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Merger Profitability in Unionized Oligopoly*

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May 2, 2000

Abstract

We examine how a merger affects wages of unionized labour and, in turn, the profitability of a merger under both Cournot and Bertrand competition. If unions are plant-specific, we find that a merger is more profitable than in a corresponding model with exogenous wages. 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 unions, on the other hand, results are reversed.

Keywords: merger profitability, trade unions, endogenous wages

JEL classification: J51, L13, L41

1 Introduction

Empirical literature suggests that mergers may affect wages (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. It is mainly concerned with how a merger affects the rivalry between firms. The purpose of this paper is to help filling this gap by analyzing mergers in a unionized oligopoly. The

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structure of the labor market is crucial for the profitability of a merger and for whether a non-merging firm earns more from a merger than a merging firm. We argue that this has important implications not only for firms' business strategies, but also for anti-trust policy as well as the empirical testing of possible links between mergers and wages.

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 assumptions in Salant *et al.* (1983) may restore the perhaps more intuitive result that mergers are most often profitable. This could be done by, on the demand side, introducing differentiated products or by, on the cost side, adding a capital stock that affects marginal costs.¹ Finally, Deneckere and Davidson (1985) show that the result in Salant *et al.* (1983) can also be reversed by changing the nature of competition. They examine the case of differentiated products and price competition, and find that a merger is *always* profitable in such a setting. Predictions from theory are then that a merger without any costs 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. One could then argue that each firm should wait, hoping that other firms merge and then be a free rider on such a merger.³

¹As anticipated in Deneckere and Davidson (1985) and shown in Lommerud and Sørsgard (1997), a merger is more profitable if the products are differentiated than what is the case with homogeneous products. On the cost side, it is shown that by assuming that the capital stock affects marginal costs a merger is more profitable than what is the case with constant marginal costs. This is shown in, for instance, Perry and Porter (1985) and McAfee and Williams (1992).

²Several studies try to explain unprofitable mergers and acquisitions. Faulí-Oller and Motta (1996) show that unprofitable mergers can occur in a setting with strategic delegation of decisions to managers. Shleifer and Vishny (1988) argue that managers with other motives than value maximization, such as the size of their organization, can trigger unprofitable mergers. Roll (1986) argues that those overestimating their ability most are also most likely to buy a firm (winner's curse). Nilssen and Sørsgard (1998) and Fridolfsson and Stennek (2000b) show that a merger that is unprofitable seen in isolation may be undertaken either to prevent or to encourage future mergers.

³This free rider problem was first pointed out in Stigler (1950). Fridolfsson and Stennek (2000a) show that this mechanism may delay a merger rather than prevent it completely.

In this paper we examine how the referred predictions from the established literature may change when we let labor be an input to production and let wages (and employment) be endogenously determined.⁴ Our model is in much the same spirit as Salant *et al.* (1983) and Deneckere and Davidson (1985). We apply a model of differentiated products, with Salant *et al.*'s homogeneous goods model as a special case, and we investigate both Cournot and Bertrand competition. The results in the literature are reproduced in a benchmark version of our model, where wages - the firms' input prices - are exogenous.

In the model, labor is the only input to production and the workers are organized in unions that are concerned about both wages and employment.⁵ In the basic version of the model we apply a monopoly union model, a special version of the right-to-manage model, where the unions set wages and the firms set employment. For our perhaps most interesting case, though, we contrast our findings with the predictions from an efficient bargaining model.

We distinguish between three different ways to organize the labor market: the unions can either be plant-specific, firm-specific or central. In the latter case all workers in the industry are organized in one union. The central monopoly union is then not only a monopolist in the labor market, but a back-seat monopolist in the product market as well. A merger is irrelevant for wage setting in such a context, because what matters is product market demand. The results from the standard literature still apply.

If we introduce a plant-specific union, the results change dramatically. A plant-specific union organizes only the workers at one plant. Then a merger between two firms does not change the number of unions, but it changes the rivalry between them. The two merged firms' unions compete more fiercely on wages to serve the merged firm. Furthermore, the initial reduction in sales would imply that employment suffers. The union will want to set a low wage as a response to a merger to dampen the reduction in employment. We find that under Bertrand competition a merger is as usual profitable, and even more so than with exogenous

⁴González-Maestre and López-Cuñat (1999) is a study in much the same spirit as ours. They 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 a wage. Since the incentive scheme is set by the owner, their setting is distinctly different from ours where we have unions that can bargain over wage (and possibly employment).

⁵The literature on unionized oligopoly is quite sizeable; see for example Brander and Spencer (1988), Dowrick (1989), Naylor (1998) and Lommerud and Sørgard (1999). There is no mention of mergers in these papers.

wages. More interestingly and in contrast to the standard literature, a merger is now profitable even for Cournot competition and homogeneous goods unless the unions are very employment-oriented. An 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 wages are always lower than the non-merging firms' wages. We find that under both Cournot and Bertrand competition a merger can be more profitable for a merging than for a non-merging firm. This holds if the unions are sufficiently wage-oriented.

If the unions are firm- rather than plant-specific, our results are reversed. If firm-specific unions, a merger between two firms implies that the merging firms' unions also merge. Then we have a higher concentration in the labor market, which dampens the rivalry between the unions. In this case a merger results in higher wages, and the merging firms now face higher wages than the non-merging firms. No surprise, then, a merger is now less profitable than in the case with exogenous wages. We find that now a merger is unprofitable under Cournot competition unless the products are very differentiated and the unions are extremely employment oriented. Under Bertrand competition, a merger is now profitable only if products are sufficiently close substitutes and the unions are sufficiently employment oriented. Since wages increase more for the merging than the non-merging firms, an outsider earns more from a merger than a participant. Thus, we see that the traditional result in the literature is restored in this respect.

