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Lommerud, Kjell Erik; Straume, Odd Rune; Sørgard, Lars

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**Downstream Merger with
Oligopolistic Input Suppliers**

Kjell Erik Lommerud*
Odd Rune Straume*
Lars Sørgard**

* University of Bergen

** Norwegian School of Economics and Business Administration

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ABSTRACT

Downstream Merger with Oligopolistic Input Suppliers

by Kjell Erik Lommerud, Odd Rune Straume, Lars Sørgard[*]

We examine how a downstream merger affects input prices and, in turn, the profitability of such a merger under Cournot competition with differentiated products. Input suppliers can be interpreted as ordinary upstream firms, or trade unions organising workers. If the input suppliers are plant-specific, we find that a merger is more profitable than in a corresponding model with exogenous input prices. In contrast to the received literature, we find that it can be more profitable to take part in a merger than being an outsider. For firm-specific input suppliers, on the other hand, results are reversed. We apply our model to endogenous merger formation in an international oligopoly, and show that the equilibrium market structure is likely to be characterised by cross-border merger.

Keywords: merger profitability, input suppliers, trade unions, cross-border merger
JEL classification: J51, L13, L41

ZUSAMMENFASSUNG

Nachgelagerte Fusionen mit oligopolistischen Inputanbietern

Wir untersuchen, inwiefern nachgelagerte Fusionen Inputpreise erhöhen und wie diese wiederum die Fusionen bei Cournot-Wettbewerb mit unterschiedlichen Produkten beeinflussen. Inputanbieter können als normale vorgelagerte Firmen oder als Gewerkschaften, die Arbeiter organisieren interpretiert werden. Wenn die Inputanbieter werksspezifisch sind, finden wir, daß eine Fusion profitabler ist, als in einem vergleichbaren Modell mit exogenen Inputpreisen. Im Gegensatz zur herkömmlichen Literatur finden wir, daß es profitabler sein kann an einer Fusion teilzunehmen, denn ein Außenstehender zu sein. Für firmenspezifische Inputanbieter andererseits, ist das Ergebnis umgekehrt. Wir wenden unser Modell auf endogene Fusionsformierung in einem internationalen Oligopol an und zeigen, daß die Gleichgewichtsmarktstruktur wahrscheinlich durch grenzüberschreitende Fusionen gekennzeichnet ist.

1   Introduction

It is often claimed that downstream mergers affect not only output prices, but also input prices. For example, empirical literature suggests that mergers may affect wages, one of the most important inputs to production (see e.g. Peoples *et al.*, 1993, and McGuckin *et al.*, 1995). Despite this evidence, the theoretical literature on mergers does not investigate any possible links between mergers and wages or input prices more in general.[1] It is mainly concerned with how a merger affects the rivalry between firms in the downstream market. The purpose of this paper is to help filling this gap by analysing mergers in a setting with oligopolistic input suppliers.

It is not clear-cut how a downstream merger affects the input supplier structure. In some instances it may lead to a merger between the merging firms' input suppliers as well. For example, the two merging downstream firms' trade unions may merge into one trade union after the merger. We characterise this as firm-specific input suppliers. In other instances the input suppliers are plant-specific and thereby do not merge as a response to the downstream merger. This could be the case if the upstream firms are traditional input suppliers of other factors than labour, or if the downstream merger is a cross-border merger and each trade union continues as a trade union for a plant in each country. We show that the input supply structure - whether input suppliers are plant- or firm-specific - is decisive for the input price responses, and thus the profitability, of a downstream merger.

In a seminal paper, Salant, Switzer and Reynolds (1983) show that in a Cournot oligopoly with homogeneous goods, linear demand and constant marginal costs, a merger is unprofitable unless the merging coalition consists of more than 80 per cent of all firms in the industry. More recent studies have shown how a relaxation of some of the

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[1]There are a few notable exceptions. González-Maestre and López-Cuñat (2001) analyse merger in a homogeneous Cournot model where each owner delegates output decisions to a manager. The manager's incentive scheme, which is endogenous in the model and thereby affected by a merger, can be regarded as an input price. Since the incentive scheme is set by the owner, their setting is distinctly different from ours where we have independent input suppliers that set input prices. In Bárcena-Ruiz and Garzón (2000) a merger affects wage setting. However, they analyse a merger from duopoly to monopoly. Horn and Wolinsky (1988a) apply a bargaining model to analyse a merger from duopoly to monopoly, either upstream (unions) or downstream (firms) merger. Our approach is different in several ways, though. Horn and Wolinsky consider downstream merger only in the case of a single upstream input supplier. For our purposes, this turns out to be the least interesting case. Furthermore, since we are concerned about the well known free rider problem in the merger literature, we apply a model which includes a non-merging firm.

assumptions in Salant *et al.* (1983) may restore the perhaps more intuitive result that mergers are most often profitable. Predictions from theory are that a merger without any cost savings is typically profitable under Bertrand competition, and typically unprofitable under Cournot competition unless products are sufficiently differentiated.[2]

More clear-cut is the theory's prediction concerning the insiders' versus the outsiders' gain from a merger. As far as we know, no studies find that it is more profitable to be one of the merging firms than to be one of the non-merging firms unless there are some exogenous cost savings following a merger.[3] One could then argue that each firm should wait, hoping that other firms merge and then be a free rider on such a merger.[4]

Our model is in much the same spirit as Salant *et al.* (1983). We apply a Cournot model of differentiated products.[5] The results in the literature are reproduced in a benchmark version of our model, where the firms' input prices - which can be wages or prices on other input factors - are exogenous.

In the model, there is only one input to production and it is supplied by an independent input supplier.[6] As is common in models of vertical relations, we assume that the upstream input suppliers set prices prior to the Cournot subgame in the downstream market. If the input supplier is an ordinary firm, it maximises profits. However, the input supplier might instead be a trade union that is concerned about both wages and employment. Profit maximisation by a firm would be analogous to rent maximisation by a trade union, one particular kind of trade-off between wages and employment. We choose a maximisation problem for the input supplier that includes a parameter capturing the trade-off between wages

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[2]Concerning product differentiation, see Deneckere and Davidson (1985) and Lommerud and Sørgard (1997); concerning the cost side, see Perry and Porter (1985) and McAfee and Williams (1992); concerning the nature of competition, see Deneckere and Davidson (1985).

[3]A referee has drawn our attention to Creane and Davidson (2000). In this paper, a merged firm retains the original firms as divisions with some autonomy. The headquarter can stage a Stackelberg quantity setting game among the divisions, and this can lead to profitable mergers with insiders benefitting more than outsiders. A quite parallel research effort is Huck, Konrad and Müller (2001).

