - \sqrt{(a-m)^2 - \frac{9b}{2}F} = \tilde{q}_1.$$

From this relationship follows, that in a Nash-equilibrium with bilateral outsourcing, i.e. $q < q_{crit}^{out/out}$, welfare cannot be increased when both participants switch from outsourcing to in-house production. This result is intuitively, since in

the case of switching the production mode, both firms act against their best strategies and thus their profits decrease as the fixed costs are not compensated by lower marginal costs. Of course, there is an increase in output and consumer surplus due to the lower marginal costs and resulting lower market price, however, due to the relative small difference between outsourcing costs and marginal costs of integrated production, this positive effect is not strong enough to compensate the firms' losses by a higher consumer surplus. Therefore, changing the production structure from bilateral outsourcing to a bilateral in-house production leads to lower welfare.

The constellations of bilateral outsourcing and different strategies can be compared in a similar way. Using the equations (5.9) and (5.11) we can calculate the threshold value for which different strategies becomes advantageous from the welfare theory point of view. The threshold values for $W^{in/out} = W^{out/out}$ are

$$\hat{q}_1 = -\frac{4a-7m}{3} + \sqrt{\frac{16}{9}(a-m)^2 + 6bF}$$
$$\hat{q}_2 = -\frac{4a-7m}{3} - \sqrt{\frac{16}{9}(a-m)^2 + 6bF}.$$

As one can see, $\hat{q}_2 < 0 < m$ applies and thus Assumption 5.1 is not fulfilled, which means that this threshold value can be neglected. Therefore, a constellation with different strategies leads to a higher welfare than a situation with bilateral outsourcing, if

$$q > \hat{q}_1 = -\frac{4a-7m}{3} + \sqrt{\frac{16}{9}(a-m)^2 + 6bF}\,. \tag{5.13}$$

To answer, if a change from the optimal choice of bilateral outsourcing towards a constellation with different strategies increases the welfare, we have to compare the equations (5.6) and (5.13), which yield

$$q_{crit}^{out/out} = \frac{9b}{4}\frac{F}{(a-m)} + m > -\frac{4a-7m}{3} + \sqrt{\frac{16}{9}(a-m)^2 + 6bF} = \hat{q}_1$$

and thus for $q \in \left(\hat{q}_1 ; q_{crit}^{out/out}\right)$ a welfare increasing change of production strategies is possible if, starting from a constellation with bilateral outsourcing, one firm would

switch to an integrated production. The marginal costs of the firm that has changed its strategy will fall, thereby reducing the average marginal costs and the market price. These effects will be accompanied by a rise in the total output. Since lower market price and higher output favour the consumer, the consumer surplus increases. Here, too however, both companies suffer profit losses: the company that continued use of outsourcing as the output price falls at constant marginal costs so that its market share falls below 50%, and the company with integrated production, as it acts against its best strategy for a given choice of the competitor. To evaluate, if it is possible, that the firm's losses are offset by the gain of the consumer, we have to distinguish two cases. In the interval $\hat{q}_1 < q < q_{crit}^{out/out}$ the marginal costs difference is sufficiently high, so that the positive effect on the consumer surplus caused by a relatively large price reduction prevails and the welfare will be higher with different production structures. If the outsourcing price is sufficiently low and lies in the interval $(m;\hat{q}_1)$, due to the relative small marginal cost difference, the negative effect on profits prevails and the welfare level in an asymmetrical production structure is smaller. We can sum up in:

Proposition 5.2:

If the market constellation is defined by bilateral outsourcing,

a) *for given costs, this constellation is superior to a constellation with bilateral in-house production,*
b) *the welfare level can be increased through an asymmetrical production organization, if the external procurement price is sufficiently high,* $\hat{q}_1 < q < q_{crit}^{out/out}$.

Figure 5.2 shows this for the special case $F = \frac{(a-m)^2}{9b}$. In this situation, both participants choose external procurement, if $q \le q_{crit}^{out/out} = \frac{a+3m}{4}$.

All combinations of fixed costs and external procurement price, which lead to the same welfare level in a constellation with bilateral outsourcing and different production structures, are illustrated by the $W^{out/out} = W^{in/out}$-curve. For any combination below this curve, $W^{out/out} < W^{in/out}$ applies, and above the curve $W^{out/out} > W^{in/out}$. This is true, since starting from any combination on this curve for every outsourcing price $q \le \frac{a+3m}{4}$ lower fixed costs implies due to a higher profit of the integrated producing firm an increasing welfare in different production

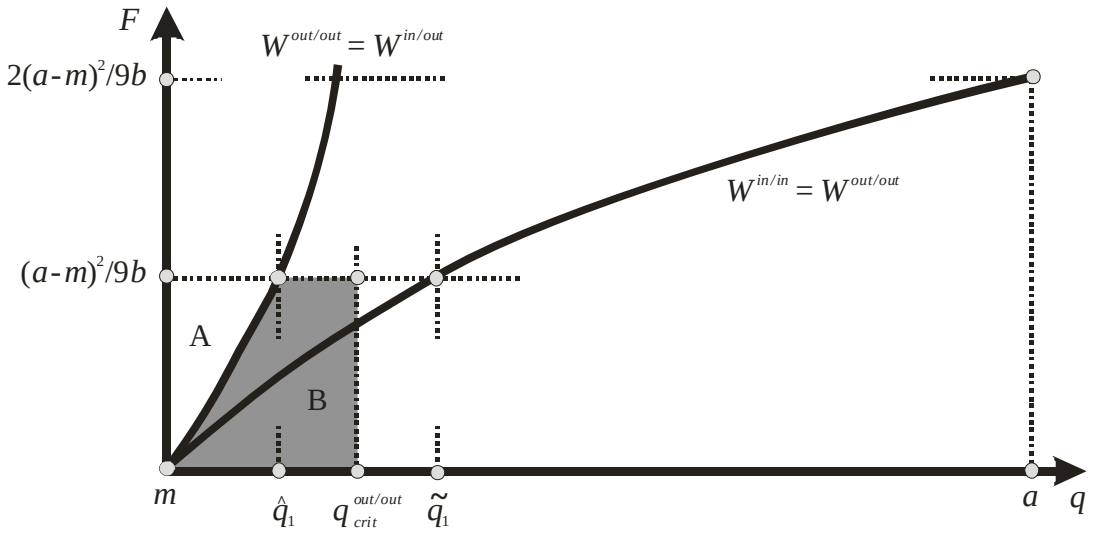
strategies, while the welfare level in a constellation with bilateral outsourcing is unchanged. The analysis shows that a constellation with bilateral outsourcing is pareto inferior to a constellation with different production strategies, i.e. $W^{out/out} < W^{in/out}$, if $\hat{q}_1 < q < q_{crit}^{out/out}$ holds.[69] This can be seen in Figure 5.2, since, at the assumed fixed costs $F = \frac{(a-m)^2}{9b}$ for $q \in [\hat{q}_1 ; (a+3m/4)]$, all combinations of the outsourcing price and the assumed fixed costs lie below the $W^{out/out} = W^{in/out}$-curve. Consequently, the equilibrium of bilateral outsourcing in this area leads to a lower welfare level compared to a constellation with different production structures. Graphically, this is shown by the grey area B, which illustrates all combinations of fixed costs and outsourcing prices, which lead to a constellation with bilateral outsourcing, but yields lower welfare than a constellation with different production structure. In opposite, area A, which is restricted by the assumed fixed costs $F = \frac{(a-m)^2}{9b}$ and the $W^{out/out} = W^{in/out}$-curve, characterizes all combinations, where the resulting constellation of bilateral outsourcing leads to a higher welfare level than a constellation of different production structures.