Monopoly union models are often contrasted with the assumption of efficient bargaining between firms and unions. We do this for the case of plant-specific unions. Even though details change, the basic result remains that unions tend to make mergers more profitable and that it becomes more profitable to participate in the merger than to remain on the outside.

The distinction between plant-specific and firm-specific bargaining has turned out to be very important. A natural question is when which model best describes a particular industry. We think international mergers, which gain in importance, point towards the plant-specific union model. Trade unions tend not to transcend national borders. Moreover, when the oligopoly in question produces differentiated goods, decentralized bargaining can imply something close to plant-specific unionism. The plant-specific union model should then be more relevant for a US or UK setting, while the firm-specific model might better fit the situation in Scandinavia and many countries in continental Europe.

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 are either price setters (Bertrand) or quantity setters (Cournot). Firms 1 and 2 are the merger candidates, and 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 without unions, and then introduce unions.

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

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

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.

Labor is the only factor of production, and each worker supplies one unit of labor to the firm at a price w per unit (wage). We assume that the labor force is homogeneous and that different brands are produced by using the same production technology, so that the only factor that ties a certain brand to a firm is patent rights.

We adopt a very simple linear production function, given by

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

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

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

Lemma 1 *If wages are exogenous, a merger is always profitable under Bertrand competition and profitable under Cournot competition if $b < 0.55$, and more profitable for the outsider than for a participant.*

Proof Results concerning Bertrand competition follows directly from Deneckere and Davidson (1985), and for Cournot competition it follows directly from Lommerud and Sørgard (1997). ■

As first shown in Deneckere and Davidson (1985), a merger in a Bertrand oligopoly allows the merging firms to coordinate their price setting and thereby raise prices which, in turn, triggers the outsiders to increase prices as well. The response from the outsiders to a merger would then add to the profitability of the initial price coordination following a merger.

Under Cournot competition, the outsiders' response is distinctly different. 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.

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 gain more from the merger than the insiders, who experience a reduction in sales.

Unions

Let us now introduce unions. They are characterised by identical Stone-Geary utility functions, given by

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

where the parameter $\theta \in \langle 0, 1 \rangle$ captures the relative importance of wages and employment to the unions.⁶ The reservation wage, \bar{w} , is equal to the wage that could be earned in the competitive sector of the economy. For simplicity, \bar{w} will be normalized to zero.

In the literature, there are different ways of modeling employment decisions and wage setting. On the one hand, one could argue that unions often have more power over wage setting than over employment decisions. In line with this reasoning, one could apply a right-to-manage model where union and firm bargain over the wage level, but the firm alone sets employment. On the other hand, bargaining over both wages and employment may emerge as an equilibrium outcome in infinitely repeated games (see Espinosa and Rhee, 1989). This is an argument for applying an efficient bargaining model, where the union has the same relative bargaining strength over wage setting as employment decisions (and possibly other relevant decision variables).

⁶ θ is a measure of the labor market distortion caused by unions. When $\theta \rightarrow 0$ the wage approaches the competitive level. θ is assumed to be equal for all unions.

In addition, strategic product market interactions strongly influence the players' preferred mode of bargaining. In fact, the existing literature suggests that the bargaining game that will emerge as the equilibrium outcome depends on the characteristics of the industry in question.⁷

We sidestep from the debate over modeling approach by applying both bargaining models. In the basic model we assume that wages are set by unions, while firms set employment. This is called a monopoly union model, and it is that special case of the right-to-manage model where the union has all the bargaining power. For the case of plant-specific unions, we contrast the findings with the results from an efficient bargaining model.⁸

We distinguish between plant-specific, firm-specific and central unions. In the former case, wages are set at plant levels. Then a merged firm will face two unions after a merger, one for each of the two merging firms. In contrast, firm-specific unions imply that the two merged firms' unions become one union following a merger. Then a merger implies a more centralized wage setting. Finally, a central union is one which organizes the workers of all firms in a given oligopoly.

A central union will set the wage

$$w = \theta \tag{4}$$

regardless of the number of firms in the industry, and regardless of whether the market game is Cournot or Bertrand.⁹ Then we have the following result:

Lemma 2 *If the wage is set by a central union, a merger will not influence the wages and the results in Lemma 1 are still valid.*

A central monopoly union 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

⁷Two recent contributions in the literature illustrate the ambiguity. Bughin (1999) finds that efficient bargaining is the most likely equilibrium outcome, 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.

⁸Manning (1987) brings out the important structural differences between various trade union models in an illuminating way.

⁹This result 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.

increasing wages, product prices will have to increase and employment will fall. What matters for wage setting is only product market demand and the union's own relative preference for wage over employment. A merger is irrelevant for wage setting in this context.

In the two remaining cases, though, we will show that a merger does affect wages. We apply the following rules of the game in the basic model with monopoly unions:

Stage 1: The firms merge or not

Stage 2: The unions set wages

Stage 3: The firms set prices (Bertrand) or quantity (Cournot)

Note that employment is indirectly determined at stage 3 of the game, when the firms set prices or quantity. Alternatively, the unions and the firms bargain over wages and employment at stage 2 of the game. We return to this case in Section 5, when applying an efficient bargaining model in a setting with plant-specific unions.

