Multi-plant Firms and Production Shifting

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Abstract

We develop an oligopoly model of horizontal mergers, in which firms compete in Cournot fashion on the final product market and acquire inputs through bilateral monopoly relations. Final products are differentiated and input prices are determined in bargaining over linear tariffs between each firm and its supplier who is a local monopolist. Our analysis identifies the impacts of a merger on the parties' bargaining power, input prices, and social welfare. We isolate two effects which benefit the merging parties: a shift in the breakdown points if goods are substitutes and a shift in the bargaining frontier given the ability of the merged firm to re-locate production. Welfare is more likely to increase the easier it is to shift production across plants and the more differentiated products are.

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1 Introduction

An important issue in economics and antitrust is how horizontal mergers affect consumer surplus and social welfare. The traditional market structure approach, which constitutes the basis for the merger guidelines in the US and the EU, generally views horizontal mergers as detrimental to competition and consumer surplus. Such a simple market structure test, however, does not incorporate the role of merger efficiencies on competitiveness and on firms' production incentives. In fact, efficiencies crucially impact not only a merger's effect on social welfare, but also firms' incentives to merge in the first place. Therefore, starting with the seminal contributions by Stigler (1950) and Williamson (1968), the trade-off between monopolization and efficiency gains of mergers has been extensively discussed in the economic literature (see, e.g., Farrell and Shapiro 1990, Perry and Porter 1985).

While there has been much controversy about whether and to what extend efficiencies should be taken into account when the antitrust authority decides to challenge a merger, the so called Efficiency Defense has by now been explicitly recognized in the regulatory guidelines. The revised Section 10 on efficiencies in the Horizontal Merger Guidelines issued by the U.S. Department of Justice and the Federal Trade Commission (2010) defines explicitly the set of "cognizable efficiencies". For instance, Pitovsky (1998) states that the Tosco-Unocal and Chrysler-Daimler mergers have not been challenged because of presentation of efficiencies. Traditionally, efficiency gains (resulting in potentially lower prices or better products) are thought to be realized i) by achieving an optimal allocation across different plants (rationalization), ii) through realization of economies of scale and scope, or iii) by enhancing technological progress. All these factors could render a horizontal mergers desirable from a social welfare perspective.

Both in theory and in practice, there has been more emphasis on a more subtle reason why a horizontal merger may decrease final prices: it increases the purchasing power of a downstream firm vis-a-vis the providers of inputs. A formal analysis of countervailing power has been attempted by von Ungern-Sternberg (1996) and Dobson and Waterson (1997). In the latter paper, a monopolistic retailer bargains over input prices with several differentiated retailers who subsequently compete in Bertrand-fashion. If the supplier grants a discount to one particular retailer, this decreases his supply to other retailers who buy at higher unit prices. This effect strengthens the supplier's bargaining position if retailers are non-integrated. By merging, retailers can then lower their input prices. Dobson and Waterson (1997) assume that a merger also reduces the variety of offered goods, which together with the monopolization effect accounts for welfare losses. Von Ungern-Sternberg (1996) considers a similar model in which, however, retailers engage in Cournot competition. In addition, he applies a bargaining solution which is different from the standard Nash-solution as used in Dobson and Waterson (1997). While these two papers assume bargaining over constant unit prices, Inderst and Wey (2007) have considered the case of efficient bargaining allowing for any price schedule. While the previous rationales for a downstream merger of retailers facing a single supplier cease to hold under efficient bargaining, they find that the incentives to merge depend now on the shape of the supplier's cost function. With increasing unit costs retailers incur higher input prices under non-integration as they essentially bargain on the margin.[1] In this paper, we study efficiencies of multi-plant mergers which arise from the firm's ability to shift its production across plants.

There are some recent papers which investigate how a merger of firms which produce differentiated goods affects input prices in the presence of plant-specific input suppliers. For this case, Lommerud et. al (2005) show that a merger is always profitable for the participants unless the goods are close to perfect substitutes and the unions' objective is to achieve higher employment level rather than higher wages. Lommerud et al. (2006) analyze national and international mergers in an unionized oligopoly where input suppliers are country-specific, and find that international mergers are always socially preferable to any market structure which involves national mergers. This is driven by the fact that international mergers decrease, while national mergers increase the wages. However, if merger formation is endogenous, there are more international mergers than socially preferred. In a closely related setup, Symeonidis (2008 and 2010) finds that downstream mergers always decrease input prices. It increases social welfare if the goods are close substitutes and if the upstream suppliers have significant bargaining power.

While this literature emphasizes the importance of production shifting for firms' incentive to form a multi-plant merger, interestingly, they all assume that products are plant-specific such that the merged firm can produce each product only at one specific plant. Therefore, production shifting is equivalent to reducing the output of one product at one plant, while increasing the output of the substitutable product at the other plant. This restriction on the firm's ability to shift production across plants is plausible for the short term. In the long term, however, a firm may be able to shift the production of a *specific* product between its existing plants.[2] For example, the Swedish multinational company Electrolux bought the Italian producer Zanussi in 1984. In 1997 Electrolux-

[1] Dobson and Waterson (1997) and von Ungern-Sternberg (1996) have only considered cost functions with constant unit costs. Inderst and Wey (2003, 2011) also allow for multiple suppliers, multilateral relations, and horizontal mergers on either stage.

[2] Straume (2003) analyzes the equilibrium market structure in the international market. Differently, he considers a framework in which the firms' produce a homogeneous product, and the labor market structure is different across countries. He found that the equilibrium market structure highly depends on the level of trade cost. He also omit the welfare analysis in the paper.

Zanussi announced some plant closures in Italy. However, the company decided to continue its production in Italy after it agreed with the metalworker's union on lower wages (Paparella 1997). In 2014, Electrolux again threatened to shift its production to the low-wage country Poland in order to close plants in Italy. Later, in the same year, the company asked for wage cuts to push the wage levels toward the wages it pays in Poland and Hungary, as an alternative solution to the plant closure (Rustico 2014).

Therefore, we impose the assumption that the production of a specific product can be shifted across plants. We consider two manufacturers offering differentiated products which acquire inputs through bilateral monopoly relations with the plant-level suppliers. Hereby, input prices are determined through bargaining between each firm and its supplier. These are vertically disintegrated, as it is in the case of wage bargaining between a labor union and a firm. In contrast to the independent manufacturers, a downstream merger allows the integrated firm to procure from both suppliers. The integrated multi-plant manufacturer may shift production between the two plants if input prices, e.g., wages, are different. As we assume convex production costs at each plant, such production shifting is costly and will not occur in the equilibrium. However, solely the threat of shifting increases the bargaining power of the integrated manufacturer and exerts downward pressure on input prices. Formally, we encounter a shift in the slope of the bargaining frontier which is beneficial to the integrated firm. Additionally, if goods are substitutes, the merged manufacturer benefits from a shift in the breakdown point.

In Section 2, we analyze the duopoly case with plant-specific input suppliers. In Section 3.1, as a benchmark case, we consider a model which is closely related to those analyzed in the literature discussed above: products are plant-specific, such that their production cannot be shifted to another plant. In this case, we find that a merger is always profitable for the downstream firms, but it decreases both consumer surplus and total welfare. This result is in line with Symeonidis (2010), who finds that a downstream merger decreases total welfare as long as the supplier's bargaining power is not very high. However, this result stands in contrast with Lommerud et al. (2005 and 2006) as suppliers in their setup have the full bargaining power. In Section 3.2, we allow the merged firm to shift its production of both products across the plants. Here, the multi-plant merger can be socially desirable if the firms' products are not very close substitutes and if the firms' capacity constraints are not very restrictive. Then, a merger decreases input prices as it increases the disagreement profit of the manufacturer against the input suppliers.