[4]This free rider problem was first pointed out in Stigler (1950). Fridolfsson and Stennek (2000) show that this mechanism may delay a merger rather than prevent it completely.

[5]It can be shown that our results are valid also for the case of Bertrand competition and differentiated products, see Lommerud, Straume and Sørgard (2000).

[6]In Farrell and Shapiro (1990a, 1990b) and Perry and Porter (1985) there are also cost effects of a merger. While in our model the cost effect is due to changes in input prices, the cost effects in their models are due to internal costs savings.

and employment, which implies that a profit maximising input supplier can be treated as a special case.[7] It should be noted that the case of a trade union that emphasise employment considerations, is parallel to the case of a non-profit-maximising firm that puts much weight on sales.

We distinguish between three different ways to organise the supply of input: the input suppliers can either be plant-specific, firm-specific or industry-specific. In the latter case all the input suppliers in the industry are organised in a single firm, which in the case of trade unions can be interpreted as one trade union for the entire industry. The single input supplier is then not only a monopolist in the input market, but a back-seat monopolist in the product market as well. A merger is irrelevant for upstream price setting in such a context, because what matters is the elasticity of product market demand, which is not affected by a downstream merger. The results from the standard literature still apply.

Our main focus is on the case of plant-specific input suppliers, which dramatically changes the results from the benchmark model. A plant-specific input supplier delivers its input to one plant only. In this case a merger between two firms does not change the number of input suppliers, but it changes the rivalry between them. The two merged firms' input suppliers compete more fiercely on input prices to serve the merged firm. We find that, in contrast to the standard literature, a merger is now profitable. The exception is the case where the input supplier is a trade union with strong preferences for employment. A highly employment-oriented union would imply that wages are close to the competitive level initially, so that a merger has only a limited effect on wages.

We show that the merging firm's input prices are always lower than the non-merging firms' input prices. Due to this a merger can be more profitable for a merging than for a non-merging firm. The exception is, again, the case where the input suppliers are trade unions with a sufficiently strong emphasis on employment. In such a case the merger has only limited effects on wages, and the traditional result about merger in Cournot oligopoly applies.

If the input suppliers are firm- rather than plant-specific, our results are reversed. In the case of firm-specific input suppliers, a merger between two firms implies that the merging firms' input suppliers also merge. One natural interpretation would be that the input suppliers are trade unions within a country, and the trade unions merge when the firms merge so there is only one trade union per firm. We then have a

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[7]By letting the input supplier set prices, we have *de facto* applied a monopoly union model in the cases where the input suppliers are trade unions. It can be shown that our results are valid also in a setting with an efficient bargaining model rather than a monopoly union, see Lommerud, Straume and Sørgard (2000).

higher concentration in the input market, which reduces the rivalry between the input suppliers. In this case a merger results in higher input prices, and more so for the merging firms than for the non-merging firm. Not surprisingly then, a merger is now less profitable than in the case with exogenous input prices. In this case a merger is unprofitable under Cournot competition unless the products are highly differentiated and the input suppliers are trade unions with an extremely strong emphasis on employment. Since input prices increase more for the merging than the non-merging firms, an outsider earns more from a merger than a participant. Thus, the traditional result in the literature is restored in this respect.

We also apply our model to endogenous merger formation. A firm can merge with either another domestic firm or a foreign firm. Given that the input suppliers are trade unions, we argue that a domestic downstream merger may lead to union merger as well, whereas a merger between a domestic and a foreign firm would not lead to such a union merger. By applying the approach introduced in Horn and Persson (2001) we show that, for a large set of parameter values, the equilibrium market structure is cross-border merger. The reason is that such a merger would reduce rents among the input suppliers, while a domestic merger would have the opposite effect.

The paper is organised as follows. In the next section we present the model, with a benchmark for comparison. In Section 3 we investigate downstream merger with plant-specific input suppliers, while we in Section 4 analyse how our results change if we have either firm-specific or industry specific input suppliers. In Section 5 we apply the model to endogenous merger formation, and in Section 6 we discuss some extension of our model. We offer some concluding remarks in Section 7.

2 Some preliminaries

Consider an oligopoly industry that consists of three firms, each producing one brand of a differentiated product. Let firm i produce brand i in quantity q_i. There is no entry or threat of entry, and firms compete in a Cournot fashion. For the moment we assume that firms 1 and 2 are the merger candidates. Later on, we allow for endogenous merger formation. We assume that the merged firm continues to produce two brands (1 and 2), making it 'larger' than either of the pre-merger firms. The outsider (firm 3) continues to produce one brand (3). Let us here first show the results found in a benchmark model with exogenous input prices, and then introduce endogenous input prices.

A benchmark

Demand for the differentiated product is characterised by a symmetric demand system, where the inverse demand function for brand 1 is given by

$$p_1 = 1 - q_1 - b(q_2 + q_3) \qquad (1)$$

with a corresponding structure for the inverse demand functions for the other brands. The parameter $b \in \langle 0, 1 \rangle$ is a measure of substitutability in demand. If $b \rightarrow 0$ the brands are regarded as (almost) unrelated, whereas $b \rightarrow 1$ corresponds to the case of (almost) homogeneous goods.

There is only one factor of production, and one unit of input is supplied to the downstream firm at a price w. We assume that the input supply from different input suppliers is homogeneous and that different brands are produced by using the same production technology, so that the only factors that ties a certain brand to a firm are patent rights or sunk marketing investments.

We adopt a very simple linear production function, given by

$$q_i = l_i \qquad (2)$$

where q_i is total quantity produced (of brand i) by firm i, and l_i is the total amount of input employed by firm i. In this case, output and input are equivalent.

As a benchmark for later comparison, consider the following result:

Lemma 1. *If input prices are exogenous and equal across firms, a downstream merger is profitable if $b < 0.55$, and more profitable for the outsider than for a participant.*

Proof. Results follow directly from Lommerud and Sørgard (1997). ∎

An outsider's best response to a reduction in sales by the merging firm is to *increase* its sales, thereby reducing the profitability of a merger. As shown in Salant *et al.* (1983), for the case of homogeneous products, the effect of the outsiders' response may dominate so that a merger is unprofitable. However, each outsider's response is dampened if products are differentiated. This explains why merger can be profitable under Cournot competition if products are sufficiently differentiated.[8]

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[8]Note that the benchmark for our analysis is *not* a Salant *et al.* (1983) type of model, where merger only leads to one firm disappearing, but a Lommerud and Sørgard (1997) type of model where a merged firm is 'larger' than other firms because it now controls two brands. There is a close parallel to Baye, Crocker and Ju (1996).