3 Plant-specific unions

The number of active unions are in this case left unchanged by a merger. The oligopoly game in the product markets takes place either with three or two participants. In the *pre-merger* game, firm i chooses either l_i or p_i , depending on which is the strategic variable, to maximize

$$\pi_i = (p_i - w_i) l_i \quad (5)$$

where w_i is the wage set by firm i 's union, which maximizes

$$U_i = (w_i)^\theta (l_i)^{1-\theta} \quad (6)$$

In the *post-merger* game, the merged firm chooses either l_1 and l_2 , or p_1 and p_2 , to maximize

$$\pi_m = (p_1 - w_1) l_1 + (p_2 - w_2) l_2 \quad (7)$$

where w_1 is the wage set by the union at plant 1, and w_2 is the wage set by the union at plant 2. These unions set their wages simultaneously by maximizing, respectively,

$$U_1 = (w_1)^\theta (l_1)^{1-\theta} \quad (8)$$

and

$$U_2 = (w_2)^\theta (l_2)^{1-\theta} \quad (9)$$

3.1 Cournot

Under Cournot competition, wages and profits in the symmetric pre-merger Nash equilibrium are given by¹⁰

$$w^C = \frac{\theta(2-b)}{2+b-2\theta b} \quad (10)$$

$$\pi^C = \frac{(2+b)^2(1-\theta)^2}{4(1+b)^2(2+b-2\theta b)^2} \quad (11)$$

In the asymmetric post-merger Nash equilibrium wages and profits are given by

$$w_1^C = w_2^C = \frac{2\theta(2-b+\theta b-2b^2-\theta b^2+b^3)}{\eta} \quad (12)$$

$$w_3^C = \frac{\theta(4-b^2-5\theta b^2+2\theta b^3)}{\eta} \quad (13)$$

$$\pi_m^C = \frac{(1-\theta)^2(2-b)^2(2+b)^2(b+1)(2+b+\theta b-b^2)^2}{2(2+2b-b^2)^2\eta^2} \quad (14)$$

$$\pi_3^C = \frac{(1-\theta)^2(1+b)^2(4-b^2-5\theta b^2+2\theta b^3)^2}{(2+2b-b^2)^2\eta^2} \quad (15)$$

where

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

We then have the following result:

Lemma 3 (i) $w_3^C > w^C$ if $\theta < \frac{1}{2}$ or b is sufficiently low.

(ii) $w^C > w_1^C = w_2^C$.

(iii) $w_3^C > w_1^C = w_2^C$.

Proof (i) From (10) and (13), $w_3^C > w^C$ if

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

¹⁰In what follows, variables without any subscript refer to pre-merger equilibrium values, while variables *with* subscript refer to post-merger equilibrium values. Further, variables with superscript *C* and *B* refer to the case of Cournot and Bertrand competition, respectively.

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

(ii) From (10) and (12), $w^C > w_1^C = w_2^C$ reduces to

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

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

(iii) From (12) and (13), $w_3^C > w_1^C = w_2^C$ reduces to

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

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

The merging firms' wages fall, while the wage set by the outsider's union will increase *or* decrease, depending on union preferences and the degree of product differentiation. Importantly, though, the merged firm always faces lower wages than do the outsider.

A merger would, *ceteris paribus*, result in lower sales for the merging parties. This is bad news for workers in the merging firms, since employment suffers. The two unions in the merging firms will respond by reducing wages and thereby soften the reduction in employment. In addition, a merger triggers competition between the two unions supplying workers to the merged firm.¹¹ This tends to reduce the wage even further. It is important to emphasise, though, that the wage-reducing effect of intensified inter-union competition is always dominant. It can be shown that if the unions are wage oriented, i.e. if θ is relatively high, a merger would trigger an *expansion* of sales by the merging firms. This is due to the fact that pre-merger profits, as well as output, are low, making it profitable for the merging firms to increase output as a response to a decrease in wages. Thus, if θ is sufficiently high, the rivalry in the labor market triggered by the merger results in lower wages *and* higher employment in the merging firms.

Absent unions, a non-merging firm would increase sales following a merger. This suggests that the union in the non-merging firm would respond to a merger by increasing wages and thereby have both increased

¹¹To understand this, note that the merged firm is very responsive to a wage reduction by one of its two unions. It could reshuffle its total sales by reducing production supplied by the high-wage union and increasing production supplied by the low-wage union. This triggers fierce competition on wages between the two unions.

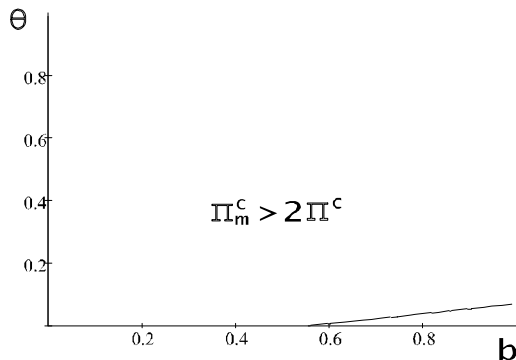


Figure 1: Merger profitability with plant-specific unions under Cournot competition.

wages and increased employment following the merger. However, as explained above, if unions are sufficiently wage oriented, the inter-union rivalry following a merger may result in an expansion of sales by the merging firms. If so, the non-merging firm would face a lower sale following a merger. The union's best response would then be to lower its wage. We see from Lemma 3 that this is true if the products are sufficiently close substitutes, implying that the spillover effect on the non-merging firm from a sales increase by the merging firm is large.

However, due to the intensified rivalry between the merging firms' unions, the wage reduction is always larger in the merged firm than in non-merged firm.

Proposition 1 *Under Cournot competition and plant-specific monopoly unions, 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 if the unions are not too employment oriented.*

Proof (i) A merger is profitable if $\pi_m^C - 2\pi^C > 0$. From Lemma 1 we know that this is true if $\theta = 0$ and $b < 0.55$. Setting $b = 1$, we can from (11) and (14) find that $\pi_m^C - 2\pi^C > 0$ 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 $\pi_m^C = 2\pi^C$. In Figure 1 we have plotted the curve where $\pi_m^C = 2\pi^C$ in a (θ, b) -diagram, using the expressions in (11) and (14). It follows immediately that $\pi_m^C > 2\pi^C$ above the curve.