In Section 4, we discuss two extensions of our model. We analyze a firm's investment decision to open a new plant, either in the home country or in a foreign country, when it bargains with the country-specific input suppliers.[3] In Section 4.1, we discuss a firm's equilibrium decision on the location of a second plant (domestic vs. foreign) at which a differentiated product is to be produced. Even if investment costs for a production plant in a foreign country are higher than for a plant in the domestic country, the manufacturer may strictly prefer the FDI. If the firm opens the new plant in the foreign country, then the firm has a strict preference to design the new product such that it can also be produced at the home plant as this improves the manufacturer's breakdown profit. The manufacturer does not have this incentive if the firm opens a second plant in the home country as the ability to shift production does not improve the threat point vis-a-vis the supplier in this scenario.

In Section 4.2, we analyze a firm's FDI decision when the country-specific suppliers have a different level of bargaining power. A firm's investment decision depends on the domestic union's bargaining power. In particular, the domestic union may have a strict preference to commit itself not to exert its full bargaining power in order to prevent the firm to invest abroad.[4] As the union may not be able to commit itself, the manufacturer and the union may play a variant of the Prisoner's Dilemma: the union may be strictly better off if it does not exert its full bargaining power as this prevents the firm from FDI.[5] As the union cannot commit itself to this action, however, the firm will invest abroad, such that the union earns lower wages and the firm earns lower profit due to the high investment costs. A recent example which is closely related is amazon in Germany and in Poland. In Germany, workers are better organized than in Poland and have a better bargaining position. By exerting their bargaining power (in the form of a strike in the weeks before Christmas in 2014), the domestic German workers tried to enforce higher wages. As a consequence, however, output shifting from German to Polish plants became profitable. Therefore, amazon had to undertake FDI investments, while the German workers were not able to make any use of their strong bargaining position.

[3] Zhao (1995) discusses a firm's FDI decision when labor is unionized. He finds that cross-hauling FDI increases (decreases) employment and national welfare if the union is wage (employment) oriented. Eckel and Egger (2009) analyze a similar problem and find that the manufacturer has incentives for FDI in order to improve the bargaining position vis a vis the input suppliers.

[4] Egger and Etzel (2014) study a model with two countries that differ in the centralization of union-wage setting. They show that in the long run, capital outflows from the country with centralized wage-setting make the two countries more dissimilar and a decentralization of the wage setting can prevent capital outflows and the export of jobs.

[5] Aloi et al. (2009) analyze a two-country scenario, in which labor is competitive in one country while it is unionized in the other. They also show that unionized workers do not have to have a strict preference for an increase in their relative bargaining power.

2 The Model

Two downstream manufacturers, located in two different countries, produce a (differentiated) product and compete in Cournot fashion in the integrated final product market. Each manufacturer operates one production plant and receives inputs through a bilateral relation with one supplier. A particular upstream labor union i is the sole supplier at plant i, $i \in \{1, 2\}$.

Opposed to final product markets, prices are negotiated in bilateral monopoly relations on intermediate goods markets. A major example of a monopolistic input supplier is a country-level labor union which bargains with the manufacturer for a uniform wage rate on behalf of the employees. Bargaining between the input supplier and the manufacturer over the input price takes place at each plant. Below we also allow manufacturers to merge, in which case both input suppliers bargain simultaneously with a single firm.

We denote the total output of downstream firm i's product by $x_i = x_{i1} + x_{i2}$, for $i \in \{1, 2\}$, where x_{ik} denotes the output of product i at plant k. If the manufacturers are independent, then each of them can only produce its own brand, and the total output at plant i is equal to x_{ii}, and $x_{ij} = 0$ for $i, j \in \{1, 2\}$ and $i \neq j$. If the two plants are run by a single owner, one of the two cases emerges, depending on the manufacturer's ability to shift the production of each products across its plants. If the production shifting is not feasible, i.e., the products are plant-specific, then the production at each plant i is equal to x_{ii} and $x_{ij} = 0$ for $i, j \in \{1, 2\}$ and $i \neq j$. If the production of each product can be shifted across plants in order to minimize production costs, then the total production at plant i is equal to $X_i = x_{1i} + x_{2i}$.

While for reasons of tractability we have to assume specific functional forms of the demand and the cost function, our main qualitative effects do not rely on these assumptions. The inverse demand for product i is given by $p_i = 1 - x_i - \gamma x_j$, for $i, j \in \{1, 2\}$ and $i \neq j$, where $\gamma \in [0, 1]$ measures the degree of product differentiation. For $\gamma = 1$, both brands are perfect substitutes while $\gamma = 0$ indicates that both brands are independent and each manufacturer is a monopolist.

The marginal costs of producing the inputs are normalized to zero. Moreover, we assume that each unit of input produces exactly one unit of the final good. Total production costs at plant i are now given by

$$c_i = \left(w_i + \frac{t \cdot X_i}{2} \right) X_i,$$

with $t \geq 0$, where w_i stands for the price of inputs from supplier i, and X_i denotes the total production of both products at plant i. When the firms are independent, then $X_i = x_i = x_{ii}$.

The production costs are linear in the input price, w_i, and convex in the production quantity. Parameter t measures the curvature of the cost function, and therefore indicates to what extent capacity constraints limit a further expansion of production. In case the manufacturers merged, the parameter t also measures the ease of shifting production between the plants. The lower t is, the easier it is to shift production of a product to the other plant, and therefore the stronger the bargaining position of the merged firm is. With a large value of t, a shift of production comes at relatively large costs, which makes the threat to shift production less powerful.[6]

We consider a two-stage game with the following timing. In the first stage, each manufacturer bargains separately with its input supplier over the price w_i. We will apply the symmetric (axiomatic) Nash-bargaining solution for each pair of manufacturers and suppliers. Moreover, both pairs bargain simultaneously. In the second stage, both manufacturers determine their production quantities non-cooperatively. If the manufacturers are independent, then the payoff function R_i of manufacturer i is strictly concave in $x_i = x_{ii}$ and given by

$$R_i = (1 - x_i - \gamma x_j)x_i - \left(w_i + \frac{tx_i}{2}\right)x_i, \text{ for } i, j \in \{1, 2\} \text{ and } i \neq j.$$

The payoff of input supplier i is

$$L_i = X_i w_i = x_{ii} w_i.$$

The Non-merger Case

We solve the game backwards. In the second stage, the manufacturers take the negotiated input prices (w_1, w_2) as given and compete in quantities in the integrated final product market.[7], [8] Each firm i chooses the optimal quantity x_i which maximizes its payoff R_i. The first-order conditions yield the following best-response functions for the firm i:

$$x_i^{\circ} = \frac{1 - \gamma x_j - w_i}{2 + t} \text{ for } i, j = 1, 2,\ i \neq j. \tag{1}$$

[6] As production costs are convex, we have to require that a downstream manufacturer does not find it optimal to open another plant. This may follow from large upfront investments for setting up another plant or economies and learning-by-doing effects at the plant level, which grow over-proportionally with total output. We analyze the firm's incentives to open a new plant in the extension of our paper.

[7] We can safely restrict consideration to the node of the game where bargaining at both firms has been successful such that both goods can be provided.

[8] We assume that the bargaining outcome from the first stage is observable for both firms.

Since input prices w_1 and w_2 are observable, each manufacturer i's optimal strategy in the second stage, $\widehat{x}_i$, can be written as a function of the input prices. This yields

$$\widehat{x}_i(w_i, w_j) = \frac{(2+t-\gamma) + \gamma w_j - (2+t)w_i}{(2+t)^2 - \gamma^2} \text{ for } i, j = 1, 2, \ i \neq j, \tag{2}$$

if both supplies are strictly positive, i.e., $w_i < 1 - \gamma(1-w_j)/(2+t)$ for $i, j = 1, 2, \ i \neq j$. If the negotiated wage for firm i exceeds $1-\gamma(1-w_j)/(2+t)$, then firm i's output equals $\widehat{x}_i(w_i, w_j) = 0$, while firm j produces $\widehat{x}_j(w_i, w_j) = (1-w_j)/(1+t)$ as long as $w_j \leq 1$ holds. Otherwise, both firm's output will be equal to zero, i.e. $\widehat{x}_i(w_i, w_j) = 0$, $i \in \{1, 2\}$.