The comparison of the welfare level between the constellations of bilateral outsourcing and bilateral integration can be similarly described. The $W^{in/in} = W^{out/out}$-curve depicts all combinations of fixed costs and external procurement price with identical welfare levels in a constellation with bilateral outsourcing and bilateral integrated production. The area under this curve characterizes the combination of fixed cost and outsourcing price, where the integrated production leads to a higher welfare level than bilateral outsourcing. As we know, if $q > \tilde{q}_1$, a change towards bilateral integration would increase the welfare level for changing the production structure from bilateral outsourcing to bilateral in-house production. This result can be explained by the huge difference of marginal costs. If for a given fixed cost level the marginal cost difference is sufficiently high, a change towards bilateral in-house production increases the consumer surplus dramatically, which can offset the negative effect on profits. It is also known, that $\tilde{q}_1 > q_{crit}^{out/out}$ holds, which means that the welfare level cannot be increased if both firms change their production structure from bilateral outsourcing to bilateral integrated production. For the assumed fixed costs $F = \frac{(a-m)^2}{9b}$, we

[69] Given the assumption for this assumed fixed costs, we obtain for the critical welfare values $\hat{q}_1 = \frac{a-m}{3}\left(\sqrt{22}-4\right)+m$ and $\tilde{q}_1 = a - \frac{a-m}{\sqrt{2}}$ with $\hat{q} < \tilde{q}_1$.

find that $\tilde{q}_1 = a-(a-m)/\sqrt{2} > q_{crit}^{out/out} = (a+3m)/4$. Thus the constellation of bilateral integration becomes pareto inferior if the firms choose optimally a constellation of bilateral outsourcing, although the consumer surplus increases due to lower marginal costs, respectively output price. This occurs, since the firms choose for given fixed costs the integrated production if the marginal costs difference is sufficiently high. However, the starting point is a constellation with bilateral outsourcing, and thus the marginal cost difference is relative small, which means that the loss of profit due to higher fixed costs cannot be compensated by an increase of the consumer surplus. Graphically this is illustrated in Figure 5.2, where all combinations of outsourcing prices $q < q_{crit}^{out/out}$ and the assumed fixed costs, $F = \frac{(a-m)^2}{9b}$ lie above the $W^{in/in} = W^{out/out}$-curve.

Figure 5.2: welfare comparison in the case of bilateral outsourcing



Notice that Figure 5.2 illustrates only the special case $F = \frac{(a-m)^2}{9b}$ and the corresponding values for the outsourcing price. For lower fixed costs these values are changing, however the derived statements are qualitatively the same. Thus, there is in any cases the possibility of a higher welfare by switching from the profit maximizing constellation of bilateral outsourcing to the constellation with different

production choices, but there will be no welfare gain if both firms change their production mode.

Bilateral Integration Characterizes the Market Constellation

As we know from the previous analysis, i.e. equation (5.7), a bilateral integrated production occurs, if $q > q_{crit}^{in/in}$.
For analysing, if another market constellation as the optimal choice of bilateral in-house production increases the welfare level, we have to compare $q_{crit}^{in/in}$ with the threshold values, which indicate the equality of the welfare levels in bilateral integration and bilateral outsourcing, respectively the equality of the welfare levels in bilateral integration and different production strategies.
From paragraph above, we know the threshold value $\tilde{q}_1$, which leads for given domestic marginal costs and fixed costs to the same welfare level in the scenarios of bilateral outsourcing and bilateral integration, i.e. $\tilde{q}_1$ describes the solution of $W^{in/in} = W^{out/out}$. Additionally, we know that $W^{in/in} > W^{out/out}$ holds for $q > \tilde{q}_1$.
For given domestic costs a comparison of the two values $q_{crit}^{in/in}$, presented in (5.7), and $\tilde{q}_1$, presented in (5.12), shows that

$$q_{crit}^{in/in} = \frac{a+m}{2} - \sqrt{\frac{(a-m)^2}{4} - \frac{9b}{4}F} > a - \sqrt{(a-m)^2 - \frac{9b}{2}F} = \tilde{q}_1 .$$

This means, that the welfare decreases if both firms use optimally the integrated production, i.e. $q_{crit}^{in/in} < q$, but both will switch to the external procurement of the input component. This result is not surprising, since a change of strategy leads to an increase in the average marginal costs and the market price, so that the market output falls. As a result, the consumer surplus falls compared to a constellation with bilateral in-house production. In addition, a change in the production structure entails profit losses for both companies as they do not pursue their best strategy. As both market sides suffer losses, welfare cannot be higher when both companies which formerly produced in-house, now procure their input goods externally.
What happens in the case of a transition to different strategies?
Using (5.10) and (5.11), by the $W^{in/in} = W^{in/out}$-curve we can illustrate all combination of marginal outsourcing costs and domestic fixed costs, which lead to the same welfare level in a situation with bilateral integrated production and a constellation in different strategies. Starting in a point on the curve, for given

marginal costs, lower domestic fixed costs increases the welfare in a constellation with bilateral integrated production more than the welfare level in a constellation with different strategies. The reason is that the fixed costs affected both firms, if the constellation is characterized by bilateral integrated production, while in a constellation in different strategies only the integrated producing firm realizes this gain. Thus, if all other parameters are unchanged, the gain in the case of bilateral integration is higher. Therefore, we can conclude, that $W^{in/in} > W^{in/out}$ occurs for all combinations of fixed costs and outsourcing price below the $W^{in/in} = W^{in/out}$-curve, while for all combinations above the $W^{in/in} = W^{in/out}$-curve, we have $W^{in/in} < W^{in/out}$.