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Irrespective of the nature of competition, the outsider will be a free rider on the merger. It will experience higher prices *and* higher sales. It will therefore gain more from the merger than the insiders, who experience a reduction in sales.

The upstream market

We model the upstream market in such a way that input suppliers can be interpreted as either traditional profit maximising firms, or as trade unions that maximise union welfare. The most convenient way is to model the input supplier as a trade union, and then treat the profit maximising firm as a special version of the utility maximising trade union. For the moment then, let us consider the trade union. We assume that wages are unilaterally set by monopoly unions.[9] They are characterised by identical Stone-Geary utility functions, given by

$$U_i = (w_i - \overline{w})^\theta (l_i)^{1-\theta} \qquad (3)$$

where the parameter $\theta \in [0,1]$ captures the relative importance of wages and employment to the unions.[10] The reservation wage, $\overline{w}$, is equal to the wage that could be earned in the competitive sector of the economy. For simplicity, $\overline{w}$ will be set equal to zero.

Now it is easily seen that, with $\overline{w} = 0$, a profit maximising input supplier would be analogous to a union that maximises rents. Further, setting $\theta = 1/2$, we have a maximisation problem that is equivalent to the one facing profit maximizing upstream firms that are allowed to set the prices of the input they deliver to downstream firms. When $\theta \to 0$, this means that the upstream input suppliers only cares about sales/employment. This approximates the situation one would get when the input supplier is a price taker at a competitively given price.

The input supply structure is assumed to be exogenously given. From Horn and Wolinsky (1988b) we know that if we allow the input supply structure to be endogenously determined, the input suppliers will have an incentive to form a single encompassing input supplier, as long as products are substitutes in the output market. However, the observation of great variation in input supply structure across different countries - for example trade union structure - indicates the importance of various institutional determinants of the organisation of input suppliers.

In this model keeping a divisionalised structure, for example after a merger, plays much the same role as keeping 'brands' in our previous model.

[9]As pointed out by Dowrick (1989), this can be viewed as a limiting case of the wage-bargaining union, where the union has all the bargaining strength.

[10]θ can be viewed as a measure of labour market distortion caused by unions. When $\theta \to 0$ the wage approaches the competitive level. θ is assumed to be equal for all unions.

In the present model we attempt to explore input price responses of downstream mergers, and the incentives for such mergers, under different exogenous input supply structures. Our main focus is directed towards the case which we find most interesting, namely that of plant-specific input supply, in which input suppliers are unable to coordinate their prices across different plants. This structure might be the natural one when the input suppliers are upstream, profit maximising firms, since there are no institutional mechanisms implying that a downstream merger should trigger a merger between input suppliers. In addition, in markets where firms are located in different countries, there are obviously both geographical and cultural obstacles to input supply cooperation. In particular, whereas international mergers is a highly prevalent phenomenon among firms, we hardly ever observe a formal cooperation between trade unions across borders.[11] One main reason is probably that capital is highly mobile between countries, whereas labour is generally not.

With domestic mergers, though, a natural modelling approach might in some cases be to assume firm-specific input suppliers. For example, trade unions are typically organised within a firm.[12] A downstream merger would then naturally lead to union merger as well. Moreover, it turns out that the merged firms' input suppliers are worse off following a downstream merger. It is then natural also to investigate the case where a downstream merger triggers an upstream merger, which is captured in the model with firm-specific input suppliers.

Since a merger is a long term commitment, it is natural for the merger candidates to anticipate the input suppliers' response to a downstream merger. In accordance with this, we let the merger decision be the stage 1 decision. Moreover, we would expect the input suppliers to anticipate how their price setting affects the price setting in the downstream market. Then we have the following sequence of moves:

Stage 1: Firm 1 and 2 decide whether or not to merge.

Stage 2: The input suppliers set input prices.

Stage 3: The downstream firms set quantities.

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[11]In 1999, the share of all mergers and aquisitions, in terms of value, that was cross-border reached nearly 31 per cent (UNCTAD, 2000).

[12]Unions are not firm-specific in all countries. In countries with very decentralised bargaining structures, as the US and the UK (to the extent that these still are unionised countries), this might perhaps best be represented as plant-specific unionism, especially when there is a substantial product differentiation among the divisions in a merged entity. The recent strike at Boeing, following the merger with McDonnell Douglas, can perhaps best be interpreted as a plant-specific union struggling, after a merger, to avoid cut-backs in employment at precisely their own plant.

3 Plant-specific input suppliers

With plant-specific input suppliers input prices are determined at plant level. The decision of whether or not to merge, is assumed to be based on a payoff comparison with the no-merger benchmark equilibrium. In the no-merger game, firm i chooses l_i to maximise

$$\pi_i = (p_i - w_i)\, l_i \tag{4}$$

where w_i is the input price set by firm i's input supplier, which maximises

$$U_i = (w_i)^\theta\, (l_i)^{1-\theta} \tag{5}$$

In the *post-merger* game, the merged firm chooses l_1 and l_2 to maximise

$$\pi_m = (p_1 - w_1)\, l_1 + (p_2 - w_2)\, l_2 \tag{6}$$

where w_1 is the input price set by the input supplier at plant 1, and w_2 is the input price set by the input supplier at plant 2. These input suppliers set their input prices simultaneously by maximising, respectively,

$$U_1 = (w_1)^\theta\, (l_1)^{1-\theta} \tag{7}$$

and

$$U_2 = (w_2)^\theta\, (l_2)^{1-\theta} \tag{8}$$

Regarding the input price response to a merger, we have the following result:[13]

> **Lemma 2.** *(i) $w_3 > w_i$ if $\theta < \frac{1}{2}$ or b is sufficiently low.*
> *(ii) $w_i > w_1 = w_2$.*
> *(iii) $w_3 > w_1 = w_2$.*

The merging firms' input prices fall, while the input price set by the outsider's input supplier will increase *or* decrease, depending on the degree of product differentiation, and union preferences in the case of trade unions. Importantly, though, the merged firm always faces lower input prices than the outsider.

The input suppliers' price setting on input is governed by the trade-off between input prices and sales. Thus, a downstream merger will lead to a change in input prices only if the nature of this trade-off is changed as a result of the merger. Providing that there are at least two

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[13]All remaining proofs are presented in the appendix. Regarding notation, subscript i refers to the symmetric no-merger outcome, whereas all other subscripts refer to the post-merger outcome.

upstream firms in the industry, a downstream merger will change the price elasticities of market shares for the input suppliers. The larger is the share of total industry sales an input supplier will lose by increasing the input price (*i.e.* the higher is the market share elasticity), the less favourable is the trade-off between higher input prices and lower sales. Consequently, the smaller is the incentive for the input supplier to push for a higher input price.