Wages are determined in the first stage of the game as a result of a simultaneous bilateral bargaining between the firm i and union i for $i \in \{1, 2\}$. Given the optimal level of productions in the second stage, firm i's payoff if it agreed with union i on wage w_i equals $\widehat{R}_i(w_i, w_j) = (1 - \widehat{x}_i(w_i, w_j) - \gamma \widehat{x}_j(w_j, w_i))\widehat{x}_i - w_i \widehat{x}_i(w_i, w_j) - \frac{t}{2}(\widehat{x}_i(w_i, w_j))^2$,while the union i's payoff is equal to $\widehat{L}_i(w_i, w_j) = \widehat{x}_i(w_i, w_j) \cdot w_i$. As there is no outside option for the firm and the union, their disagreement points are equal to zero. We can formalize the symmetric Nash bargaining problem between firm i and supplier i as

$$\max_{w_i} \widehat{R}_i(w_i, w_j) \cdot \widehat{L}_i(w_i, w_j) = \left[(1 - \widehat{x}_i - \gamma \widehat{x}_j)\widehat{x}_i - w_i \widehat{x}_i - \frac{t}{2}(\widehat{x}_i)^2\right] [\widehat{x}_i w_i]. \tag{3}$$

Each firm i and union i chooses the equilibrium wage rate w_i^* which maximizes their Nash product and is a best response to the negotiated wage rate, w_j, between firm j and union j. As the firms and the unions are symmetric the equilibrium wage rates which maximize the Nash products (3) are identical and given by

$$w_1^* = w_2^* = \frac{2+t-\gamma}{8+4t-\gamma}. \tag{4}$$

Substituting (4) into (2) yields the symmetric output levels

$$x_1^* = x_2^* = \frac{3(2+t)}{(2+t+\gamma)(8+4t-\gamma)} \tag{5}$$

Given the these quantities, each firm's profit equals

$$R^* = \frac{9(2+t)^3}{2(2+\gamma+t)^2(8-\gamma+4t)^2},$$

while each union's wage bill is equal to

$$L^* = \frac{3(2+t)(2-\gamma+t)}{(2+\gamma+t)(8-\gamma+4t)^2}.$$

3 The Case of Integration

A merger of downstream manufacturers yields a multi-plant firm. We investigate such a merger in different scenarios. In Section 3.1, we analyze the benchmark case where each brand can only be produced at one specific plant. In this case, the downstream merger improves firm's bargaining position against the suppliers, unless the products are independent. If bargaining breaks down with supplier i, the manufacturer will increase the supply of good $j \neq i$, which can partially compensate the foregone profits from not supplying brand i as long as $\gamma > 0$. In Section 3.2 and Section 3.3, we introduce the option to shift the production of each product across the plants, i.e., the manufacturer can produce both brands at both plants. The possibility of production shifting makes demand for each input more elastic, so that a merger enhances the bargaining position of the merged firm and leads, as we will show, to even lower input prices.

The manufacturers' benefits from the merger are threefold. First, if goods are (imperfect) substitutes, i.e., $\gamma > 0$, then there is the standard monopolization effect on the final goods market. Second, the possibility to shift production transforms the bargaining frontier in favor of the integrated manufacturer. Third, the merger implies a shift in the breakdown payoff. The last effect is more pronounced if the firm can shift the production across its plants and exists for all $\gamma \geq 0$. Finally, in Section 3.4, we compare the outcomes under the different regimes, which summarizes our results and provides more intuition for them.

3.1 Analysis of the Benchmark Case with No Production Shifting

Suppose that manufacturers are merged. Moreover, in this benchmark case, we assume that brand i can only be produced at plant plant i, i.e., production shifting is not possible even if the firm is operating at both plants. We can write the payoff function of the multi-plant firm as

$$R^M = (1 - x_1 - \gamma x_2)x_1 + (1 - x_2 - \gamma x_1)x_2 - w_1 X_1 - w_2 X_2 - \frac{t}{2}(X_1)^2 - \frac{t}{2}(X_2)^2. \quad (6)$$

Similar to the no merger case, the total production at plant i is equal to the total production of brand i, i.e., $X_i = x_i = x_{ii}$.

In the second stage, the merged firm takes the input prices (w_1, w_2) as given and maximizes its profit (6) by producing

$$\widehat{x}_i(w_1, w_2) = \frac{(2+t)(1-w_i) - 2\gamma(1-w_j)}{(2+t)^2 - 4\gamma^2}, \quad (7)$$

if both supplies are strictly positive, i.e., if $w_i < 1 - 2\gamma(1 - w_j)/(2+t)$ for $i, j = 1, 2$, $i \neq j$. If the latter condition does not hold for product i, then we obtain $\widehat{x}_i(w_1, w_2) = 0$, while $\widehat{x}_i(w_1, w_2) = (1 - w_j)/(2+t)$ if $w_j \leq 1$ and $\widehat{x}_i(w_1, w_2) = \widehat{x}_i(w_1, w_2) = 0$ otherwise.

We now set up the bargaining problem. Similarly to the previous case, bargaining with the two suppliers proceeds simultaneously and separately.[9] If the firm reaches agreements with both unions then its payoff equals

$$\widehat{R}^M(w_1, w_2) = \sum_{i,j \in \{1,2\}, i \neq j} \left[(1 - \widehat{x}_i - \gamma \widehat{x}_j) \cdot \widehat{x}_i - (w_i + t \cdot \widehat{x}_i)/2) \cdot \widehat{x}_i\right],$$

and the union i gets $\widehat{L}_i(w_1, w_2) = w_i \cdot \widehat{x}_i$

In contrast to the previous analysis, the breakdown payoff of the manufacturer is no longer zero. Suppose thus that there is a breakdown in bargaining with union i. Then, the merged firm can only produce product j at plant j for the given input price w_j such that $\widehat{x}_i^D = 0$. The manufacturer maximizes its profit $R^M = (1 - x_j)x_j - w_j x_j - \frac{t}{2}(x_j)^2$ by choosing the optimal output level $\widehat{x}_j^D(w_j) = (1 - w_j)/(2+t)$ if $w_j \leq 1$ and $\widehat{x}_j^D(w_j) = 0$ otherwise. If bargaining between the firm and union i fails, then the firm will get the profit equal to

$$\widehat{R}_i^{MD}(w_j) = \max\left\{\frac{(1 - w_j)^2}{2(2+t)}, 0\right\}. \tag{8}$$

As the unions do not have any outside options, they get a profit of zero in the case of disagreement. Proceeding analogously to the previous Section 2, the merged firm and union i maximize the symmetric Nash product, i.e., they agree on

$$\max_{w_i} \left[\widehat{R}^M(w_i, w_j) - \widehat{R}_i^{MD}(w_j)\right] \cdot \widehat{L}_i(w_i, w_j)$$

The unique equilibrium is given by the input prices and production quantities

$$w_1^M = w_2^M = \frac{2 + t - 2\gamma}{8 + 4t - 2\gamma}, \tag{9}$$

$$x_1^M = x_2^M = \frac{3(2+t)}{(2 + t + 2\gamma)(8 + 4t - 2\gamma)} \tag{10}$$

Lemma 1. *The benchmark case with integrated manufacturers and no production shifting has a unique equilibrium where equilibrium quantities are given by x_i^M in (10) for both goods $i \in \{1, 2\}$.*

[9] When a downstream firm bargains with two independent upstream suppliers simultaneously, the disagreement payoffs can be constructed in several ways. We assume that if firm i bargains with the representative union i, then it takes the expected outcome at the other plant $j \neq i$ as given. This way of formalizing disagreement points are also used by Horn and Wolinsky (1988) and Eckel and Egger (2009).

The firm's equilibrium profit equals

$$R^M = \frac{9(2+t)^2}{4(2+2\gamma+t)(4-\gamma+2t)^2}, \tag{11}$$

while each union earns a wage bill of

$$L^M = \frac{3(2+t)(2-2\gamma+t)}{4(2+2\gamma+t)(4-\gamma+2t)^2}. \tag{12}$$

If the products are independent, i.e. $\gamma = 0$, then merging without the ability to shift production of the different brands between the plants does not affect the manufacturers' bargaining power as (9) falls together with (4). In that case, also the equilibrium production quantities stay unaffected. There are two separate final goods markets, which are monopolized both pre- and post-merger.