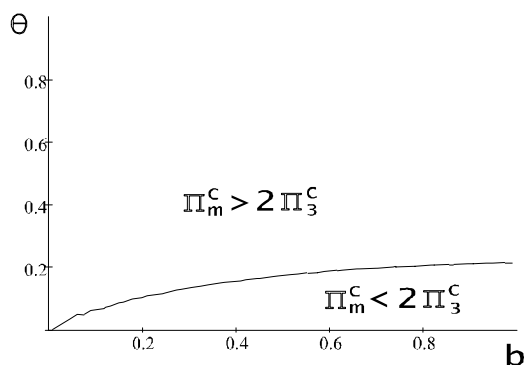


Figure 2: Insider versus outsider profitability of a merger with plant-specific unions under Cournot competition.

(ii) A participant earns $\pi_m^C/2$ and the non-merging firm π_3^C in the post-merger equilibrium. We know from Lemma 1 that for $\theta = 0$, then $\pi_m^C - 2\pi_3^C < 0$. Setting $b = 1$ and using the expressions reported in (14) and (15), we have that $\pi_m^C - 2\pi_3^C < 0$ if $20\theta - 7\theta^2 > 4$. This condition is met if $\theta < 0.21$. Then we know that for $\theta, b \in (0, 1)$ there are critical values where $\pi_m^C - 2\pi_3^C = 0$. In Figure 2 we have plotted the curve where $\pi_m^C = 2\pi_3^C$ in a (θ, b) -diagram, using the expressions in (14) and (15). Obviously, $\pi_m^C > 2\pi_3^C$ above the curve. ■

We see from the Proposition that the results in the received literature - referred to in Lemma 1 - is reproduced when θ approaches zero. This is the case where the union in the limit is concerned only about employment and not about wages and thus wages approach the competitive level. Then a merger (in the limit) has no effect on wages, and it is profitable only if the products are sufficiently differentiated ($b < 0.55$).

When $\theta > 0$, wage matters for the unions. They are then concerned about *both* wages and employment. It turns out that there is a hump-shaped relationship between θ and post-merger wage responses. This, in turn, determines a similar relationship between θ and merger profitability. For low levels of θ , pre-merger wages 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. As shown in Figure 1, a merger is

profitable even if products are (almost) identical if θ is above a certain threshold level.

From Lemma 3 we know that the wage 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 when the unions are sufficiently wage-oriented. This is in contrast to the result in the received literature. As far as we know, in all theoretical studies it is found that the profitability of a merger is larger for an outsider than for an insider.

3.2 Bertrand

If the nature of competition in the product market is characterised by Bertrand competition, wages and profits in the symmetric pre-merger Nash equilibrium are given by

$$w^B = \frac{\theta(2+b-3b^2)}{(2+3b-2\theta b-2\theta b^2-b^2)} \quad (16)$$

$$\pi^B = \frac{(1-b)(1+b)(1-\theta)^2(2+3b-b^2)^2}{4(1+2b)(2+3b-2\theta b-2\theta b^2-b^2)^2} \quad (17)$$

In the asymmetric post-merger Nash equilibrium wages and profits are given by

$$w_1^B = w_2^B = \frac{2\theta(1-b)\alpha}{\beta} \quad (18)$$

$$w_3^B = \frac{\theta(1-b)\rho}{\beta} \quad (19)$$

$$\pi_m^B = \frac{(1-b)(1-\theta)^2(4+8b+b^2-2b^3)^2\alpha^2}{2(1+2b)(2+2b-b^2)^2\beta^2} \quad (20)$$

$$\pi_3^B = \frac{(1-b^2)(1-\theta)^2(1+b-b^2)^2\rho^2}{(1+2b)(2+2b-b^2)^2\beta^2} \quad (21)$$

where

$$\beta = 4 + 12b - 4\theta b + 5b^2 - 9\theta b^2 - 2\theta^2 b^2 - 9b^3$$

$$+ \theta b^3 - 2\theta^2 b^3 - 3b^4 + 7\theta b^4 + 2b^5 - 2\theta b^5 > 0$$

$$\alpha = 2 + 5b + \theta b + b^2 + 2\theta b^2 - 3b^3 + \theta b^3 > 0$$

$$\rho = 4 + 12b + 9b^2 - 3\theta b^2 - b^3 - 3\theta b^3 - 2b^4 + 2\theta b^4 > 0$$

We then have the following results:

Lemma 4 (i) $w^B > w_1^B = w_2^B$.

(ii) $w_3^B > w_1^B = w_2^B$.

(iii) $w_3^B > w^B$ unless b and θ are close to 1.

Proof (i) From (16) and (18), $w^B > w_1^B = w_2^B$ reduces to

$$\frac{\theta b (1 - \theta) (2b + 1) (1 - b) A}{(2 + 3b - 2\theta b - b^2 - 2\theta b^2) B} > 0$$

where $A = 4 + 8b + 3b^4 - 2b^3\theta - 7b^3 - 3b^2 - 2\theta b^2 > 0$ and $B = (1 + b - b^2) (4 + 8b + b^2 - 2b^3) - \theta b (4 + 9b + 2\theta b - b^2 + 2\theta b^2 - 7b^3 + 2b^4)$. The numerator is obviously positive for $\theta, b \in \langle 0, 1 \rangle$. We can also see that the denominator is 'least positive' if $\theta \rightarrow 1$. Inserting $\theta = 1$ yields

$$2 (2 + b - 3b^2) (1 - b) (2b + 1) (2 + 2b - b^2)$$

which is positive for $b \in \langle 0, 1 \rangle$. Thus the denominator is also positive for $\theta, b \in \langle 0, 1 \rangle$.