The market share elasticities will change as a result of changes in the rivalry (1) between downstream firms and (2) between upstream input suppliers.

(1) Reduced product market competition

Consider a situation in which firm 1 and 2 buy their inputs from a single input supplier, whereas a second input supplier is setting the input price for sales to firm 3. Analysing a merger between firm 1 and 2 in this situation would be one way to isolate the effect of reduced product market competition on the price setting on inputs.[14]

Comparing pre- and post-merger input prices for the merger participants in this case, we find that

$$\Delta w = \frac{\theta^2 b^3 \left(1 - \theta\right) \left(2 + \theta b\right)}{2 \left(2 + b - \theta^2 b^2\right) \left(2 + 2b - \theta^2 b^2\right)} > 0 \qquad (9)$$

Hence, a reduction of product market competition leads to an increase in input prices. This is in line with findings in related union-oligopoly models, where input prices are wages (see e.g. Dowrick, 1989). Reduced product market competition means that the input suppliers' market shares get less elastic. In other words, the less competitive is the product market, the smaller is the reduction in an input supplier's share of total industry sales resulting from a marginal increase in the price level on inputs. Thus, a more concentrated downstream industry means that the trade-off between higher input prices and lower sales is more favourable for the input supplier, and the input supplier will optimally set a higher input price. In addition, this effect is reinforced by the strategic complementarity of input prices.

The magnitude of the increase in input prices due to reduced product market competition is highly dependent on the degree of product differentiation. From (9) it is easily found that

$$\frac{\partial \left(\Delta w\right)}{\partial b} > 0$$

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[14]Reduced product market competition affects price setting on inputs only to the extent that it affects market share elasticities for the input suppliers. Thus, there must be some degree of competition between input suppliers for this effect to be present (cf. the case of industry-specific input suppliers in Section 4.2).

Thus, a higher degree of substitutability in demand implies that the increase in input prices from a reduction in product market competition is larger. This is quite intuitive. If products are almost unrelated, market shares are hardly affected by the price setting on inputs and thus play a very limited role for the optimal behaviour of input suppliers. As products become closer substitutes, though, market shares become increasingly sensitive to input price differentials, and changes in the degree of product market competition have a greater influence on input price setting.

(2) Increased competition between input suppliers
For the input suppliers of the merger participants, changes in market share elasticities due to the merger is mainly caused by what we could term a *second-sourcing effect*. That is, when the merged firm is costlessly able to shift production between its two plants the market shares of the input suppliers belonging to the merged firm are highly dependent on *within-firm* input price differentials, making the market shares more elastic. This pulls in the direction of lower input prices. This effect is reinforced by the rivalry between the merged firm's input suppliers.

One way to isolate the second-sourcing effect is to fix the input prices of firm 2 and 3 at the pre-merger level (see (A.1) in the appendix) when calculating the post-merger equilibrium. In this case input supplier 1 will set the input price[15]

$$w_1 \mid_{w_2,w_3 \ fixed} = \frac{\theta \left(2 + \theta b - 2b\right)}{2 + b - 2\theta b} \tag{10}$$

Comparing (10) and (A.1) we find that the change in input prices due to the second-sourcing effect is given by

$$\Delta w_1 = \frac{-\theta b \left(1 - \theta\right)}{\left(2 + b - 2\theta b\right)} < 0$$

Furthermore, we also see that $\frac{\partial(\Delta w_1)}{\partial b} < 0$. Second-sourcing, created by the merger, implies that the market shares of the merged firm's input suppliers become more elastic, causing the input suppliers to reduce input prices. Since the relative market shares become more sensitive to within-firm input price differentials when products are closer substitutes, this effect is increasing in b. In addition, this effect is reinforced by the competition between the input suppliers within the merged firm. This

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[15]For sufficiently high values of b we have a corner solution with all production taking place at plant 1, but this is not important for the argument.

effect can be introduced by letting also w_2 be determined endogenously post-merger. In this case we find that

$$w_1 \mid_{w_3 \; fixed} = \frac{2\theta \left(4 + 3\theta b^2 + b^3 - \theta b^3 - 2\theta b - b^2 - 4b\right)}{\left(2 + b - 2\theta b\right)\left(4 + \theta b^2 - b^2 - 4\theta b\right)} \quad (11)$$

Comparing (10) and (11) we find that

$$\Delta w_1 = \frac{-\theta^2 b^2 \left(4 - b\right)\left(1 - \theta\right)}{\left(2 + b - 2\theta b\right)\left(4 + \theta b^2 - b^2 - 4\theta b\right)} < 0$$

Since input prices are strategic complements, rivalry between the input suppliers causes input prices to drop further. The strength of this effect is highly sensitive to the degree of product differentiation. From (11) we see that $w_1, w_2 \to 0$ when $b \to 1$. In the extreme case, when products are homogeneous, input prices in the merged firm are competed down to the reservation level.

For the outside firm, Lemma 2 shows that the merger has an ambiguous effect on input prices. This is due to two opposing forces governing the outside input supplier's price setting. On one hand, product market competition is reduced, which points in the direction of higher input prices, as we have seen above. On the other hand, since input prices are strategic complements, an input price drop for the merged firm provides the outside firm's input supplier with an incentive to reduce input prices. If products are sufficiently close substitutes, the input price reduction for the merged firm is sufficiently large for the latter effect to dominate, resulting in lower input prices also for the outside firm (cf. Lemma 2).

Proposition 1. *With plant-specific input suppliers, a merger is (i) always profitable for the participants unless $b > 0.55$ and θ is close to zero, and (ii) more profitable for a participant than for the outsider unless θ is very low.*

We see from Proposition 1 that the results in the received literature - referred to in Lemma 1 - is reproduced when θ approaches zero. As already noted, in this case an input supplier (trade union) only cares about sales (employment). Therefore a price (wage) close to the reservation price (wage) results both before and after the merger. We are in fact close to what the situation would have been with an input supplier (trade union) without market power. In this case, a merger (in the limit) has no effect on input prices, and it is profitable only if the products are sufficiently differentiated ($b < 0.55$).