However, if goods are (imperfect) substitutes, i.e. $\gamma > 0$, then a merger improves the firms' bargaining position as the equilibrium post-merger wages (9) fall short of the pre-merger wages (4). Such a merger for which manufacturers cannot shift the production of the brands also lowers the output of each product and, therefore, consumer surplus. While unions receive a lower wage bill, i.e. $w_i^M \cdot x_i^M < w_i^* \cdot x_i^*$, the merged firms' profit exceeds the firms' joint pre-merger profits. In this case, the downstream merger monopolizes the final goods market.

Lemma 2. *If the products are plant-specific, i.e., shifting the production of one brand to another plant is not possible, then a downstream merger decreases consumer surplus, unless products are independent. In this case, the merger does not affect equilibrium outcomes.*

3.2 Production Shifting

In contrast to the benchmark case in Section 3.1, we now allow the manufacturer to shift the production of each product between the two plants. First, we derive for each plant the optimal brands to be produced and the optimal respective production quantities given the wages (w_1, w_2). The aggregate quantity of the goods we denote by $X = X_1 + X_2 = x_1 + x_2$, where X_i denotes the overall output at plant i and x_i denotes, as before, the overall output of brand i. The manufacturer chooses X_1 to minimize his production costs of quantity X, i.e.,

$$C(X_1, X, w_1, w_2) = -w_1(X_1) - w_2(X - X_1) - \frac{t}{2}(X_1)^2 - \frac{t}{2}(X - X_1)^2.$$

If $0 \leq w_i \leq 1$ holds, then the firm's cost minimizing production quantities at the plants 1 and 2 are given by

$$X_1 = \begin{cases} 0, & \text{if } w_1 - w_2 \geq tX \\ X, & \text{if } w_2 - w_1 \geq tX \\ \frac{tX - w_1 + w_2}{2t}, & \text{otherwise} \end{cases}, \tag{13}$$

$$X_2 = X - X_1.$$

Given the cost minimizing quantities, the total cost of the merged firm, $C(X, w_1, w_2) = \min_{\{0 \leq X_1 \leq X\}} C(X_1, X, w_1, w_2)$, can be written as

$$C(X, w_1, w_2) = \begin{cases} \frac{t}{2}X^2 + Xw_2, & \text{if } w_1 - w_2 \geq tX \\ \frac{t}{2}X^2 + Xw_1, & \text{if } w_2 - w_1 \geq tX \\ \frac{t}{2}X^2 + Xw_2 - \frac{1}{4t}(tX - w_1 + w_2)^2, & \text{otherwise} \end{cases}, \tag{14}$$

which is differentiable in all three parameters. The optimal production levels can be determined by maximizing the merged firm's profit (6) which can be rewritten as

$$R^M = (1 - x_1 - \gamma x_2)x_1 + (1 - x_2 - \gamma x_1)x_2 - C(x_1 + x_2, w_1, w_2). \tag{15}$$

Lemma 3. *For $\gamma \in [0, 1)$ and given input prices (w_1, w_2), the integrated manufacturer chooses the unique supply levels*

$$x_1 = x_2 = \tilde{x}(w_1, w_2) = \begin{cases} \frac{1-w_2}{2(1+t+\gamma)}, & \text{if } w_1 - w_2 \geq \frac{t(1-w_2)}{1+t+\gamma} \\ \frac{1-w_1}{2(1+t+\gamma)}, & \text{if } w_2 - w_1 \geq \frac{t(1-w_1)}{1+t+\gamma} \\ \frac{2-w_1-w_2}{2(2+t+2\gamma)}, & \text{otherwise} \end{cases}. \tag{16}$$

If $\gamma = 1$ the aggregate supply of both goods is uniquely determined and equal to $2\tilde{x}(w_1, w_2)$.

Proof. Suppose $\gamma < 1$. We first show that at an optimum $x_1 = x_2$. Leaving X constant, we choose x_1 to maximize

$$x_1(1 - x_1 - \gamma(X - x_1)) + (X - x_1)(1 - (X - x_1) - \gamma x_1).$$

Differentiation yields the first-order condition $-4x_1(1 - \gamma) + 2X(1 - \gamma) = 0$, which together with strict concavity proves the assertion. The optimization problem thus reduces to choosing x to maximize $R^M = 2x(1 - x(1 + \gamma)) - C(2x, w_1, w_2)$. This problem is strictly concave and calculating the first order conditions for the various cases yields (16). **Q.E.D.**

By substituting (16) in (13) we get the optimal level of production at plant i as a function of the wages are:

$$\tilde{X}_i(w_i, w_j) = \begin{cases} 0, & \text{if } w_i - w_j \geq \frac{t(1-w_j)}{1+t+\gamma} \\ \frac{1-w_i}{1+t+\gamma}, & \text{if } w_j - w_i \geq \frac{t(1-w_i)}{1+t+\gamma} \\ \frac{t - w_i(1+t+\gamma) + w_j(1+\gamma)}{t(2+t+2\gamma)}, & \text{otherwise} \end{cases}$$

Given $\tilde{x}$ and $\tilde{X}_i$ we can calculate the payoffs. The reduced profit function of the manufacturer is denoted by $\tilde{R}^M(w_1, w_2) = 2\tilde{x} \cdot (1 - \tilde{x} - \gamma\tilde{x}) - C(2\tilde{x}, w_1, w_2)$ and that of supplier i by $\tilde{L}_i(w_1, w_2) = w_i \cdot \tilde{X}_i(w_1, w_2)$.

3.3 Unions-Firm Bargaining with Production Shifting

In the first stage of the game the merged firm bargains simultaneously with the two unions. If the firm reaches agreements with both unions then its payoff equals $\tilde{R}^M(w_1, w_2)$, while union i gets $\tilde{L}_i(w_1, w_2)$. We assume that the merged firm can fully shift production between its plants, i.e., it can produce both brands at both plants even if it fails reaching an agreement with union i.

Suppose that the manufacturer does not find an agreement with union 1. Then the total production of goods 1 and 2 equal $x_1 = x_{1j}$ and $x_2 = x_{2j}$. The firm's optimal production levels which maximize its disagreement profit $(1 - x_1 - \gamma x_2)x_1 + (1 - x_2 - \gamma x_1)x_2 - (x_1 + x_2)w_2 - \frac{t}{2}(x_1 + x_2)^2$ can be determined from the first-order conditions and are equal to

$$x_1 = x_2 = \frac{1 - w_j}{2(1 + t + \gamma)} \tag{17}$$

as long as $w_j < 1$ and $\gamma < 1$. If $w_j \geq 1$, then $x_1 = x_2 = 0$, and if the products are perfect substitutable, i.e. $\gamma = 0$, then the aggregate output X is uniquely determined and equal to $2x_1$. Concluding, the disagreement payoff if bargaining with union i fails equals

$$\tilde{R}_i^0 = \max\left\{\frac{(1 - w_2)^2}{2(1 + t + \gamma)}, 0\right\}. \tag{18}$$

The breakdown payoff (18) strictly exceeds the breakdown payoff in the case production shifting is not possible, i.e., (8), unless the two products are perfect substitutes. The symmetric Nash bargaining problem between the firm and union i can be formalized as

$$\max_{w_i} \left[\tilde{R}^M(w_i, w_j) - \tilde{R}_i^0(w_j)\right] \cdot \tilde{L}_i(w_i, w_j).$$

With integration and unrestricted production shifting, analogous to the previous subsection we obtain the following equilibrium wages and quantities

$$w^{M,W} = \frac{t}{3 + 4t + 3\gamma}, \tag{19}$$

$$x^{M,W} = \frac{3(1 + t + \gamma)}{(3 + 4t + 3\gamma)(2 + t + 2\gamma)}. \tag{20}$$

Lemma 4. *If manufacturers are merged and production shifting is possible without restrictions, then $\gamma < 1$ yields a unique equilibrium where quantities are given by (20).*

If $\gamma = 1$, the aggregate supply of the non-differentiated products is uniquely determined as $2x^{M,W}$.