From equations (5.10) and (5.11) we obtain the threshold values

$$\bar{q}_1 = \frac{4a+7m}{11} - \sqrt{\frac{16}{121}(a-m)^2 - \frac{18}{11}bF} \tag{5.14a}$$

$$\bar{q}_2 = \frac{4a+7m}{11} + \sqrt{\frac{16}{121}(a-m)^2 - \frac{18}{11}bF}\,, \tag{5.14b}$$

at which the welfare level is the same when either different strategies or bilateral in-house production strategies are used. When comparing the threshold values with the critical value for in-house production, $q_{crit}^{in/in} < q < \bar{q}_1$ and $q_{crit}^{in/in} < \bar{q}_2 < q$ must be met to ensure an increase in welfare when switching from a constellation with bilateral in-house production to one with different strategies.

As it can be seen, both terms only provide only a solution if $F \leq \frac{8}{11}\frac{(a-m)^2}{9b}$. In connection with Assumption 5.2, this means that for $\frac{8}{11}\frac{(a-m)^2}{9b} < F \leq \frac{(a-m)^2}{9b}$ a change to a constellation with different production structures always has a welfare increasing effect. Starting in a constellation with bilateral integrated production, a change towards different strategies leads to a rise in the average marginal costs of production and, consequently, the market price. At the same time, output and consumer surplus are lower. This is met by an increase in the producer rent. Although the outsourcing company now suffers a profit loss, since its market share falls below 50%, the profit gain of the company that keeps on producing integrated is sufficiently high, so that there is not only a rise in the producer rent, but in welfare as well. To sum, this results since the fixed cost saving is high enough and can offset the loss concerning by higher average marginal costs. If for the given

outsourcing price $q_{crit}^{in/in} < q < \frac{a+m}{2}$ holds, the profit of the outsourcing company is lower but still positive, while in the case of $q > \frac{a+m}{2}$ the outsourcing firm will realize negative profits.

We now analyse the situation where $F < \frac{8}{11}\frac{(a-m)^2}{9b}$ applies. This requirement ensures that by using the marginal values (5.14a) and (5.14b), areas can be identified in which, from the welfare theory point of view it is preferable to choose bilateral in-house production or a constellation with different strategies, although the firms will optimally decide for a integrated production. For analysing this, Assumption 5.1, i.e. $\bar{q}_{1;2} \in (m;a)$ has to apply too, which is met by the threshold values for the case $F < \frac{8}{11}\frac{(a-m)^2}{9b}$. Comparing the threshold values (5.14a) and (5.14b) with the critical value for the in-house production, we find that

$$q_{crit}^{in/in} = \frac{a+m}{2} - \sqrt{\frac{(a-m)^2}{4} - \frac{9b}{4}F} < \frac{4a+7m}{11} - \sqrt{\frac{16(a-m)^2}{121} - \frac{18}{11}bF} = \bar{q}_1$$

$$q_{crit}^{in/in} = \frac{a+m}{2} - \sqrt{\frac{(a-m)^2}{4} - \frac{9b}{4}F} < \frac{4a+7m}{11} + \sqrt{\frac{16(a-m)^2}{121} - \frac{18}{11}bF} = \bar{q}_2,$$

which allows us to characterize conditions, under which a change of the production mode from bilateral in-house to different strategies increases the welfare.

However, we have to compare the threshold values (5.14a) and (5.14b) with the second requirement of Assumption 5.1, i.e. $\bar{q}_{1;2} < (a+m)/2$. Comparing the margin for positive profits in different strategies with the threshold values shows, that for any fixed costs with $F < \frac{8}{11}\frac{(a-m)^2}{9b}$, $\bar{q}_1 < (a+m)/2$ applies as well. Thus, the firm, which switch to outsourcing, will still realize a positive profit. In contrast, $\bar{q}_2 < (a+m)/2$ only applies if $\frac{5}{8}\frac{(a-m)^2}{9b} < F < \frac{8}{11}\frac{(a-m)^2}{9b}$. For the case of $F < \frac{5}{8}\frac{(a-m)^2}{9b}$ and an external procurement price of $\bar{q}_2 < q < a$, a change towards different strategies increase welfare, but then the outsourcing participant does not gain any positive profits. At this point, the fixed cost savings are too low, relative to

the increase in marginal costs. However, in this case, the positive profit effect of the still in-house producing participant outweighs the negative effects on the consumer surplus and the profit of the outsourcing company.
Finally, we find that the welfare in different strategies is higher than in a constellation with bilateral integrated production if

$$q_{crit}^{in/in} < q < \bar{q}_1 \text{ or } q_{crit}^{in/in} < \bar{q}_2 < q < a .$$

Notice, that depending on the parameter, the firm which use outsourcing can gain positive profits or realize a loss. We can summarize as follows:

Proposition 5.3:

If the market constellation is characterized by bilateral in-house production,

a) *for given costs, this constellation is superior to a constellation with bilateral outsourcing,*
b) *the welfare level can in any case be increased by an asymmetric production organization if the fixed costs are sufficiently high,* $\frac{8}{11}\frac{(a-m)^2}{9b} < F < \frac{(a-m)^2}{9b}$,
c) *the welfare level can be increased by an asymmetric production organization for* $q_{crit}^{in/in} < q < \bar{q}_1$ *or* $\bar{q}_2 < q < a$ *if the fixed costs are sufficiently low,* $F < \frac{8}{11}\frac{(a-m)^2}{9b}$.