(ii) From (18) and (19), $w_3^B > w_1^B = w_2^B$ reduces to

$$\frac{\theta (1 - b) b (2b + 1) (2 + 3b - b^2) (1 - \theta)}{\beta} > 0.$$

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

(iii) From (16) and (19), $w_3^B > w^B$ reduces to

$$\frac{\theta b^2 (1 - \theta) (1 + 2b) (1 - b) C}{(2 + 3b - 2\theta b - b^2 - 2\theta b^2) \beta} > 0$$

where $C = 4 + 8b + 2b^3\theta + b^2 - 2b^3 - 2\theta b^2 - 8\theta b - 4\theta$. The denominator is obviously positive for $\theta, b \in \langle 0, 1 \rangle$, while the sign of the numerator depends on the sign of C . A closer inspection of C reveals that $C > 0$, implying that the numerator is also positive, unless b and θ are close to 1. ■

We see from Lemma 4 that under Bertrand competition the merging firms' post-merger equilibrium wages will always fall. The outsider, on the other hand, faces higher post-merger wages, unless the products are very close substitutes and the unions are very wage oriented. It will always be the case, though, that the merged firm faces lower wages than the outsider. By comparing with Lemma 3, we see that the results are quite similar with the case of Cournot competition. The intuition for the results here is analogous to the intuition we gave for the results in Lemma 3.

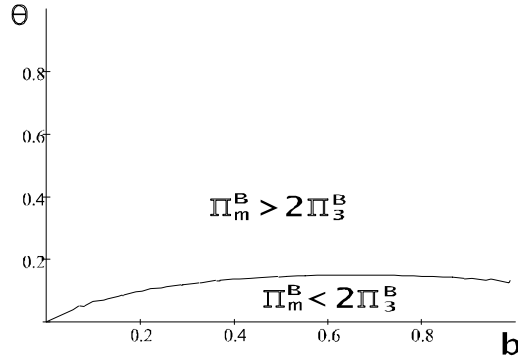


Figure 3: Insider versus outsider profitability of a merger with plant-specific unions under Bertrand competition.

Proposition 2 *Under Bertrand competition and plant-specific monopoly unions, a merger is (i) always profitable for the participants, and (ii) more profitable for a participant than for the outsider if the unions are not too employment oriented.*

Proof: (i) We know from Lemma 1 that for exogenous wages $\pi_m^B > 2\pi^B$. Given the results shown in Lemma 4, it is trivial to see that $\pi_m^B > 2\pi^B$ in this setting as well.

(ii) We know that for $\theta = 0$, $\pi_m^B < 2\pi_3^B$. By using the expressions in (20) and (21), it can be shown that $\pi_m^B = 2\pi_3^B$ for different combinations of $\theta, b \in (0, 1)$. In Figure 3 we have shown the curve where $\pi_m^B = 2\pi_3^B$ in a (θ, b) -diagram. Obviously, above the curve $\pi_m^B > 2\pi_3^B$. ■

We know from Lemma 1 that if wages are exogenous, then a merger is always profitable under Bertrand competition. As shown in Lemma 4, wages fall in the merged firm following a merger and it falls more than what is the case for the non-merging firms. It is then obvious that a merger is profitable for the merging parties in this setting, and even more so than in the case of exogenous wages.

More interestingly, we find that a merger can be more profitable for an insider than for an outsider. This is the case if the unions are sufficiently wage oriented. The range of parameter values of θ and b for which such a result is found is shown in Figure 3. By comparing with Figure 2, we see that this result mirrors the result we found under Cournot competition. The intuition for the result is, as was the case under Cournot competition, that the initial drop in employment in the merged firm as well as the rivalry between the unions triggered by the merger, result in a larger wage reduction in the merged firm than in the non-merged firm.

4 Firm-specific unions

If unions are organized at *firm* level, a merger between two or more firms will implicitly lead to a higher degree of centralization in wage setting, since the merged firm only confronts one union in the post-merger game.

In the second stage of the post-merger game, the merged firm chooses either l_1 and l_2 , or p_1 and p_2 , to maximize

$$\pi_m = (p_1 - w_m) l_1 + (p_2 - w_m) l_2 \quad (22)$$

where w_m is the wage set by the merged firm's union, which maximizes

$$U_m = (w_m)^\theta (l_1 + l_2)^{1-\theta} \quad (23)$$

4.1 Cournot

The pre-merger equilibrium outcome, in terms of wages and profits, is given by (10)-(11).

In the asymmetric post-merger Nash equilibrium wages and profits are given by

$$w_m^C = \frac{\theta(2 + b + \theta b - b^2)}{2 + 2b - \theta^2 b^2} \quad (24)$$

$$w_3^C = \frac{\theta(2 + 2\theta b - \theta b^2)}{2 + 2b - \theta^2 b^2} \quad (25)$$

$$\pi_m^C = \frac{2(1 - \theta)^2 (1 + b) (2 + b + \theta b - b^2)^2}{(2 + 2b - \theta^2 b^2)^2 (2 + 2b - b^2)^2} \quad (26)$$

$$\pi_3^C = \frac{(1 - \theta)^2 (1 + b)^2 (2 + 2\theta b - \theta b^2)^2}{(2 + 2b - \theta^2 b^2)^2 (2 + 2b - b^2)^2} \quad (27)$$

Comparing the two equilibria we find the following result:

Lemma 5 $w_m^C > w_3^C > w^C$.