For the profit maximising input suppliers that set input prices - the case of $\theta = 1/2$ - we see from the Proposition that a merger is always
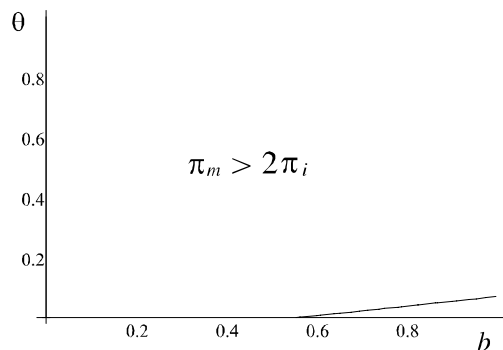
Figure 1: Merger profitability with plant-specific input suppliers

profitable for the merging firms and it is always more beneficial to be an insider than an outsider. Obviously, the driving force is the input price changes reported in Lemma 1. The merging firm will face lower input prices, and the merging firm's input price is lower than the corresponding input price for the outside firm.

If the input suppliers are trade unions, we see from the Proposition that it matters whether they are employment-oriented or not. If an input supplying firm is not a profit maximiser, it matters correspondingly how it weighs a higher price against lower sales. Here, we concentrate on the trade union example. We find the existence of a hump-shaped relationship between θ and post-merger wage responses.[16] This, in turn, determines a similar relationship between θ and merger profitability. For low levels of θ, pre-merger input prices are close to the competitive level, and there is not much room for wage reductions. As θ increases, though, the larger is the wage reduction following a merger, increasing the profitability for the merger participants. However, for very high values of θ, the unions have a strong preference for high wages, and even though there are considerable room for wage reductions, a merger will only trigger small adjustments in wages. Nevertheless, for values of θ close to 1, even a marginal reduction in post-merger wages will make a merger profitable for the participants.

Product differentiation triggers two opposing forces in our model, and the strength of these forces are determined by the degree of differentiation. On the one hand, a lower degree of product differentiation

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[16]This is quite natural. A change in wages takes place if a merger changes the trade-off between wages and employment. This trade-off is of importance when both wages and employment matter for the trade unions, which is especially the case for medium values of θ. Equilibrium input prices and profits are provided in the appendix.

$$\theta$$

$$\pi_m > 2\pi_3$$
$$\pi_3 < \pi_i$$

$$\pi_m > 2\pi_3$$
$$\pi_3 > \pi_i$$
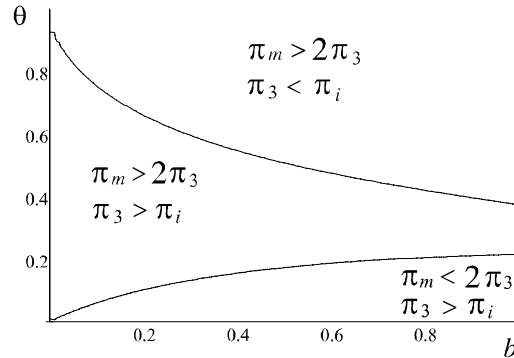
$$\pi_m < 2\pi_3$$
$$\pi_3 > \pi_i$$

$$b$$

Figure 2: Insider versus outsider profitability of a merger when input suppliers are plant-specific

makes the outsider's aggressive response stronger, which tends to make a merger less profitable (cf. Lemma 1). On the other hand, if products are close substitutes, the degree of competition between input suppliers is fierce, making a merger highly effective as a disciplinary device towards the input suppliers. From Proposition 1 it is apparent that these two effects tend towards cancelling each other out, making a merger profitable for every degree of product differentiation, the exception being when the input suppliers are trade unions with a very strong emphasis on employment. As shown in Figure 1, a merger is profitable even if products are (almost) identical as long as θ is above a certain treshold level.

From Lemma 2 we know that the input price reduction following a merger is always larger in the merged firm than in the non-merged firm. This helps explain the result illustrated in Figure 2. A merging firm gains more from a merger than what is the case for the non-merged firm. This is always true for the profit maximising input supplier, and true for the case of trade unions as long as the unions are sufficiently wage-oriented. Furthermore, from Figure 2 we also see that if θ and b are sufficiently high, a downstream merger will actually harm the outside firm, in terms of profits.

4   Other types of input supply structures

As shown in the previous section, a downstream merger may lead to a reduction in upstream rents when input suppliers are plant-specific. This illustrates that after a downstream merger the input suppliers would have extra incentives to coordinate their input prices in order to reduce the rivalry between them. One way to do so is for the merging down-

stream firms' input suppliers to merge.[17] If so, the input suppliers are firm- rather than plant-specific. In this section we contrast the outcome derived in the previous section for plant-specific input suppliers with the case with firm-specific input suppliers. In addition, we briefly describe the case with a single input supplier for the entire industry.

4.1 Firm-specific input suppliers

If input suppliers are organised at firm level, a merger between two or more firms will implicitly lead to a higher degree of centralisation in input price setting, since the merged firm only confronts one input supplier in the post-merger game. In the second stage of the post-merger game, the merged firm chooses l_1 and l_2 to maximise

$$\pi_m = (p_1 - w_m) \, l_1 + (p_2 - w_m) \, l_2 \tag{12}$$

where w_m is the input price set by the merged firm's input supplier, which maximises

$$U_m = (w_m)^\theta \, (l_1 + l_2)^{1-\theta} \tag{13}$$

Lemma 3. $w_m > w_3 > w_i$.

After the merger, equilibrium input prices increase for both the insiders and the outsider, but the merged firm faces a higher input price than the outsider. Comparing with Lemma 2, the results are reversed when we go from plant-specific to firm-specific input suppliers.

The results in Lemma 3 follow straightforwardly from our discussion of input price responses with plant-specific input suppliers. We noted that a downstream merger affects the rivalry both in the product market and in the input supply market, and that in the case of plant-specific input suppliers the two effects work in opposite directions. In this case, though, the two effects pull in the same direction. A downstream merger leads to less rivalry both in the product market and in the upstream market, and both effects tend to increase input prices.

After the merger, there is an asymmetry between the firms. The merging firm offers two brands while the non-merging firm offers one brand. For a uniform input price in the industry, this would imply that the input price/sales ratio is lower for the merged firm's input supplier. It will then be optimal for the merged firm's input supplier to set a price in excess of the input price facing the outside firm. Consequently, the

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[17]Collusion is another way this can be achieved, but this is not further pursued in the present paper. For such an analysis within the context of a unionised international duopoly, see Straume (2002).
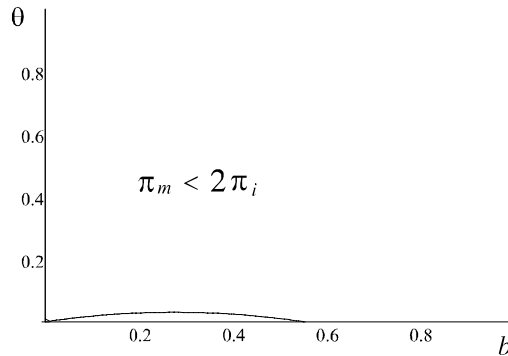
Figure 3: Merger profitability with firm-specific input suppliers

input price increase due to the merger is larger for the merged firm than for the non-merged firm.