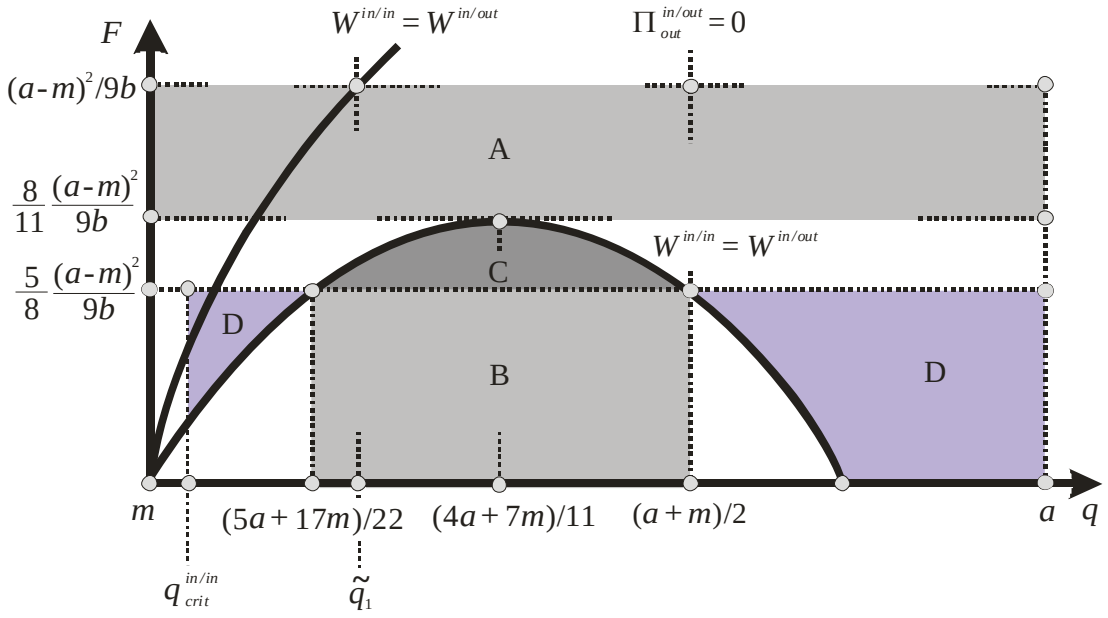
The statements above are illustrated in Figure 5.3.
In the case of $F = \frac{(a-m)^2}{9b}$, there is an equilibrium with full integration if $q > q_{crit}^{in/in} = (a+m)/2$. Also, we know that bilateral integration leads to higher welfare as a constellation with bilateral outsourcing if $\tilde{q}_1 < q$. Thus $q_{crit}^{in/in} < q < \tilde{q}_1$ characterizes the points where the optimally production choice is pareto inferior to a constellation with bilateral outsourcing. Comparing the values we showed that $\tilde{q}_1 < q_{crit}^{in/in}$ holds, which means that the optimally constellation of bilateral in-house production is always pareto superior to a constellation of bilateral outsourcing. Graphically, this is demonstrated by the fact that the combinations $F = \frac{(a-m)^2}{9b}$ and $q > q_{crit}^{in/in} = (a+m)/2$ lie below the $W^{in/in} = W^{out/out}$-curve.

The $W^{in/in} = W^{in/out}$-curve is significant for comparing the scenario with bilateral integration to one with different strategies, where $W^{in/in} > W^{in/out}$ applies for any combinations below this curve. As we demonstrated, there will no external procurement prices, which fulfils $W^{in/in} = W^{in/out}$ if $\frac{8}{11}\frac{(a-m)^2}{9b} < F < \frac{(a-m)^2}{9b}$. Therefore, for this range of fixed costs, all combinations lie above the $W^{in/in} = W^{in/out}$-curve, which is demonstrated by the light grey area A. In this case, a transition from bilateral integration to different structures increases the welfare, i.e. $W^{in/in} < W^{in/out}$.

From the above analysis, we know that for $\frac{5}{8}\frac{(a-m)^2}{9b} < F < \frac{8}{11}\frac{(a-m)^2}{9b}$ the critical value $\bar{q}_2$, from which a constellation with different strategies leads to higher welfare than a constellation with bilateral integration is smaller than $(a+m)/2$, the point from which definitively bilateral integration, i.e. $\bar{q}_2 < (a+m)/2$. Figure 5.3 also illustrates this range of fixed costs. In $F = \frac{5}{8}\frac{(a-m)^2}{9b}$, the threshold values for equal welfare levels are given by $\bar{q}_1 = (5a+17m)/22$ and $\bar{q}_2 = (a+m)/2$. The critical value at which bilateral integration occurs, is $q_{crit}^{in/in} = \frac{a+m}{2} - \frac{a-m}{2}\sqrt{3/8}$, with $q_{crit}^{in/in} < \bar{q}_1 < \bar{q}_2$. Thus, we definitively obtain a constellation with bilateral integrated production for $q \in (\bar{q}_1 ; \bar{q}_2)$. Assuming that $F = \frac{5}{8}\frac{(a-m)^2}{9b}$, Figure 5.3 shows by the light grey area B, that for any external procurement price $q \in (\bar{q}_1 ; \bar{q}_2)$, the combinations are below the $W^{in/in} = W^{in/out}$-curve and thus, $W^{in/in} > W^{in/out}$ applies. In what follows, area B characterizes a range of outsourcing prices, for which a change from the optimal bilateral integration towards a structure with different production modes is pareto inferior.

As Figure 5.3 also illustrated by the area C, for a bilateral integrated constellation with $\frac{5}{8}\frac{(a-m)^2}{9b} < F < \frac{8}{11}\frac{(a-m)^2}{9b}$ there is always an interval of outsourcings prices $q \in (\bar{q}_1 ; \bar{q}_2)$, in which range a change towards different production modes decreases the welfare level. However, this also means that for $q \in (q_{crit}^{in/in} ; \bar{q}_1)$ and $q \in (\bar{q}_2 ; a)$, welfare can be increased by switching to different structures, as these combinations lie above the $W^{in/in} = W^{in/out}$-curve. Assuming $F = \frac{5}{8}\frac{(a-m)^2}{9b}$, this is demonstrated by the areas D.

Figure 5.3: welfare comparison in the case of bilateral integration



As in the case of bilateral outsourcing, Figure 5.3 focuses only on the special cases $F = \frac{(a-m)^2}{9b}$ and $F = \frac{5}{8}\frac{(a-m)^2}{9b}$. However, similar to the paragraph above, our general conclusions are qualitatively unaffected by these fixed cost levels, since the changes in the different values do not change the order of these values. Therefore, independent of the fixed cost level, it is not possible to increase the welfare by changing the market constellation to bilateral outsourcing, if the integrated production characterizes the Nash-equilibrium. On the other hand, under certain circumstances it is possible to generate a higher welfare level, if instead of optimal bilateral integration, the firms produce by using different strategies.