Proof From (10), (20) and (21), and after rearranging, $w_m^C > w_3^C$ reduces to

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

while $w_3^C > w^C$ reduces to

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

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

After the merger, equilibrium wages increase for both the insiders and the outsider, but the merged firm faces a higher wage than the outsider. Comparing with Lemma 3, the results are reversed when we go from plant-specific to firm-specific unions.

At first glance, the result in Lemma 5 may come as a surprise. As was the case for plant-specific unions, the merging firm would, all else equal, reduce sales and thereby reduce employment following a merger. We would expect the union to lower wages, so that it could have both lower wages and lower employment. However, in this case the merger between the firms also implies that the two unions merge. This increase in centralization, from three to two unions, dampens the rivalry between the unions and thereby tends to increase wages. As shown in Lemma 5, this dampening-of-competition effect in the labor market more than offsets the tendency to lower wages to dampen the reduction in employment.

Note the difference between plant-specific and firm-specific unions. The former cares only for employment at its own plant. Then there is a tendency that unions undercut each other in the wage setting, to capture a larger number of jobs for their own plant. A firm-specific union cares for the employment level at both the two plants in a merged firm, which reduces the tendency to undercut wages.

After the merger, there is an asymmetry between the firms. The merging firm offers two brands while the non-merging firm offers one brand. The firm-specific union in the merged firm then internalizes the externality between the brands. An increase in output price triggered by an increase in wages will now imply that some of the sales of one brand are reshuffled to the other brand offered by the merged firm and thereby employment is partly reshuffled within the merged firm. Due to this the merged firm's union increases the wage more than the union in the non-merged firm does.

Proposition 3 *Under Cournot competition and firm-specific monopoly unions, 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.*

Proof (i) We know from Lemma 1 that if $\theta = 0$, then $\pi_m^C > 2\pi^C$ if $b < 0.55$. Then we know that there are combinations of $\theta, b \in \langle 0, 1 \rangle$ such that $\pi_m^C = 2\pi^C$. By using the expressions in (11) and (26), we find these combinations of θ and b . They are plotted in a (θ, b) -diagram in Figure 4. Obviously, above the curve shown in Figure 4 $\pi_m^C < 2\pi^C$.

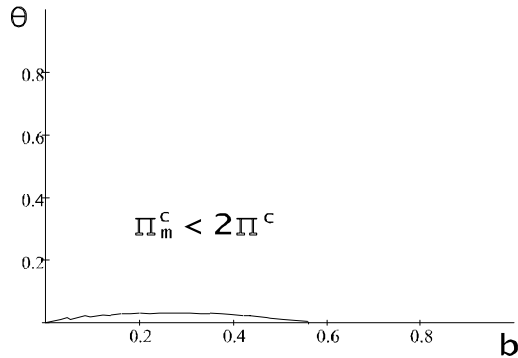


Figure 4: Merger profitability with firm-specific unions under Cournot competition.

(ii) We know from Lemma 1 that for exogenous wages, $\pi_m^C < 2\pi_3^C$. Given the result in Lemma 5, it is trivial to see that the result in Lemma 1 applies in this case too. ■

In Figure 4 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 for a merger to be profitable in the presence of firm-specific unions we have to impose extremely strong additional assumptions regarding union preferences. This is no surprise, given that a merger triggers a wage increase in the merged firm and this wage increase is larger than the one in the non-merged firm. By comparing with Figure 2, we see the importance of the union structure. While it is very likely that a merger is profitable under Cournot competition if we have plant-specific unions, it is very unlikely that a corresponding merger in an industry with firm-specific unions is profitable.

Note also from part (ii) of Proposition 3 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 unions. However, it is in line with the results in the received literature. Since we know that a merger with exogenous wages is more profitable for an outsider than for an insider, it is obvious that this conclusion still holds when a merger results in a higher wage increase for the merged firm than for the non-merged firm.

4.2 Bertrand

The pre-merger equilibrium outcome, in terms of wages and profits, is given by (16)-(17).

In the asymmetric post-merger Nash equilibrium wages and profits are given by

$$w_m^B = \frac{\theta(1-b)\kappa}{(2+4b-2b^2-\theta^2b^2-4b^3-\theta^2b^3+2b^4)} \quad (28)$$

$$w_3^B = \frac{\theta(1-b)(2+4b+2\theta b+3\theta b^2-2b^3)}{(2+4b-2b^2-\theta^2b^2-4b^3-\theta^2b^3+2b^4)} \quad (29)$$

$$\pi_m^B = \frac{2(1-b)(1-\theta)^2(1+b-b^2)^2\kappa^2}{(1+2b)(2+2b-b^2)^2(2+4b-2b^2-\theta^2b^2-4b^3-\theta^2b^3+2b^4)^2} \quad (30)$$

$$\pi_3^B = \frac{(1+b)(1-b)(1-\theta)^2(1+b-b^2)^2(2+4b+2\theta b+3\theta b^2-2b^3)^2}{(1+2b)(2+2b-b^2)^2(2+4b-2b^2-\theta^2b^2-4b^3-\theta^2b^3+2b^4)^2} \quad (31)$$

where

$$\kappa = 2 + 5b + \theta b + b^2 + 2\theta b^2 - 3b^3 + \theta b^3 > 0$$

Then we have the following result:

Lemma 6 $w_m^B > w_3^B > w^B$.