The merged firm's profit in the equilibrium is equal to

$$R^{M,W} = \frac{9(1+\gamma+t)^2}{(2+2\gamma+t)(3+3\gamma+4t)^2}, \tag{21}$$

while each union gets wage bill equals

$$L^{M,W} = \frac{3t(1+\gamma+t)}{(2+2\gamma+t)(3+3\gamma+4t)^2}. \tag{22}$$

3.4 Comparison of the results

In this subsection, we compare the equilibrium outcomes by a merger which enables production shifting with the pre-merger case and the benchmark case where a merged firm cannot shift production.

A merger which gives the opportunity to shift production increases the firms' bargaining position against the unions. As a result, the bargaining process yields the equilibrium wages (19) which are strictly below the pre-merger wages (4). Moreover, as long as goods are no perfect substitutes, a merged firm which can shift production between the plants negotiates strictly lower wages than a merged firm without this ability, i.e., $w_i^{M,W} < w_i^M$ for any $\gamma < 1$. If the products are identical, i.e., $\gamma = 1$, the ability to shift production does not affect the equilibrium wages. Intuitively, the ability to shift production between the plants increases the merged firm's bargaining power and therefore exerts downward pressure on the equilibrium wages as long as goods are heterogeneous. If products are identical, the ability to shift production does not add an instrument for the merged firm such that the cases are indistinguishable and equilibrium wages are equal.

Equilibrium quantities are affected through a merger which allows to shift production as follows. If the products are close substitutes, i.e., $\gamma \in [\sqrt{13}-3, 1] \approx [0.61, 1]$, then the post-merger outputs are lower than the pre-merger equilibrium quantities, such that a merger which allows for production shifting decreases consumers surplus. This effect is grounded in the merged firm's market power: similar to Cournot markets with homogeneous products the equilibrium outputs are lower under a monopoly than under a duopoly. If the two brands are close to independent, i.e., $\gamma \in [0, 0.25]$, then the opposite holds. A merger which allows for production shifting increases the equilibrium outcomes and therefore consumers surplus. This effect is grounded in the merged firm's strong outside option, which exerts downward pressure on input prices and therefore spurs production as opposed to the pre-merger case. The concentration of market power through a merger is less important in this scenario as (close to) independent goods imply that in the pre-merger case both markets were also (nearly) monopolized. For the intermediate cases, i.e., $\gamma \in (0.25, \sqrt{13} - 3)$, the effect of a merger which allows for production shifting on consumer surplus is ambiguous. While merging increases market power and tends to harm consumers, production shifting enhances the manufacturer's bargaining power vis-a-vis the supplier, which reduces equilibrium wages and therefore enhances output. Which of these effect dominates depends on the capacity constraint parameter $t = t(\gamma)$ with

$$\bar{t}(\gamma) = \frac{4(1-\gamma^2) - 3\gamma(3 - \sqrt{5 - 4\gamma})}{2(4\gamma - 1)}.$$

which indicates the costs of production shifting. If t is rather low, i.e., $t < \bar{t}(\gamma)$, then production shifting is inexpensive such that the second effect outweighs the first effect and the merger enhances consumer surplus. If, however, t is rather large, i.e., $t > \bar{t}(\gamma)$, then the former effect dominates the latter such that the merger stifles joint output and consumer surplus.

Note that the threshold value $\bar{t}(\gamma)$ is a decreasing function of the product differentiation parameter $\gamma \in (0.25, \sqrt{13} - 3)$. While a higher substitutability between the products enhances the concentration of market power which is induced by a merger, a lower convexity parameter tends enhance the manufacturer's bargaining power, to decrease input prices and to raise outputs. Therefore, the consumer surplus-lowering effect of a larger substitutability between the products can be counterbalanced by a lower t

Next, we compare the manufacturer's profits between the different scenarios. Note first that as long as $\gamma < 1$, the equilibrium wages are lower, the equilibrium output levels are larger and therefore also the profit level is larger for the merger which allows for production shifting compared to the merger which does not. If $\gamma = 1$, the merger types are indistinguishable such that wages, quantities and profits are identical. Second, if production shifting is feasible, then the post-merger wages are lower than the pre-merger wages and the merged firm's equilibrium profit exceeds the joint profit of the two independent firms.

Proposition 1 (Effects of a merger on equilibrium outcomes if production shifting is feasible)

i) *A merger which allows for production shifting decreases the wage rates, i.e.,* $w_i^{M,W} < w_i^*$, for $i \in \{1, 2\}$.

ii) *A merger which allows for production shifting has ambiguous effects on the equilibrium quantities which depend on the degree of product differentiation,* γ*, and the capacity constraint of the plants,* t*. If the goods are close substitutes,* $\gamma \in [\sqrt{13} - 3, 1]$, *then the merger strictly decreases outputs for any positive value of* t*. If the goods are close to independent,* $\gamma \in [0, 0.25]$*, then the merger strictly increases outputs for any positive value of* t*. For the intermediate cases,* $\gamma \in (0.25, \sqrt{13} - 3)$*, the merger strictly decreases (increases) the output if the cost parameter is above (below) a threshold value* $\bar{t}(\gamma)$ *which is a function of the product differentiation parameter. The merger does not affect the output if the cost parameter equals* $\bar{t}(\gamma)$*.*

iii) *If the goods are not perfect substitutes, then the post-merger profit is higher if product shifting is possible than if it is not. Else, profits are the same under both merger cases. If the goods are related, i.e.,* $\gamma > 0$*, then the merged firm's profit strictly exceeds the firms' joint pre-merger profits. If the goods are independent, then the merged firm's profit equals the firms' joint pre-merger profit.*

Finally, we compare the social welfare outcomes in the different scenarios. Note that in each scenario. $x := x_1 = x_2 = X_1 = X_2$ holds in equilibrium. Then, social welfare SW is a function of the equilibrium quantity x, the product substitutability γ and the cost convexity t. In particular,

$$SW(x, \gamma, t) = 2\left((1 - (\gamma + 1)x)x + \frac{1}{2}x^2 - \frac{t}{2}x^2\right) = 2x - (t + 2\gamma + 1)x^2. \quad (23)$$

Straightforward calculations yield the following corollary which shows that consumer surplus and social welfare are aligned.

Manufacturer's profit	equilibrium wage	equilibrium quantity
$R^* = \frac{9(2+t)^3}{2(2+\gamma+t)^2(8-\gamma+4t)^2}$	$w_1^* = w_2^* = \frac{2+t-\gamma}{8+4t-\gamma}$	$x_1^* = x_2^* = \frac{3(2+t)}{(2+t+\gamma)(8+4t-\gamma)}$
$R^M = \frac{9(2+t)^2}{4(2+2\gamma+t)(4-\gamma+2t)^2}$	$w_1^M = w_2^M = \frac{2+t-2\gamma}{2(4+2t-\gamma)}$	$x_1^M = x_2^M = \frac{3(2+t)}{(8+4t-2\gamma)(2+t+2\gamma)}$
$R^{M,W} = \frac{9(1+\gamma+t)^2}{(2+2\gamma+t)(3+3\gamma+4t)^2}$	$w^{M,W} = \frac{t}{3+4t+3\gamma}$	$X_1 = X_2 = x^{M,W} = \frac{3(1+t+\gamma)}{(3+4t+3\gamma)(2+t+2\gamma)}$

Table 1: *An overview of the equilibria in the different scenarios.*

Corollary 1.(Effects of a merger on social welfare if production shifting is feasible)

i) *A merger which does not allow for production shifting decreases total welfare if the products are not independent and does not change total welfare if the products are independent.*

ii) *A merger which allows for production shifting has ambiguous effects on total welfare. If the goods are close substitutes,* $\gamma \in [\sqrt{13} - 3, 1]$*, then the merger strictly* *decreases total welfare for any positive value of t. If the goods are close to independent, $\gamma \in [0, 0.25]$, then the merger strictly increases total welfare for any positive value of t. For the intermediate cases, $\gamma \in (0.25, \sqrt{13} - 3)$, the merger strictly decreases (increases) total welfare if the cost parameter is above (below) a threshold value $\bar{t}(\gamma)$. The merger does not affect total welfare if the cost parameter equals $\bar{t}(\gamma)$.*

iii) *If the goods are not perfect substitutes, then total welfare is higher if product shifting is possible than if it is not. Otherwise, total welfare is the same under both merger cases.*

Our results can be used to gain interesting further insights into the effects of downstream mergers. If firms 1 and 2 which are asymmetric with respect to their efficiency t, then wages are further lowered at the inefficient plant. This is driven by the fact that the threat of shifting production to the efficient plant improves the inefficient manufacturer's bargaining position significantly, whereas the threat point of shifting production from the efficient to the inefficient plant cannot improve the manufacturer's bargaining position by much. Therefore, it is especially the inefficient firm which has an incentive to search for merging partners.