Different Strategies Characterize the Market Constellation

In our previous analysis, we already looked in part at the constellation with different strategies, which is given by

$$q_{crit}^{out/out} = \frac{9b}{4}\frac{F}{(a-m)} + m < q < q_{crit}^{in/in} = \frac{a+m}{2} - \sqrt{\frac{(a-m)^2}{4} - \frac{9b}{4}F}\,.$$

From the previous analysis, we know that for the threshold value $\hat{q}_1$, for which welfare is higher with different production organizations than with bilateral outsourcing, for all fixed costs according Assumption 5.3 the condition

$$\hat{q}_1 = -\frac{4a-7m}{3} + \sqrt{\frac{16}{9}(a-m)^2 + 6bF} < \frac{9b}{4}\frac{F}{(a-m)} + m = q_{crit}^{out/out}$$

applies. Therefore, a transition to bilateral outsourcing does not increase the welfare. Here, too, the explanation is intuitive. The deviation of the in-house producing participant raises the average marginal costs and thus, the output price, which results in a reduction in the output amount and, consequently in a lower consumer surplus. Since the firm acts against its best response strategy, its profits decline. On the other hand, the outsourcing participant gets a higher market share and can increase its profits by increasing the output amount. This effect, however, does not compensate other market participants' losses. Thus, welfare would be lower at bilateral outsourcing in comparison to a constellation in different strategies. Graphically, this was shown in Figure 5.2, where all outsourcing prices $q > q_{crit}^{out/out}$ for the assumed fixed cost level $F = \frac{(a-m)^2}{9b}$ lie below the $W^{out/out} = W^{in/out}$-curve.

Similarly, when the outsourcing company switches to in-house production, it acts against its best response strategy and loses profit. In addition, the still in-house producing company loses profits, as its market share falls. In contrast, the consumer surplus increases. However, the positive effect is not sufficient to compensate for the negative effects. Thus, welfare decreases. Formally, this is documented for any fixed costs by

$$q_{crit}^{in/in} = \frac{a+m}{2} - \sqrt{\frac{(a-m)^2}{4} - \frac{9b}{4}F} < \frac{4a+7m}{11} \pm \sqrt{\frac{16(a-m)^2}{121} - \frac{18}{11}bF} = \bar{q}_{1;2}.$$

This result was pointed out in a graphical way in Figure 5.3. For the assumed fixed costs of $F = \frac{5}{8}\frac{(a-m)^2}{9b}$, the optimal choice of different production structures is characterized by $q < q_{crit}^{in/in}$. As we can see, all combination of this given fixed cost level and outsourcing prices, which lead to a constellation with different strategies, are lying above the $W^{in/in} = W^{in/out}$-curve.

Proposition 5.4:

A market constellation characterized by asymmetric production strategies is pareto superior.

The previous analysis allows for a simple and clear cut conclusion. If in a market of independent final good companies, some choose to procure their input externally while others produce their required input themselves, the companies act profit maximizing and also for the benefit of a welfare oriented institution. The reason is that, based on this equilibrium with unchanged costs, welfare cannot be increased by a change of production structure. On the other hand, in the case of identical production structures, despite the companies' profit orientation, at given costs a change towards an asymmetric production organization may well be accompanied by a gain in welfare. This may provide some leeway for market interference by influencing operational decisions the production structure.

5.5 Concluding Remarks

The chapter's aim was to demonstrate the strategic interactions of production organizations and its welfare implications in a duopoly with homogeneous goods. Outsourcing was interpreted as a long-term investment decision whereby fixed costs could be saved. On the other hand, the marginal costs of external procurement are higher than the marginal costs of in-house production. Consequently, the trade-off between fixed cost savings and a rise in marginal costs determines the company's production choice. Thereby, with this decision, the cost structure as well as its market position is influenced. As this is true for all companies, the choice of the production organization has a strategic component. Given the different cost parameters, the resulting strategic interactions characterize the market equilibrium. Here we find for given fixed costs, that at a relatively small marginal cost difference, outsourcing becomes the dominant strategy, whereas at a sufficiently high marginal cost difference, both companies will choose in-house production. In the case of a medium marginal cost differences, there will be different production structures. Via the marginal costs, the choice of organization affects the output price and the consumer. Since both sides of the market, i.e. producer and consumer, are affected, we analysed the effects of the production choice from the welfare point of view.
A comparison of the welfare levels of the given market structure in equal production modes and the other constellations revealed that the optimally chosen production strategy is not always pareto superior. Here, we find that for a number of sufficiently

big (small) marginal cost disadvantages of external procurement, welfare is higher in different strategies than in the dominant organization of bilateral outsourcing (bilateral in-house production). This means that for a constellation with bilateral outsourcing, the negative effect on firm's profits will be offset by the increase of consumer surplus, while n the case of a constellation with bilateral in-house production, the profit increase of the still integrated producing firm will compensate the profit loss of the no outsourcing firm and the decrease of consumer surplus. Additionally, we find that if the firms' profit orientation leads to equal production modes, for given costs, a change of the production structure by both firms never increase the welfare level.
In contrast, in the case of a constellation with different production structures, the companies' profit orientation ensures the pareto superiority.
Notice, that we assume profit maximizing behaviour for the firms. Thus, there are no incentives for the firms to change their decisions. However, given the decisions of the firms, our aim is to analyse via comparative static, if profit orientation by the firms lead to pareto superior situations or if there is scope for interactions of a welfare interested government and set incentives for changing the production mode. From our analysis, we thus come to the conclusion that in the case of identical production strategies for given costs, market interference affecting the companies' production choice may be required in order to increase welfare, while interferences affecting the companies' production choice decreases the welfare in case of different production modes.

Appendix

Appendix A: Nash-Equilibria of the Production Structure

For the Nash-equilibria, the profits of a firm in the different scenarios have to be compared.

a) bilateral outsourcing as a Nash-equilibrium

Outsourcing is the choice of firm A (B), if for a given outsourcing decision of firm B (A) the profit by using the external procurement is higher than by producing integrated, i.e. $\Pi^{out/out} > \Pi_{in}^{in/out}$ holds. Using the profit defined in Table 5.3, this is

characterized by $\frac{1}{9b}[a-q]^2 > \frac{1}{9b}[a+q-2m]^2 - F$. For given values of a, q and m the condition of an advantageous external procurement is

$$\frac{4}{9b}(a-m)\cdot(q-m) < F. \tag{A.5.1}$$

On the other hand, if firm B (A) chooses the integrated production, the choice of firm A (B) will be the external procurement if $\Pi_{out}^{in/out} > \Pi^{in/in}$, i.e. $\frac{1}{9b}(a+m-2q)^2 > \frac{1}{9b}(a-m)^2 - F$. For given values of a, q and m the condition of an advantageous external procurement is now

$$\frac{4}{9b}(a-q)\cdot(q-m) < F. \tag{A.5.2}$$

Comparing the conditions (A.5.1) and (A.5.2), we have, with the assumption $q > m$, for given values of the different parameters that $(a-q) < (a-m)$. From this follows, that if (A.5.1) is fulfilled, also (A.5.2) holds, and therefore condition (A.5.1) describes the constraint for a dominant Nash-equilibrium with bilateral outsourcing.