Implications for merger profitability are stated in the following proposition:

Proposition 2. *With firm-specific input suppliers, a merger is (i) profitable for the participants only if $b < 0.55$ and θ is close to zero, and (ii) more profitable for the outsider than for a participant.*

In Figure 3 we have shown the set of parameter values for which the merger is profitable for the participants. We see that except for a few combinations of low θ and low b, a merger is unprofitable. It suggests that if the input suppliers are profit maximising firms, a merger is never profitable in the presence of firm-specific input suppliers. If the input suppliers are trade unions, we have to impose extremely strong assumptions regarding union preferences for a merger to be profitable. This is no surprise, given that a merger triggers a wage increase for the merged firm and this wage increase is larger than the one in the non-merged firm.

Comparing with Figure 1, we see the importance of the input supply structure. While it is very likely that a merger is profitable with plant-specific input suppliers, it is highly *unlikely* that a corresponding merger in an industry with firm-specific input suppliers is profitable.

Note also from part (ii) of Proposition 2 that in this case it is better being the outsider than being a participant in the merger. This is in contrast to our results with plant-specific input suppliers. However, it is in line with the results in the received literature. Since we know that a merger with exogenous input prices is more profitable for an outsider than for an insider, it is obvious that this conclusion still holds when a

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merger results in a higher input price increase for the merged firm than for the non-merged firm.

4.2 An industry-specific input supplier

If there are no obstacles to cooperation between the input suppliers, it is obvious that the input suppliers could gain by coordinated behaviour. If input suppliers are profit maximising firms, anti-trust policy would in many countries prevent the input suppliers from establishing a cartel or to merge to a monopoly. If the input suppliers are trade unions, on the other hand, there are in many countries no constraints on the cooperation between different trade unions. If all the firms in the industry recruit workers from an integrated labour market with a high degree of worker mobility, we would reasonably expect the workers to be organised in a single encompassing union (cf. Horn and Wolinsky, 1988b).

It is easily shown that, in this model, an industry-specific input supplier will set the input price

$$w = \theta \tag{14}$$

regardless of the number of firms in the industry. Thus, a merger would not affect input prices at all. In Lommerud, Straume and Sørgard (2000) we show that this result also holds for Bertrand competition.[18]

A central monopoly input supplier can drive an oligopoly from the back-seat, so-to-speak. It controls the strategic interaction among firms by having the ability to fix the marginal production costs of all the participants. By increasing input prices, product prices will have to increase and sales will fall. A merger is irrelevant for input price setting in this context, since it does not affect the elasticity of labour demand.

5 An application: Domestic versus international merger

A corollary of our model is that international mergers can be more profitable than domestic mergers. This prediction can be explored in greater detail by looking at a more specific set-up. Assume that, pre-merger, firm 1 and 2 are located in a 'domestic' country, whereas firm 3 is located in a 'foreign' country. To make things simple, we abstract from trade

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[18]In fact, this result is more general, and does not hinge on the assumption of linear demand. Under the assumption of constant elasticity of demand, Dowrick (1989) shows that if the union is organised on an industry-wide basis, the wage is independent of the degree of product market competitiveness, while Riley (1995) shows that this result holds for a general demand function, *i.e.*, the elasticity of industry labour demand is independent of the degree of product market competition.

costs and assume that the firms compete in a single market.[19]

In our setting, the difference between a domestic and an international merger can be found in the changes it causes on the input supply structure. Let us now interpret input suppliers as trade unions. In line with our previous discussion we assume that a cross-border downstream merger does not lead to a merger between the trade unions of the merging firms, whereas, in the case of a domestic downstream merger, this will indeed be the case.

In order to make predictions about merger formation in this particular variant of our model, we will make use of an approach developed by Horn and Persson (2001), which treats the merger process as a cooperative game of coalition-formation, where the players are free to communicate and write binding contracts. Using the terminology of Horn and Persson, we let an ownership structure M_i be a partition of the set $N = \{1, 2, 3\}$ of owners (firms) into coalitions. Excluding the possibility of complete monopolisation, there are three possible categories of market structures, with a combined total of four different ownership structures:

1. The decentralised structure (no merger): $M_n = \{1, 2, 3\}$
2. A domestic merger: $M_d = \{(1 + 2), 3\}$
3. A cross-border merger: $M_c = \{(1 + 3), 2\}$ and $M_c' = \{1, (2 + 3)\}$

Without going into details about the theoretical foundations, the approach involves a comparison of any two possible ownership structures M_i and M_j, where M_i is said to dominate M_j (M_i *dom* M_j) if the combined profits of the *decisive group* of owners are larger in M_i than in M_j. The *decisive group* of owners are the owners that are expected to be able to influence whether M_i will be formed instead of M_j, and vice versa.

Which are the *decisive* owners? We do not allow payments between coalition, so owners belonging to *identical coalitions* in the two structures cannot affect whether M_j will be formed instead of M_i, but all remaining owners can influence this choice and are thus *decisive*. If they participate in a non-singleton coalition in M_j that does not exist in M_i, this coalition requires the consent of all members of the coalition to be formed. Alternatively, if they stand alone in M_j and thus lose partners by moving from M_i to M_j, they can forgo surplus in M_i in order to prevent M_j from being formed.[20]

Finally, the solution concept is the *core*. Those structures that are in the core (*i.e.* the structures that are *undominated*) are defined as *equilibrium ownership structures*. Using this criterion, we are able to state the following:

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[19]This corresponds to the 'third-market' model of Brander and Spencer (1985).

[20]See Horn and Persson (2001) for a formal definition of *decisive owners*.

Proposition 3. *The equilibrium market structure implies cross-border merger, unless $b > 0.55$ and θ is close to zero, for which the equilibrium market structure implies no merger.*

Given the previous results regarding the effects of downstream mergers on input prices, the intuition behind this result is quite intuitive. In the model of endogenous merger formation that we use, mergers are conducive to market structures with large industry profits. In our model such market structures are characterised by cross-border merger, since this is a more efficient way to reduce rents among the input suppliers.

6   Extensions

Our basic model is rather stylised, so it is natural to check the robustness of our results. Let us therefore explain how results may change when we extend our basic model in two different directions. For more details, see Lommerud, Straume and Sørgard (2000).