4 Extensions - Production shifting and FDI

In this section, we study a firm's incentives to invest in a foreign country in the presence of country-specific labor unions. In Section 4.1, we assume that a firm can open a new plant in order to produce a differentiated product. We analyze under which conditions the firm invests in the domestic and under which it invests in a foreign country. Hereby, we distinguish two cases depending on the firm's production shifting ability. In Section 4.2, we assume homogeneous products, but heterogeneous bargaining power of the country-specific unions and analyze firm's FDI incentives.

4.1 Domestic vs. Foreign Investments

Suppose a manufacturer produces one product at a domestic plant with inputs it receives through a bilateral relation with a supplier. We analyze the following three stage game. In the first stage, the manufacturer can make an investment to open a new production plant to produce a differentiated product. There is a fixed investment cost H for opening a new plant in the home country and a fixed cost $F > H$ for opening the plant in a foreign country. In the second stage, the manufacturer bargains for each of its plants with the country-specific input supplier(s). If it did not open a new plant at the first stage, then it bargains with the domestic input supplier over the input price w_1. If it invested in the home country, it bargains with the domestic union over the input prices w_1 and w_2, where w_i is the input price at plant i. If it invested in the foreign country, it bargains simultaneously with the domestic supplier over input price w_1 and the foreign supplier over input price w_2. In the third stage, the firm produces the products and sells them in the final integrated market.

The demand and cost specifications are as in the previous sections. The manufacturer transforms one unit of each input to the one unit of the output. The total production cost of the firm at plant i equals $c_i = (w_i + t \cdot X_i/2) \cdot X_i$, where X_i is the total production at plant i. The inverse demand for the firm's product i is given by $p_i = 1 - x_i - \gamma x_j$, where x_i, $i \in \{0, 1\}$, denotes the total output of product i and $0 \leq \gamma \leq 1$ denotes the products' substitutability. The firm can produce in a country only if it reached an agreement with the monopolistic supplier in that country.

As before, we distinguish between two scenarios. In the first case, the products are plant-specific, i.e., product i can only be produced at plant i. In the second scenario, production shifting is feasible and both brands can be produced at both plants. Depending on the firm's investment decision at the first stage, we analyze all three sub-games separately via backward induction. Next, we compare the equilibrium profits to determine the optimal investment decision for the firm. Finally, we compare social welfare levels under the different scenarios.

If the manufacturer does not invest at the first stage, we indicate equilibrium outcomes with index ^{S}, if it invests in the home country we index outcomes with ^{H}, and if the firm invests a foreign country we use index ^{F}. The additional index ^{W} means that production shifting is feasible.

If the manufacturer decides not to invest, then it owns a single plant only. In the last stage of the game, it maximize its profit $R^S = (1 - x_1)x_1 - (w_1 + t \cdot x_1/2) \cdot x_1$ for a given wage rate w_1. Thus, the optimal production level equals $\hat{x}_1(w_1) = (1 - w_1)/(2 + t)$, if $w_1 < 1$ and $\hat{x}_1(w_1) = 0$ otherwise. In the second stage, the firm bargains with the union over the wage w_1. If the firm reaches an agreement with the union then it makes profit $\hat{R}^S(w_1) = (1 - \hat{x}_1(w_1))\hat{x}_1(w_1) - (w_1 + t \cdot \hat{x}_1(w_1)/2) \cdot \hat{x}_1(w_1)$, while the supplier gets payoff equal to $\hat{L}^S(w_1) = w_1 \hat{x}_1^S(w_1)$. In the case of a disagreement both players get payoff zero. We can formalize the symmetric Nash bargaining as

$$\max_{w_1} \hat{R}^S(w_1) \cdot \hat{L}^S(w_1). \tag{24}$$

The equilibrium wage rates maximizes the Nash product and equals $w^S = 1/4$. Given the equilibrium wage rates, the firm's equilibrium output is $x^S = 3/(8 + 4t)$, and profit is $R^S = 9/(64 + 32t)$, while the supplier earns $L^S = 3/(32 + 16t)$.

Next, we assume that the firm invests $H > 0$ and opens a new plant in the home country to produce a differentiated product. As suppliers are country-specific, the firm bargains with the same supplier at both plants. Therefore, the ability to shift production across plants does not play a role in the bargaining process and the equilibrium outcomes are the same if shifting is possible and if it is not. Consequently, without loss of generality, we assume that products are plant-specific.

In the final stage, the manufacturer chooses x_1 and x_2 to maximize its profit,

$$R^H(x_1, x_2, w_1, w_2) = \sum_{i,j\in\{1,2\},i\neq j} [(1 - x_i - \gamma x_j)x_i - (w_i + t \cdot x_i/2) \cdot x_i] - H.$$

The optimal production levels are given by (16). In the second stage, the firm negotiates both input prices with the same supplier in the home country. If the firm can reach an agreement with the union then it earns a profit of

$$\hat{R}^H(w_1, w_2) = R^H(\hat{x}_1(w_1, w_2), \hat{x}_2(w_1, w_2), w_1, w_2),$$

while the union earns $\hat{L}^H(w_1, w_2) = w_1\hat{x}_1(w_1, w_2) + w_2\hat{x}_2(w_1, w_2)$. In the case of disagreement, both the firm and the union get a payoff of zero. Therefore, the firm and the union maximize the Nash product

$$\max_{w_1,w_2} \hat{R}^H(w_1, w_2) \cdot \hat{L}^H(w_1, w_2). \tag{25}$$

The equilibrium wage levels which solve (25) are given by $w_1^H = w_2^H = 1/4$. In equilibrium, the manufacturer produces $x_1^H = x_2^H = 3/(8 + 4t + 8\gamma)$ and gets profit $R^H = 9/(32 + 16t + 32\gamma) - H$, while the supplier earns $L^H = 3/(16 + 8t + 16\gamma)$.

Lemma 5. *For any $\gamma \in [0, 1]$ and for any $t > 0$, there is a $H^C > 0$ such that the manufacturer will not invest in the home country if $H > H^C$. In contrast, it earns a strictly higher profits if it invest in the home country as long as $H < H^C$.*

If the firm invests F and opens a new plant in a foreign country, then the analysis of the production and the bargaining stages are the same as in Section 3.1 and Section 3.2, depending on the possibility of the production shifting. If the manufacturer cannot shift production, the equilibrium wages, outputs and union profits are given by (9), (10) and (12). If shifting is feasible, then the equilibrium is characterized by (19), (20) and (22). The manufacturer's profit equals $R^F = R^M - F$ if production shifting is not possible and $R^{F,W} = R^{M,W} - F$ if production shifting is possible.