b) bilateral in-house production as a Nash-equilibrium

In contrast to the comparison above, firm A (B) chooses the integrated production, if for given integrated production of firm B (A), the profit with bilateral in-house production is bigger than in a constellation with different strategies, i.e. $\Pi^{in/in} > \Pi_{out}^{in/out}$. Using the profit levels defined in Table 5.3, this condition can be written as $\frac{1}{9b}[a-m]^2 - F > \frac{1}{9b}[a+m-2q]^2$. Thus, for given values of a, q and m the condition for internal production of both firms is

$$\frac{4}{9b}(a-q)\cdot(q-m) > F. \tag{A.5.3}$$

However, if firm B (A) chooses outsourcing, the choice of firm A (B) will be the internal production if $\Pi_{in}^{in/out} > \Pi^{out/out}$, i.e. $\frac{1}{9b}(a+q-2m)^2 - F > \frac{1}{9b}(a-q)^2$. For given values of a, q and m this condition is fulfilled if

$$\frac{4}{9b}(a-m)\cdot(q-m) > F\,. \tag{A.5.4}$$

As one can see, under the assumption $q > m$, for given values of the different parameters $(a-q) < (a-m)$ occurs. From this follows, that if (A.5.3) is fulfilled, also (A.5.4) is met. Thus, condition (A.5.3) describes the constraint for a dominant Nash-equilibrium with bilateral in-house production.

c) Nash-equilibrium in different strategies

Using (A.5.1) and (A.5.3) gives the condition of a Nash-equilibrium in different strategies, where we find

$$\frac{4}{9b}(a-q)\cdot(q-m) < F < \frac{4}{9b}(a-m)\cdot(q-m)\,. \tag{A.5.5}$$

PART IV: SUMMARY

This part summarizes the main findings of the thesis about outsourcing if markets are imperfect. Also the relevance of the results for politics will be briefly emphasized.

Chapter 6

Conclusion

Due to globalization, the international division of work has gained in importance. However, international division of labour is a synonym for international outsourcing, which has become a central topic in the media and politics because of its consequences. As many empirical studies show, international outsourcing leads to lower wages and, at least in the short-run perspective, less employment for low-skilled jobs that are usually outsourced.

The assumption behind our procedure is that the government is interested in an adequate income and high employment for low-skilled worker and thus favours less outsourcing. The present thesis is a positive analysis of different policies and their impacts on outsourcing. From our findings, we may conclude if a policy is an appropriate instrument to avoid outsourcing and increase employment or not. However, to make it more precisely, we never argue that a particular instrument is the only one or the best policy to reach the underlying government target.

In the Chapter 2 and 3, we pursue the argument high labour costs respectively wage differences are the driving force for outsourcing, the domestic wage level has to decline for less outsourcing. If lower wages cannot be realized, another way to make domestic production more attractive has to be found. This can be realized by a higher domestic productivity at given wages. One instrument, to realize at least one of these requirements, i.e. lower wages or higher productivity, is profit sharing.

As shown in Chapter 2, the implementation of a profit sharing scheme for high-skilled workers increases the productivity, respectively the effort, of this labour type, which also affects the wage for low-skilled employment and the outsourcing demand. Due to the complementary relationship of the labour types, the enhanced high-skilled labour demand, induced by higher effort, makes the low-skilled trade union more aggressive, which implies higher wages for the low-skilled employment. Therefore, low-skilled employment may realize an adequate wage income, a goal often expressed by trade unions, social organizations or politics. On the other hand, since low-skilled employment can be substituted by outsourcing, this promotes a

production mode with more external procurement. As the analysis showed, this does not necessarily mean less low-skilled employment since two opposed employment effects, a labour demand increasing productivity effect and a labour demand decreasing wage effect, occur. Therefore, a profit sharing scheme for high-skilled employment may in fact lead to higher employment and wages for low-skilled labour in a single firm despite an increase in international outsourcing. From this point of view, we can conclude that profit orientation of managers may help to realize the postulated political targets of an adequate wage income and higher employment of low-skilled workers in a single firm.

As a direct participation of the low-skilled in a firm's success is often postulated, we also analyses this requirement and its effects on outsourcing and the wage level. Here, we find that an implementation of profit sharing for low-skilled workers reduces the wage set by the trade union. Due to the substitution of wage income by profit income, a direct participation of low-skilled employment in a firm's success via profit sharing reduces domestic labour costs and favours domestic production. Since profit income may compensate for loss of wage income, we recognise an instrument that is able to achieve the goal of more domestic employment without decreasing workers income. However, the analysis in Chapter 3 also shows that a firm will desist from implementing profit sharing, if it can set the profit share unilaterally. Thus, alternative ways for implementing those compensation schemes as to be found. In fact, there are two other ways to implement a profit sharing scheme. The first is a restrictive way, where the implementation is mandatory by law. Since this is not very reasonable, only the second way really is an option. Here, firms or employer federations and trade unions determine the wage and also the profit share through bilateral negotiations.

Besides the cost differences, often the rising pressure of competition is used to explain outsourcing. This argumentation is close to the cost saving argument, since a higher intensity of competition requires a strategy that leads to a strong market position, which can be done by cost reduction through outsourcing. Therefore, the firm's decisions of the production structure, i.e. on outsourcing, have to ensure a strong position within a sector by fighting against the competition pressure. However, as the argument postulated, the decisions of one firm generate reactions of its competitor. For example, if one firm uses more outsourcing, another firm can either follow this strategy or operate with less external procurement. Since these actions affect the intensity of competition, there is a strategic relationship between outsourcing decisions. In the Chapter 4 and 5, we analyse this strategic relationship, the competition effect and the effects of different policy instruments to determine in