Bertrand competition. We know from the literature that if Bertrand competition prevails in a differentiated products industry, then a merger with exogenous input prices is always profitable. With plant-specific input suppliers, we find that this result is reinforced. More interestingly, we find that - as is the case with Cournot competition and endogenous input prices - an insider can be better off than an outsider as a result of a merger. If the input suppliers are firm-specific, though, a merger can be unprofitable even in a setting with Bertrand competition. The driving force is the input price increase following a merger. Hence, our main results hold also in this extended version of our model. The reason is that the change in input prices following a merger most of all depends on the rivalry between the input suppliers, and the nature of this rivalry - input prices being strategic complements - is independent of the nature of competition in the product market.

Efficient bargaining. In the basic model we have assumed that the input suppliers unilaterally set the input price while the downstream firm has complete discretion over sales decisions. In the case of trade unions, this is a special case of the right-to-manage model. The union and the firm bargain over the wage while the firm sets employment. In the literature this model is often contrasted with the efficient bargaining model, where the union has the same relative bargaining strength over wage setting as well as employment decisions (and possibly other relevant decision variables). The existing literature suggests that the bargaining game that will emerge as the equilibrium outcome depends on the characteristics of the industry in question.[21] It is then natural to

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[21]Bughin (1999) finds that efficient bargaining is the most likely equilibrium out-

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check whether our results still hold if we apply an efficient bargaining model rather than a monopoly union model. We have only investigated the case of plant-specific unions. It turns out that the qualitative results depends on the relative bargaining strength of the players. However, we find that our main results are still valid. A merger can be profitable even in a Cournot setting without any exogenous fixed costs savings, and the insider may earn more from a merger than an outsider. The intuition is that efficient bargaining introduces two opposing forces. On the one hand, the unions can extract a share of the potential profit increase following a merger. This tends to make a merger less profitable in a setting with efficient bargaining. On the other hand, the merged firm will have a better bargaining position since it can bargain with two different unions.[22] The two opposing forces tend towards cancelling each other out for a large set of parameter values.

7   Conclusions

In this paper we have shown that the organisation of input suppliers is decisive for input price responses to a downstream merger, and hence for the profitability of such a merger. While plant-specific input suppliers tend to increase the profitability of a merger and may even make it more profitable to take part in a merger than being an outsider, the results are reversed in a setting with firm-specific input suppliers.

Our results suggest that firms considering to merge in an industry with oligopolistic input suppliers should be concerned about how the input suppliers respond to a possible merger. The existence of plant-specific input suppliers is obviously an argument in favour of a merger, from firms' point of view. The reason is that a downstream merger would trigger an increased degree of competition between the input suppliers of the merging firms, thereby reducing the rent captured by the input suppliers. However, the argument in favour of downstream merger is also an argument in favour of merger among the input suppliers. By doing so they can prevent the reduction in their own rent. The plant-specific input suppliers are then not plant-specific after the merger, but instead *de facto* firm-specific input suppliers. The downstream firms should anticipate such an outcome. We extend our model to an endogenous merger formation model to take this into account. We show that the equilibrium market structure might be cross-border merger. The rea-

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come, even more so under the threat of entry. Petrakis and Vlassis (2000) finds that right-to-manage bargaining is the equilibrium outcome if the unions' bargaining power is sufficiently high, while Espinosa and Rhee (1989) find that efficient bargaining may emerge as an equilibrium outcome in infinitely repeated games.

[22]See also Davidson (1988).

son is that merger between input suppliers is less likely in cross-border mergers. If so, the downstream firms merge across borders to reduce the rent extracted by the input suppliers.

Finally, we think our results could guide future empirical research on the wage effects of mergers. The results in the received empirical literature are mixed. Some find support for a wage increase following a merger, some for a wage cut, while others find no effect at all.[23] If one in the same data material combines mergers with plant-specific and firm-specific unions, one might find that mergers have - if any - only a limited effect on wages. According to our results the underlying truth could be that some mergers result in wage drops while others give wage rises. A proper empirical test should then start with a detailed study of the union structure which, in turn, should lead to a discrimination in the data material between industries with plant- and firm-specific unions.

Appendix: Proofs of Lemmas and Propositions

Solving the no-merger game by backwards induction, we find that input prices and profits in the symmetric Nash equilibrium are given by

$$w_i = \frac{\theta (2 - b)}{2 + b - 2\theta b} \tag{A.1}$$

$$\pi_i = \frac{(2 + b)^2 (1 - \theta)^2}{4 (1 + b)^2 (2 + b - 2\theta b)^2} \tag{A.2}$$

In the case of *plant-specific* input suppliers, input prices and profits in the asymmetric post-merger Nash equilibrium are given by

$$w_1 = w_2 = \frac{2\theta (2 - b + \theta b - 2b^2 - \theta b^2 + b^3)}{\eta} \tag{A.3}$$

$$w_3 = \frac{\theta (4 - b^2 - 5\theta b^2 + 2\theta b^3)}{\eta} \tag{A.4}$$

$$\pi_m = \frac{(1 - \theta)^2 (2 - b)^2 (2 + b)^2 (b + 1) (2 + b + \theta b - b^2)^2}{2 (2 + 2b - b^2)^2 \eta^2} \tag{A.5}$$

$$\pi_3 = \frac{(1 - \theta)^2 (1 + b)^2 (4 - b^2 - 5\theta b^2 + 2\theta b^3)^2}{(2 + 2b - b^2)^2 \eta^2} \tag{A.6}$$

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[23]Cremieux *et al.* (1996) and Peoples *et al.* (1993) find support for a wage cut following a merger, while McGuckin *et al.* (1995) find the opposite result. Hekmat (1995) find no evidence of any link between mergers and wages, while Gokhale *et al.* (1993) find no or only limited evidence of a link between takeovers and wages.

where

$$\eta = 4 + 4b - 4\theta b - b^2 - 3\theta b^2 - 2\theta^2 b^2 - b^3 + \theta b^3 + 2\theta^2 b^3 > 0$$

In the case of *firm-specific* input suppliers, input prices and profits in the asymmetric post-merger Nash equilibrium are given by

$$w_m = \frac{\theta\left(2 + b + \theta b - b^2\right)}{2 + 2b - \theta^2 b^2} \tag{A.7}$$

$$w_3 = \frac{\theta\left(2 + 2\theta b - \theta b^2\right)}{2 + 2b - \theta^2 b^2} \tag{A.8}$$

$$\pi_m = \frac{2\left(1 - \theta\right)^2 \left(1 + b\right) \left(2 + b + \theta b - b^2\right)^2}{\left(2 + 2b - \theta^2 b^2\right)^2 \left(2 + 2b - b^2\right)^2} \tag{A.9}$$

$$\pi_3 = \frac{\left(1 - \theta\right)^2 \left(1 + b\right)^2 \left(2 + 2\theta b - \theta b^2\right)^2}{\left(2 + 2b - \theta^2 b^2\right)^2 \left(2 + 2b - b^2\right)^2} \tag{A.10}$$

Proof of Lemma 2. (i) From (A.1) and (A.4), $w_3 > w_i$ if

$$\frac{\theta b^2 \left(1 - \theta\right) \left(4 - 4\theta - 4\theta b + 2\theta b^2 - b^2\right)}{\eta \left(2 + b - 2\theta b\right)} > 0.$$

The denominator is obviously positive for $\theta, b \in \langle 0, 1\rangle$. The numerator is positive if $\left(4 - 4\theta - 4\theta b + 2\theta b^2 - b^2\right) > 0$. Rearranging yields $4\left(1 - \theta\left(1 + b\right)\right) + b^2\left(2\theta - 1\right) > 0$. We see that this condition holds if $\theta < \frac{1}{2}$ or if b is sufficiently low.