Proof From (28) and (29), and after rearranging, $w_m^B > w_3^B$ reduces to

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

The numerator is obviously positive for $\theta, b \in \langle 0, 1 \rangle$. We see that the denominator is 'least positive' if $\theta \rightarrow 1$. Inserting $\theta = 1$ yields $(1-b)(2b+1)(2+2b-b^2) > 0$ for $b \in \langle 0, 1 \rangle$. Thus the denominator is also positive for $\theta, b \in \langle 0, 1 \rangle$. From (16) and (29), $w_3^B > w^B$ reduces to

$$\frac{\theta b^2(1-b)(1-\theta)(2+6b+2\theta+5\theta b+2b^2+3\theta b^2-4b^3)}{(2+4b-2b^2-\theta^2b^2-4b^3-\theta^2b^3+2b^4)(2+3b-2\theta b-2\theta b^2-b^2)} > 0.$$

It is immediately obvious that the numerator is positive. The denominator is 'least positive' if $\theta \rightarrow 1$. Inserting $\theta = 1$ into the denominator yields

$$(3b+2)(1-b)^2(2b+1)(2+2b-b^2) > 0$$

for $b \in \langle 0, 1 \rangle$. Thus the denominator is also positive for $\theta, b \in \langle 0, 1 \rangle$. ■

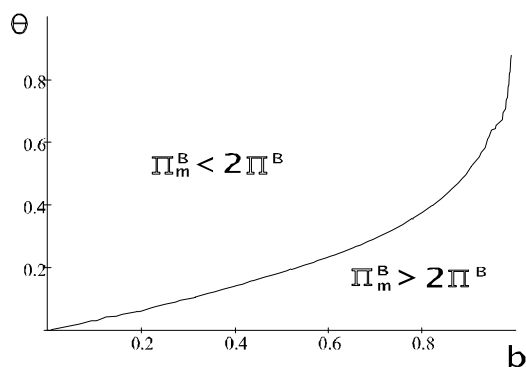


Figure 5: Merger profitability with firm-specific unions under Bertrand competition.

As was the case with Cournot competition, we find that post-merger wages increase, and the merged firm faces a higher wage than the non-merging firm. The intuition is analogous to the one we reported for the case with Cournot competition.

Proposition 4 *Under Bertrand competition and firm-specific monopoly unions, a merger is (i) profitable for the participants only if the unions are sufficiently employment oriented and if products are sufficiently close substitutes, and (ii) more profitable for the outsider than for a participant.*

Proof (i) We know from Lemma 1 that $\pi_m^B > 2\pi^B$ for $b \in \langle 0, 1 \rangle$ when $\theta = 0$. By comparing (30) and (17), it can be shown that $\pi_m^B - 2\pi^B = 0$ for $\theta, b \in \langle 0, 1 \rangle$. In Figure 5 we have plotted the curve $\pi_m^B - 2\pi^B = 0$ in a (θ, b) -diagram. Obviously, $\pi_m^B > 2\pi^B$ in the South-East part of the Figure.

(ii) Combining the results in Lemma 1 and Lemma 6, it is trivial to see the result in the Proposition. ■

As shown in Lemma 1, a merger in a setting without unions is always beneficial for the participants. When wages are endogenous, this is no longer always true. This is illustrated in Figure 5. The area below the curve in Figure 5 shows the set of parameter values for which the merger is profitable for the participants.

Obviously, the wage increase triggered by a merger can result in an unprofitable merger. If θ is relatively low, the unions are concerned about losing employment. Consequently, the wage increase due to the merger is limited. This explains why a merger is more profitable for low than for high values of θ . If b is relatively large, both the monopolization

effect as well as the response from the outsider are strong following a merger. Both factors tend to be beneficial for the merging firms, which explains why it is more likely that a merger is profitable for a high than for a low value of b .

Finally, note that the outsider benefits more from a merger than an insider. This result is identical to the finding in the received literature. In our setting the wage increases following a merger, which is larger for the merging than the non-merging firm, is an additional argument for a merger being more profitable for an outsider than for an insider.

5 Efficient bargaining

The efficient bargaining model is often used to contrast the results from monopoly union models. In the monopoly union model, union behaviour is to a large extent governed by the labor demand function. The efficient bargaining model, where wage and employment is set in a simultaneous bargain, is more reminiscent of profit sharing, so we should expect the profit level of the firm to play an important role in wage determination. To save space, we will in this section concentrate on the case where unions are organized at plant level. The analysis of the case of firm specific unions with efficient bargaining runs along the same broad lines.

In the pre-merger game, each firm-union pair simultaneously agree on a contract (w_i, l_i) , or (w_i, p_i) , depending on whether the mode of competition is Cournot or Bertrand, that maximizes¹²

$$\left[(w_i)^\theta (l_i)^{1-\theta} \right]^\gamma \left[(p_i - w_i) l_i \right]^{1-\gamma} \quad (32)$$

where $\gamma \in (0, 1)$ is a measure of the union's relative bargaining strength. We assume that γ is equal for all firm-union pairs.

In the post-merger game, the merged firm bargains with two unions simultaneously. Using the model for multiunit bargaining developed by Davidson (1988), efficient bargaining between the merged firm and its two unions leads to a contract (w_1, w_2, l_1, l_2) , or (w_1, w_2, p_1, p_2) , that solves

$$\max \left[(w_1)^\theta (l_1)^{1-\theta} \right]^\gamma \left[(p_1 - w_1) l_1 + (p_2 - w_2) l_2 - (\hat{p}_2 - w_2) \hat{l}_2 \right]^{1-\gamma} \quad (33)$$

$$\max \left[(w_2)^\theta (l_2)^{1-\theta} \right]^\gamma \left[(p_1 - w_1) l_1 + (p_2 - w_2) l_2 - (\hat{p}_1 - w_1) \hat{l}_1 \right]^{1-\gamma} \quad (34)$$

¹²The fall-back payoffs in the Nash maximand are set equal to zero.

where \widehat{p}_1 and \widehat{l}_1 are the price and output, respectively, of good 1 in case of a bargaining conflict between the merged firm and union 2. And similarly, \widehat{p}_2 and \widehat{l}_2 are the price and output of good 2 in case of a bargaining conflict between the merged firm and union 1.