Lemma 6.

i) *If production shifting is not feasible, then for any* $\gamma \in (0,1]$ *and for any* $t > 0$, *there is a positive* $F^C > H^C$ *such that the manufacturer will not invest in the foreign country if* $F > F^C$. *If* $\gamma = 0$, *then* $F^C = H^C$. *The firm earns a strictly higher profits if it invest in the foreign country as long as* $F < F^C$.

ii) *If production shifting is feasible, then for any* $\gamma \in [0,1)$ *and for any* $t > 0$, *there is a positive* $F^{C,W} > F^C$, *such that the firm who can shift the production will not invest in the foreign country if* $F > F^{C,W}$. *If* $\gamma = 1$, *then* $F^{C,W} = F^C$. *The firm earns a strictly higher profits if it invest in the foreign country as long as* $F < F^{C,W}$

Given the results in Lemma 4 and Lemma 5, we can summarizes the firm's investment incentives in the first stage as in the following proposition. Therefore, we define the threshold values $D := \frac{9}{16}\frac{\gamma}{(4t+-\gamma+4)^2}\frac{4t-\gamma+8}{t+2\gamma+2}$ and $D^W := \frac{9}{16}\frac{\gamma+1}{(4t+3\gamma+3)^2}\frac{8t+7\gamma+7}{t+2\gamma+2}$.

Proposition 2.(Domestic vs. foreign investments)

i *If production shifting is not feasible, the manufacturer invests in the foreign country if* $F < F^C$ *and* $F - H < D$. *It invests in the home country if* $H < H^C$ *and* $F - H > D$. *Otherwise, it does not open a second plant.*

ii *If production shifting is feasible, then the manufacturer invests in the foreign country if* $F < F^{C,W}$ *and* $F - H < D^W$. *It invests in the home country if* $H < H^C$ *and* $F - H > D$. *Otherwise, it does not open a second plant.*

There are different incentives for a firm to open a new plant. First of all, if $\gamma < 1$, the firm introduces a new differentiated product in the second plant and thereby increases overall demand. Second, a new plant reduces production costs as plants' production functions are convex and as the overall production quantity can be optimally split among the plants. Third, if the firm makes a foreign direct investment, then it improves its bargaining position vis-a-vis the country specific unions and reduces input prices. Note that this effect is absent for domestic investments. Lemma 5 and Proposition 2 also imply that a firm's investment incentives are even higher if production shifting is possible. Therefore, for the manufacturer it is desirable to design a new product such that it can be produced at various plants.

Note that threshold value D is increasing in γ, i.e., $\partial D/\partial\gamma > 0$. If production shifting is not possible, a foreign investment is especially desirable if the goods are substitutes as this strengthens the firm's bargaining position by increasing its breakdown profit. If goods are complements, however, threshold value D is rather low as foreign investments cnnot improve the firms bargaining power by much, such that the difference in profitability between foreign and home investments vanishes. Note furthermore that foreign investments raise the manufacturer's breakdown profit for all γ if production shifting is feasible, such that the threshold value D^W is not monotonic in γ.

Finally, we investigate the effects of FDI on domestic social welfare SW^D which is defined as the sum of domestic firms' profits, domestic unions' wages the domestic consumer's surplus. Hereby, we abstract from the investment costs F and H and assume that half of the consumers are domestic consumers, i.e., consumer surplus equals $x^2/4$. Then, social welfare after opening a new plant in the home country equals $SW^{D,H} := 2x(1-\gamma x-x)-tx^2+x^2/4$ where x denotes the quantity which is produced at both plants, while under FDI the domestic social welfare is given by $SW^{D,F} := 2x(1-\gamma x - x)-tx^2+x^2/4-wx$, where x is the equilibrium quantity and w is the wage paid by the domestic firm to workers in the foreign country. If production shifting is not feasible, then domestic social welfare is always lower if the firm invests in a foreign country instead of at home. While foreign investments cannot enhance the firm's bargaining position by much, wages paid to foreign workers diminish domestic social welfare. If production shifting is feasible, however, the effect of FDI on domestic social welfare depends on firms' capacity constraint t. For small t, foreign investments enable the firm to shift a large share of its output rather cheaply, such that the firm and consumers benefit from lower input prices. If the downward pressure on input prices is rather low, i.e., if t is very large or if t is at an intermediate level, but goods are rather independent, then domestic social welfare suffers from FDI due to the wages paid to foreign workers. Figure 1 illustrates the difference in domestic social welfare $\Delta SW = SW^{D,F} - SW^{D,H}$ as a function of γ for three different values of t if production shifting is feasible.

Our results can be used to gain insights into the effects of mergers in related scenarios. Suppose, for instance, that domestic and foreign firms, which get inputs from their plant-specific suppliers, offer differentiated products and compete in oligopolistic fashion. Then, mergers of domestic firms can increase domestic social welfare if the merged firms can enforce lower input prices and thereby steal market shares of their foreign competitors.

4.2 Foreign Investments Under Asymmetric Bargaining

So far, we have assumed that countries are symmetric. In this chapter, however, we suppose that unions differ between countries with respect to their bargaining power. Indeed, labor organizations are more professional in Western European countries, compared to those in Eastern Europe. We investigate the effects of such bargaining power on foreign direct investments (FDI) and on equilibrium wages if a domestic firm can

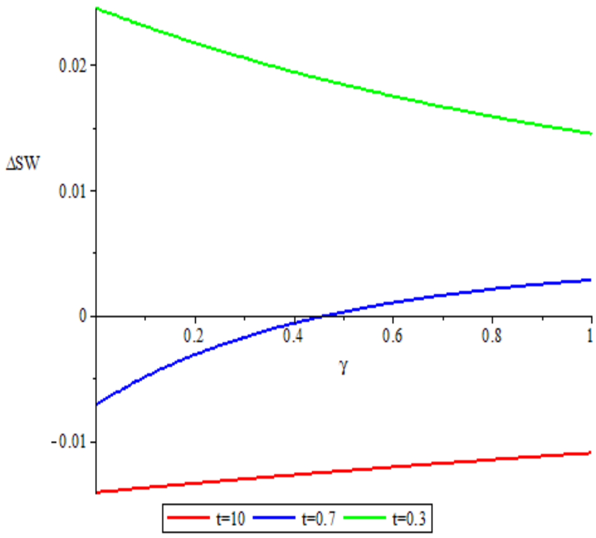

Figure 1: The effects of FDI vs. home investment on domestic welfare.

decide to invest in a country where workers' organization is weaker.

Our analysis yields the interesting result that a domestic union's high bargaining power may result in particularly low wages for the domestic workers. If a firm faces a powerful union, it has higher incentives to invest in production plants abroad. Such investments, however, were unprofitable if labor organization was weaker in the domestic country. Such investments, however, strengthen the bargaining position of the domestic firm via-a-vis the domestic union. The production plant in the foreign country gives the firm a better outside option such that it can negotiate wages which are lower, compared to the situation in which Nash bargaining is symmetric (i.e., in which the firm and the domestic union have the same bargaining power).

Our analysis proceeds as follows. A party's bargaining power can be measured via the exponent with which this party's objective enters the Nash product. Let R denote the firm's profits and L the overall wage bill of workers in the respective country. Whereas bargaining in the foreign country is symmetric, i.e., the parties maximize $\max_w R \cdot L$, we say that the domestic firm has bargaining power $\alpha \in [0,1]$ if the parties maximize $\max_w R^{1-\alpha} \cdot L^{\alpha}$.

In the benchmark case, we investigate the equilibrium outcomes if the firm bargains exclusively with the domestic union. Analogous computations to the previous subsection yield that the parties agree on wage $w^{S,\alpha} = \alpha/2$ and output $x^{S,\alpha} = (2-\alpha)/(4+2t)$. The firms makes profit $R^{S,\alpha} := (1-x^{S,\alpha})x^{S,\alpha} - (w^{S,\alpha} + tx^{S,\alpha}/2)x^{S,\alpha}$, while the worker's wages amount to $L^{S,\alpha} = x^{S,\alpha} \cdot w^{S,\alpha}$. Note that firm's profit is strictly monotonic decreasing in α, while the union's wage bill is increasing in α.