(ii) From (A.1) and (A.3), $w_i > w_1 = w_2$ reduces to

$$\frac{\theta b \left(1 - \theta\right) \left(4 + 4b - b^2 - b^3 - 2\theta b^2 \left(1 - b\right)\right)}{\left(2 + b - 2\theta b\right)\eta} > 0.$$

which holds for $\theta, b \in \langle 0, 1\rangle$.

(iii) From (A.3) and (A.4), $w_3 > w_1 = w_2$ reduces to

$$\frac{\theta b \left(2b + 1\right)\left(2 - b\right)\left(1 - \theta\right)}{\eta} > 0$$

which is true for $\theta, b \in \langle 0, 1\rangle$. ∎

Proof of Proposition 1. (i) A merger is profitable if $\pi_m - 2\pi_i > 0$. From Lemma 1 we know that this is true if $\theta = 0$ and $b < 0.55$. From Lemma 2 it must be the case that this is also true for $b < 0.55$ and $\theta > 0$.

For $b > 0.55$ we know (from Lemma 1) that $\pi_m - 2\pi_i < 0$ if $\theta = 0$. Setting $b = 1$, we can from (A.2) and (A.5) find that $\pi_m - 2\pi_i > 0$ if:

$$\frac{-9 + 138\theta - 127\theta^2 + 8\theta^3(1 + \theta)}{72(2\theta - 3)^2} > 0.$$

This condition is met if $\theta > 0.07$. Then we know that for $\theta \in \langle 0, 1 \rangle$ and $b \in \langle 0.55, 1 \rangle$ there are critical values where $\pi_m = 2\pi_i$. In Figure 3 (section 3) we have plotted the curve where $\pi_m = 2\pi_i$ in a (θ, b)-diagram, using the expressions in (A.2) and (A.5). It follows immediately that $\pi_m > 2\pi_i$ above the curve.

(ii) A participant earns $\pi_m/2$ and the non-merging firm π_3 in the post-merger equilibrium. We know from Lemma 1 that for $\theta = 0$, then $\pi_m - 2\pi_3 < 0$. Setting $b = 1$ and using the expressions reported in (A.2) and (A.6), we have that $\pi_m - 2\pi_3 < 0$ if $20\theta - 7\theta^2 > 4$. This condition is met if $\theta < 0.21$. Then we know that for $\theta, b \in \langle 0, 1 \rangle$ there are critical values where $\pi_m - 2\pi_3 = 0$. In Figure 4 (section 3) we have plotted the curve where $\pi_m = 2\pi_3$ in a (θ, b)-diagram, using the expressions in (A.2) and (A.6). Obviously, $\pi_m > 2\pi_3$ above the curve . ∎

Proof of Lemma 3. From (A.1), (A.7) and (A.8), and after rearranging, $w_m > w_3$ reduces to

$$\frac{\theta b \left(1 - b\right) \left(1 - \theta\right)}{\left(2 + 2b - \theta^2 b^2\right)} > 0$$

whereas $w_3 > w_i$ reduces to

$$\frac{\theta b^2 \left(1 - \theta\right) \left(2 + 2\theta - \theta b\right)}{\left(2 + 2b - \theta^2 b^2\right) \left(2 + b - 2\theta b\right)} > 0$$

It can easily be seen that both inequalities hold for $b, \theta \in \langle 0, 1 \rangle$. ∎

Proof of Proposition 2. (i) We know from Lemma 1 that if $\theta = 0$, then $\pi_m > (<) 2\pi_i$ if $b < (>) 0.55$. From Lemma 3 it must also be the case that $\pi_m < 2\pi_i$ if $b > 0.55$ and $\theta > 0$. Then we know that there are combinations of $\theta \in \langle 0, 1 \rangle$ and $b \in \langle 0, 0.55 \rangle$ such that $\pi_m = 2\pi_i$. By using the expressions in (A.2) and (A.9), we find these combinations of θ and b. They are plotted in a (θ, b)-diagram in Figure 5 (section 4.1). Obviously, above the curve shown in Figure 5 $\pi_m < 2\pi_i$.

(ii) We know from Lemma 1 that for exogenous input prices, $\pi_m < 2\pi_3$. Given the result in Lemma 3, it is trivial to see that the result in Lemma 1 applies in this case too. ∎

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Proof of Proposition 3. When comparing M_d and M_n, the decisive group of owners consists of the merger participants in M_d. The comparison of equilibrium payoffs in this case coincides with the case of firm-specific input suppliers in Section 4.1. Let $\pi_i(M_j)$ be the equilibrium profits of firm i in ownership structure M_j. From Proposition 2 we know that $\pi_m(M_d) > 2\pi_i(M_n)$, implying M_d *dom* M_n, if $b < 0.55$ and θ is close to zero. For other parameter values, the dominance relation is reversed. Likewise, when comparing M_c and M_n, the decisive owners are the merger participants in M_c. This coincides with the case of plant-specific input suppliers in Section 3, and from Proposition 1 we know that $\pi_m(M_c) > 2\pi_i(M_n)$, implying M_c *dom* M_n, unless $b > 0.55$ and θ is close to zero. For this (small) set of parameter values, the dominance relation is reversed. Finally, when comparing M_c and M_d, all three owners are decisive. In this case we have to compare total industry profits in the two different market structures. This corresponds to a comparison of post-merger industry profits for the case of plant-specific and firm-specific input suppliers, respectively. Using (A.5), (A.6), (A.9) and (A.10) in the appendix, we find that $\sum_{i=1}^{3} \pi_i(M_c) > \sum_{i=1}^{3} \pi_i(M_d)$, implying M_c *dom* M_d, for the entire set of parameter values. Hence, M_c is undominated unless $b > 0.55$ and θ is close to zero, for which M_n is undominated. ∎

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