which way they affect the production mode, i.e. outsourcing activities. Furthermore, we study, the impact of profit maximizing behaviour on welfare.
In Chapter 4, starting with the assumption that outsourcing is motivated by avoiding fixed costs of domestic production, but is also associated with higher marginal costs, we analyse the impact of competition. Here, we affirm the statement that higher competition leads to more outsourcing. We also show that lower domestic costs lead to less outsourcing and higher employment. Our findings support the call for lower labour costs and the implementation of investment cost subsidies. In addition, we identify the taxation system as another policy instrument. For the underlying motive, we find in our analysis that a higher consumption tax in a fixed cost intensive branch leads to more outsourcing and less employment. Thus differentiated taxes for different sectors may be justified to reach the intended employment target.
However, as demonstrated in the chapter our results depend on the outsourcing motivation. In case of a reserved motivation, where outsourcing is associated with higher fixed costs but lower marginal costs as the domestic input production, the opposite effects of competition and consumption taxation are observed. For a tax system aimed at reducing outsourcing, we may conclude that in fixed cost intensive sectors the consumption tax should be low, while in sectors where outsourcing is motivated by saving marginal costs the tax should be high.
Based on the fixed cost saving argument of outsourcing, in Chapter 5 we identify the conditions for different production constellations in a duopoly model. Comparing for given costs, the welfare levels of the resulting strategies with that of other constellations, we illustrate, if profit maximizing behaviour of firms lead to a pareto superior production structure. Since we show that the assumed profit maximizing behaviour of firms does not necessarily lead to a pareto superior situation. Therefore, market interactions by the government, which affect the production structure, may be justified from a welfare point of view. To be more precisely, this statement is only valid for a certain range of costs domestic production and external procurement, if the firms using the same production mode and only one firm changes its decision. For the case, where different strategies are observed, the analysis shows, that a governmental interaction for all cost parameters lead to a decrease of the welfare.
As this thesis points out, there are a lot of strategies which affect the firms' decision concerning the production mode and thus the amount of outsourcing if labour markets or product markets are imperfect.
Furthermore, the analysis discusses the impacts and the effectiveness of the different policies, by illustrating in which ways they can affect the organizational choice. However, it is important to keep in mind that the effects of the analysed instrument

depend on many parameters, not all of which are represented by the different models. Therefore, this thesis is a positive analysis only, where we show the general impact of different instruments and cannot give a final answer, as to which policy is the best strategy to realize the underlying aims. Thus, we only show which policies can be used to achieve the underlying outsourcing and employment targets, by focusing on a partial analysis.

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Deutsche Kurzzusammenfassung

Die Aus- bzw. Verlagerung inländischer Produktionsprozesse an eigenständige Anbieter bzw. ins Ausland und die damit verbundenen Folgen sind durch die Globalisierung immer stärker in den Blickpunkt von Medien, Politik und Forschung gerückt. Auch in der Wirtschaftswissenschaft wurde dieses Phänomen aufgegriffen. Hierbei erfolgten vor allem Untersuchungen bezüglich der zu erwartenden Auswirkungen für Löhne und der Beschäftigung durch die Auslagerung. Im Rahmen dieser Arbeit wird dieser Strang der Forschung erweitert, indem die Wirkungen verschiedener Einflussfaktoren auf die Unternehmensentscheidung bezüglich des Outsourcings, als auch auf das Lohn- und Beschäftigungsniveau analysiert werden.
Die vorliegende Doktorarbeit kann dabei gedanklich in zwei Teile gegliedert werden. Der erste Teil, welcher sich aus den Kapiteln 2 und 3 zusammensetzt, befasst sich mit der Wirkung von alternativen Lohnsystemen wie der Gewinnbeteiligung auf die Outsourcingentscheidung. Hierbei wird angelehnt an der Struktur europäischer Arbeitsmärkte unterstellt, dass die Lohnsetzung für gering-qualifizierte Arbeitskräfte durch eine Gewerkschaft erfolgt. Kapitel 3 und 4, bildet den zweiten Teil der Dissertation. Dieser beschäftigt sich mit dem strategischen Zusammenhang der Outsourcingentscheidungen von Firmen und damit mit dem Einfluss der Wettbewerbsintensität in einer Branche. Darüber hinaus werden die Auswirkungen verschiedener Politikinstrumente betrachtet.

The Role of Profit Sharing in a Dual Labour Market with Flexible Outsourcing

Als eine Begründung für die Auslagerung von Prozessen dienen hohe inländische Lohnkosten, insbesondere die für gering-qualifizierte Arbeitskräfte. Allerdings, so die vorherrschende Meinung in der Bevölkerung, soll es keine Dumpinglöhne geben, um die Abwanderung der Produktion zu verhindern. Folglich bedarf es eines Instrumentes, welches die Arbeitskosten und damit den Lohn senkt, jedoch die Einkommenssituation der Arbeitnehmer nicht verschlechtert.
Dieser Interessenkonflikt von Unternehmen auf der einen und Arbeitnehmer bzw. Gewerkschaften auf der anderen Seite, ließe sich durch eine Gewinnbeteiligung lösen, da hierdurch bei gleichem Einkommen durch die Substitution von Lohn- durch Gewinneinkommen, die Arbeitskosten und damit der Lohn gesenkt werden könnten.

Dieser Teil der Arbeit untersucht, welchen Einfluss eine Gewinnbeteiligung für Hochqualifizierte auf die gewerkschaftlich festgelegten Löhne gering-qualifizierter Arbeitskräfte und damit auf die Auslagerungsentscheidung mit sich bringt. Die Analyse zeigt, dass durch die Einführung der Gewinnbeteiligung die Produktivität der Hochqualifizierten und damit die Arbeitsnachfrage nach ihnen steigen. Dies wiederum eröffnet der Gewerkschaft die Möglichkeit, einen höheren Lohn für gering-qualifizierte Arbeitnehmer durchzusetzen, da sich gleichzeitig durch die Komplementarität der Arbeitstypen die Nachfrage nach gering-qualifizierten Arbeitskräften steigt. Da diese Tätigkeiten durch Outsourcing substituiert werden können, wird durch die gestiegenen Lohnkosten vermehrt eine Auslagerung stattfinden. Folglich kann durch eine Gewinnbeteiligung für Hochqualifizierte ein höheres Lohnniveau für gering-qualifizierte Arbeiter erzielt werden, allerdings erhöht dies gleichzeitig die Outsourcingaktivitäten. Als Beschäftigungseffekte können ein negativer Einfluss durch die Substitution von gering-qualifizierten Arbeitskräften durch Outsourcing, aber auch ein positiver Einfluss durch die gestiegene Produktivität der Hochqualifizierten identifiziert werden, wobei nicht eindeutig ist, welcher der beiden dominiert.

Can Committed Profit Sharing Lower Flexible Outsourcing?