Second, we determine equilibrium wages and output levels if the manufacturer invests in a second production plant in a foreign country. Whereas the domestic firm has a high bargaining power, the firm has a higher breakdown profit than in the benchmark case which allows the manufacturer to hold wages low. Straightforward computations yield that the domestic workers get wage $w_1^{F,\alpha} = (2t\alpha + 5\alpha)t/(4t^2 + 16t - 2\alpha + 16)$ and produce $X_1^{F,\alpha} = (2t + 5)(a + 2)(2 - \alpha)/((2t^2 + 8t + 8 - \alpha)(8 + 2t))$, while foreign workers earn $w_2^{F,\alpha} = t(t + \alpha + 2)/(4t^2 + 16t - 2\alpha + 16)$ and produce $X_2^{H,\alpha} = 3(t + 2)(t + \alpha + 2)/((2t^2 + 8t + 8 - \alpha)(2t + 8))$. The manufacturer earns $R^{H,\alpha} := (1 - X_1^{F,\alpha} - X_2^{F,\alpha})(X_1^{F,\alpha} + X_2^{F,\alpha}) - X_1^{H,\alpha}(w_1^{F,\alpha} + tX_1^{F,\alpha}/2) - X_2^{F,\alpha}(w_2^{F,\alpha} + tX_2^{F,\alpha}/2)$ and the domestic union gets $L^{H,\alpha} = w_1^{H,\alpha} \cdot X_1^{H,\alpha}$.

The firm's maximum investment is given by the difference of firm's profits $F^C(\alpha) := R^{F,\alpha} - R^{S,\alpha}$. The firm's willingness to pay for a foreign direct investment is strictly monotonic increasing on $\alpha \in [0, 1]$. Consequently, a domestic union which has a high bargaining power may render FDI profitable.

Given the manufacturer has opened a new plant in the foreign company, then the domestic workers earn, compared to the benchmark scenario, strictly less for all $\alpha \in (0, 1]$, both in terms of wages, i.e., $w^{S,\alpha} - w_1^{H,\alpha} > 0$ for all $\alpha \in (0, 1]$ as in terms of total wage bills, i.e., $L^{S,\alpha} - L^{H,\alpha} > 0$ for all $\alpha \in (0, 1]$. For $\alpha = 1$, wages and total wage bills are identical in the two scenarios.

Consider the following game. Let $\alpha \in [0, 1]$ denote the domestic union's bargaining power and $F > 0$ denote the costs of a foreign direct investment. The union in the foreign country has bargaining power of 0.5. At the first stage, the firm decides if to invest in the foreign country. Second, the firm bargains (simultaneously) with the union(s) over the wages $w^{*,\alpha}$. Third, the firms produce equilibrium quantities $X_i^{*,\alpha}$ at plant i. The domestic union earns a wage bill of $L^{*,\alpha} = w^{*,\alpha}X_1^{*,\alpha}$.

Proposition 3. (Prisoner's dilemma of wage bargaining)

For all $\alpha \in (0, 1]$, there is a $\varepsilon > 0$ s.t. $L^{S,\alpha-\varepsilon} > L^{H,\alpha}$. If $F^C(\alpha) > F$, but $F^C(\alpha - \varepsilon) < F$, then $L^{*,\alpha-\varepsilon} > L^{*,\alpha}$.

The first part follows from the fact that $L^{S,\alpha} - L^{H,\alpha} > 0$ for all $\alpha \in (0, 1]$, while $L^{S,\alpha}$ is continuous and decreasing in α. To see the second part note that F is strictly monotonic increasing on $\alpha \in [0, 1]$. If $F^C(\alpha) > F$ holds, then the firm will invest in the foreign country such that the domestic union gets wage bill $L^{F,\alpha}$. If the union's bargaining power, however, was only $\alpha - \varepsilon$, then the FDI does not pay off for the firm, such that the union earns $L^{S,\alpha-\varepsilon}$.

The manufacturer and the domestic union play a variant of the Prisoner's Dilemma. If the union could commit not to exert its full bargaining power, but to forego a sufficient part of it, the manufacturer would not engage in FDI and both the union and the

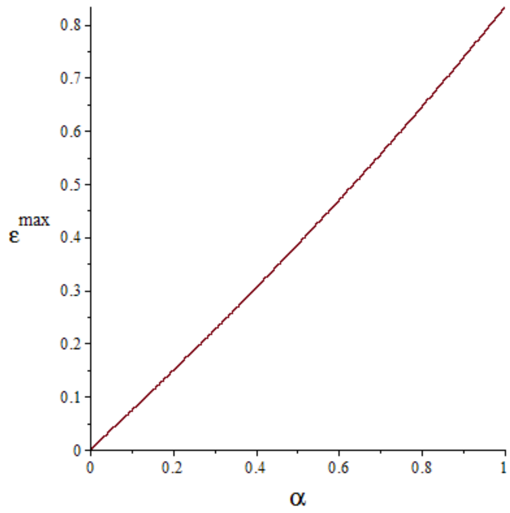

Figure 2: $\varepsilon^{\max}$ as a function of the domestic union's bargaining power α.

manufacturer could be better of. If the manufacturer, however, does not engage in FDI, the union has an incentive to deviate and exert its full bargaining power. As there is no commitment device for the union, the manufacturer anticipates that the union will use its entire bargaining power. Therefore, a marginal increase in the domestic union's bargaining power α may render FDI profitable, such that both the manufacturer's and the domestic union's payoff have a discrete drop in comparison with the benchmark scenario. If the domestic union's bargaining power had been lower in the beginning, then in certain parameter ranges the manufacturer would have had abstained from FDI and the domestic union would have realized a higher wage.

In order to investigate quantitatively how much of its bargaining power the domestic union would be willing to forego, we give an example for the case $t = 1$. The largest parameter ε for which $L^{S,\alpha-\varepsilon} > L^{H,\alpha}$ holds we denote $\varepsilon^{\max}$. Figure 2 shows that the share of bargaining power the domestic union was willing to forego strictly increases with α. For $\alpha = 0.5$, the union would be willing to accept a bargaining power of $\alpha - \varepsilon^{\max} \approx 0.11$ as long as this could prevent the firm from investing in the foreign country. For $\alpha = 1$, the union would be even willing to accept $\alpha - \varepsilon^{\max} \approx 0.17$ in order to prevent the firm from FDI. Consequently, the high bargaining power of a domestic union makes domestic workers *much worse* off if it induces the firm to FDI. Workers would be rather willing to forego most of their power in order to prevent the firm from outsourcing, in which case the union's bargaining power suffers heavily.

5 Conclusion

In this paper, we analyze how the merger and investment decisions of multi-plant firms, which receive inputs from plant-specific suppliers, depend on the ability of production shifting across plants. So far, the economic literature has focused on multi-plant and cross-border mergers where firms' products were plant-*specific*. While we analyzed such a setup in our benchmark model, in the main part we introduced the possibility of a multi–plant firm to shift the production of all brands across the plants. The benchmark may reflect a merger's short-term analysis as relocating the production of a specific brand may not be feasible in the short run. In the long run, however, such production shifting seems natural. Our analysis shows that a merger decreases input prices in general. In the benchmark case, a merger never increases consumer surplus and social welfare. But if the multi-plant firm can move its production across the plants, then a merger may increase consumer surplus and social welfare, unless the firm's products are close substitutes. In this case, the merger's monopolization effect out-weights the benefits from enforcing lower input prices.

Our findings are relevant for merger control. If antitrust authorities decide on international merger proposals, they should take into account if production shifting is feasible or not as this ability crucially impact on equilibrium welfare outcomes. The ability to shift production may be a substantial part of the merger's efficiency defense: production shifting allows the firms to countervail unions' bargaining power and therefore to increase consumer and social welfare. Without the ability to shift production, however, a merger's monopolization effects is likely to detriment welfare outcomes.

As an extension, we studied a firm's investment decision for opening a new plant. The firm has a strong incentive to design a new differentiated product either at a home or a foreign plant. Due to the improvement in bargaining power, however, a firm's incentives are typically higher for a FDI investment.

In a second extension, we investigate the scenario that domestic and foreign unions have heterogeneous bargaining power. We find that the domestic union may be strictly worse of through an increase of its bargaining power, as this may render FDI profitable, such that all players are worse off in equilibrium. The firm and the union play a variant of the Prisoner's Dilemma, which could not be overcome as long as the union cannot commit to relinquishing its strong bargaining position.

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