Aufbauend auf dem Ergebnis, dass eine Gewinnbeteiligung für Hochproduktive nicht die Auslagerung gering-qualifizierter Arbeitsplätze eingrenzt und damit unter Umständen negative Beschäftigungswirkungen für diesen Arbeitstyp auftreten, wird in diesem Teil die Gewinnbeteiligung für Geringqualifizierte diskutiert. Ein weiterer Unterschied zum vorangegangenen Abschnitt ist, dass die Gewerkschaft nicht mehr nur den Lohn, sondern auch die Arbeitsproduktivität bestimmt, also keine individuelle Entscheidung über die Produktivität getroffen wird. Unter diesen Annahmen zeigt sich, dass die von der Gewerkschaft gesetzte Produktivität unabhängig von der eingeführten Gewinnbeteiligung ist. Zudem wird deutlich, dass die Einführung einer Gewinnbeteiligung zu der angesprochenen Lohnsenkung führen kann und, aufgrund der substitutionellen Beziehung von inländischen Arbeitskräften und Outsourcing, weniger Auslagerung betrieben wird. Da der Unternehmer die Entscheidung über die Gewinnbeteiligung trifft, wird ferner untersucht, inwieweit es für ihn lohnenswert ist dieses Entlohnungssystem einzuführen. Die Analyse offenbart, dass es aus Unternehmenssicht optimal ist, keine Gewinnbeteiligung einzuführen. Grund hierfür ist, dass der einsetzende Lohnsenkungseffekt und die damit einhergehende Gewinnerhöhung nicht den

Einkommensverlust des Unternehmers durch die Verteilung eines Gewinnanteils an die Arbeitnehmer kompensiert.

Outsourcing Motives, Competitiveness and Taxation

Dieses Kapitel zeigt den strategischen Aspekt des Outsourcings, indem es den Einfluss der Entscheidung eines Unternehmens auf die Outsourcingentscheidung einer anderen Firma, also den strategischen Zusammenhang der Entscheidung über die Produktionsstruktur, explizit darstellt. Zu diesem Zweck wird ein Oligopolmodell mit homogenen Gütern unterstellt, indem sich das zu produzierende Gut aus mehreren Inputkomponenten zusammensetzt, wobei jede einzelne Stufe der Inputproduktion ausgelagert werden kann. Jede Unternehmung hat demnach die Wahl zwischen dem vollständigen Fremdbezug bzw. der vollständigen Integration oder sie kann sich für eine partielle Auslagerung entscheiden. Anreiz für die Auslagerung bildet i) die Möglichkeit der Einsparung von Fixkosten bzw. ii) die Realisierung geringerer Grenzkosten. Um von vornherein zu vermeiden, dass es zu vollständiger Auslagerung der Inputproduktion kommt, muss neben den erwähnten Vorteilen auch ein Nachteils des Outsourcing existieren. Im ersten Fall ist dies durch höhere Grenzkosten des Outsourcings im Vergleich zur integrierten Produktion gegeben, während im zweiten Fall beim Outsourcing zusätzliche Fixkosten entstehen. Demnach lässt sich die Motivation für die Auslagerung durch die beiden Trade-offs i) Fixkosteneinsparung bei gleichzeitiger Erhöhung der Grenzkosten und ii) niedrigere Grenzkosten bei gleichzeitig höheren Fixkosten charakterisieren.
Der Grad des Outsourcings wird dabei von den Kosten und der Wettbewerbsintensität beeinflusst. Sowohl der strategische Zusammenhang, als auch der Wettbewerbseinfluss werden hierbei für die zwei Kostenmotive, dargelegt. Während der strategische Zusammenhang unabhängig von der Motivation für Outsourcing ist, ist diese ausschlaggebend für den Wettbewerbseinflusses. Durch den Verlust an Marktmacht einhergehend mit geringerem Gewinn, erhöht ein intensiverer Wettbewerb den Anreiz, die Fixkosten der Produktion zu vermeiden. Ist die integrierte Produktion mit der Erbringung von Fixkosten verbunden, so wird ein intensiverer Wettbewerb zu mehr Outsourcing führen, während bei der Existenz von Fixkosten des Outsourcings die inländische Produktion ansteigt.
Eine Änderung der Auslagerungsentscheidung kann auch der Staat durch seine Politikmaßnahmen hervorrufen. Als solch ein Instrument wird, im Rahmen dieses Kapitels, die Verbrauchssteuer angesehen. Auch hier ist das Outsourcingmotiv entscheidend für die Wirkung der Steuer. Da diese die Menge auf dem Outputmarkt

verringert, wirkt sie wie eine höhere Wettbewerbsintensität. Folglich führt eine höhere Steuer zu mehr Outsourcing, wenn die inländische Produktion fixkostenintensiv ist, während sie zu weniger Outsourcing führt, wenn der Fremdbezug mit Fixkosten verbunden ist. Dieses Ergebnis liefert eine wichtige wirtschaftspolitische Implikationen, rechtfertigt es doch differenzierende Steuern auf Grundlage der Motivation für die Auslagerung.

Welfare Effects of Strategic Outsourcing in a Duopolistic Market

Um im Wettbewerb zu bestehen und damit am Markt zu existieren, müssen Unternehmen Strategien finden und umsetzen, welche Vorteile gegenüber den Konkurrenten generieren. Ein solcher Vorteil kann über Outsourcing realisiert werden, wenn es die Kosten senkt bzw. die Produktivität erhöht oder zur Differenzierung und damit als Alleinstellungsmerkmal dient. Allerdings werden andere Firmen in einer Branche auf die Änderungen der Organisationstruktur einer Firma reagieren, so dass die Produktionsentscheidung auch eine strategische Komponente beinhaltet.
Unter der Annahme das die Auslagerung durch die Einsparung von Investitionskosten, einhergehend mit höheren Grenzkosten, motiviert ist, zeigt dieser Abschnitt anhand der Relation von Fix- und Grenzkosten, wann sich alle, keine oder einige Firmen einer Branche für die Auslagerung entscheiden. Vereinfachend wird in diesem Rahmen unterstellt, dass sich das homogene Gut aus einer nicht teilbaren Inputkomponente zusammensetzt, so dass sich jedes Unternehmen der Wahl des vollständigen Outsourcings bzw. der vollständigen Integration gegenübersieht.
Da durch die Produktionsstrategie die Renten von Produzenten und Konsumenten berührt werden, wird die Wohlfahrt der sich einstellenden Marktkonstellation der Rentensumme anderer Konstellationen gegenübergestellt. Durch diesen Vergleich kann ermittelt werden, ob durch das gewinnmaximierende Verhalten der Firmen sich eine pareto superiore Konstellation einstellt. Diese Gegenüberstellung zeigt, dass für gegebene Produktionskosten ausgehend von einer Konstellation in der unterschiedliche Produktionsstrategien ergriffen werden die Rentensumme nicht erhöht werden kann, während sich ausgehend von gleichen Strategien unter Umständen eine höhere Rentensumme erzielen lässt, wenn stattdessen unterschiedliche Strategien verfolgt werden. Demnach führt das individuell rationale Verhalten der Unternehmen nicht notwendigerweise zu einer pareto superioren Situation, womit sich staatliche Eingriffe rechtfertigen lassen.