5.1 Cournot

Under Cournot competition, wages and profits in the symmetric pre-merger Nash equilibrium are given by

$$w^C = \frac{\gamma\theta}{2 - \gamma + 2b - 2\gamma\theta b} \quad (35)$$

$$\pi^C = \frac{(1 - \gamma)(1 - \gamma\theta)}{(2 - \gamma + 2b - 2\gamma\theta b)^2} \quad (36)$$

The post-merger outcome with efficient bargaining at plant level under Cournot competition is the outcome of the following simultaneous maximization problem:

$$\max_{w_1, l_1} \left((w_1)^\theta (l_1)^{1-\theta} \right)^\gamma \left((p_1 - w_1)l_1 + (p_2 - w_2)l_2 - (\widehat{p}_2 - w_2)l_2 \right)^{1-\gamma} \quad (37)$$

$$\max_{w_2, l_2} \left((w_2)^\theta (l_2)^{1-\theta} \right)^\gamma \left((p_1 - w_1)l_1 + (p_2 - w_2)l_2 - (\widehat{p}_1 - w_1)l_1 \right)^{1-\gamma} \quad (38)$$

$$\max_{w_3, l_3} \left((w_3)^\theta (l_3)^{1-\theta} \right)^\gamma \left((p_3 - w_3)l_3 \right)^{1-\gamma} \quad (39)$$

where

$$p_1 = 1 - l_1 - bl_2 - bl_3$$

$$p_2 = 1 - l_2 - bl_1 - bl_3$$

$$p_3 = 1 - l_3 - bl_2 - bl_1$$

$$\widehat{p}_2 = 1 - l_2 - bl_3$$

$$\widehat{p}_1 = 1 - l_1 - bl_3$$

The equilibrium levels of wages and profits are given by:

$$w_1^C = w_2^C = \frac{(2 - \gamma + \gamma\theta b - b)\gamma\theta}{\varphi} \quad (40)$$

$$w_3^C = \frac{(2 - \gamma)\gamma\theta}{\varphi} \quad (41)$$

$$\pi_m^C = \frac{2(1-\gamma\theta)(1-\gamma+b-\gamma\theta b)(2-b+\gamma\theta b-\gamma)^2}{\varphi^2} \quad (42)$$

$$\pi_3^C = \frac{(1-\gamma)(1-\gamma\theta)(2-\gamma)^2}{\varphi^2} \quad (43)$$

where

$$\varphi = 4b + 2\gamma^2\theta b + 4 - 4\gamma\theta b - 2\gamma b - 4\gamma - 2b^2 + 4\gamma\theta b^2 + \gamma^2 - 2\gamma^2\theta^2 b^2 > 0$$

Then we have the following effect on wages:

Lemma 7 $w_3^C > w^C > w_1^C = w_2^C$

Proof From (35) and (41), $w_3^C > w^C$ reduces to $\frac{2\gamma\theta b^2(1-\gamma\theta)^2}{\varphi(2+2b-\gamma-2\gamma\theta b)} > 0$. We see that this holds for $\theta, b, \gamma \in \langle 0, 1 \rangle$. From (35) and (40), $w^C > w_1^C = w_2^C$ reduces to $\frac{\gamma\theta b(2-\gamma)(1-\gamma\theta)}{\varphi(2+2b-\gamma-2\gamma\theta b)} > 0$, which is also true for $\theta, b, \gamma \in \langle 0, 1 \rangle$. ■

We see that the effect on wages are identical to what we found with a monopoly union model, except that now the outsider's wage will increase for all combinations of parameter values. However, the driving force is now somewhat different. A merger reduces the profit potential for the merging firms. This reduces the potential for profit extraction for the unions in questions. In addition, and analogous to the case in the monopoly union model, a merger triggers competition between the two unions. These two effects explain why the wages drop in the merging firms. The non-merging firm, on the other hand, has a larger profit potential following merger. Its union's best response is to increase its wage.

Proposition 5 *Under Cournot competition and efficient bargaining at plant level a merger is profitable if products are sufficiently differentiated. The set of (θ, b) -values for which a merger is profitable increases with the unions' relative bargaining strength. A merger is also more profitable for a participant than for the outsider if products are sufficiently differentiated and if the unions have sufficient bargaining strength.*

Proof Using (36) and (42), it can be shown that $\pi_m^C - 2\pi^C = 0$ for different combinations of $\theta, b, \gamma \in \langle 0, 1 \rangle$. In Figure 5 and 6 we have plotted the curve $\pi_m^C - 2\pi^C = 0$ for $\gamma = 1/4$ and $\gamma = 3/4$, respectively, in a (θ, b) -diagram. Obviously, $\pi_m^C > 2\pi^C$ in the North-West corner of the Figures.

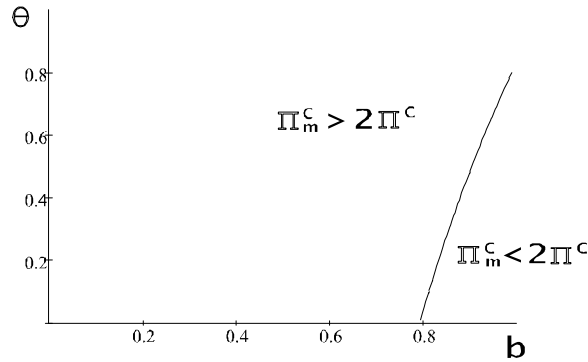


Figure 6: Merger profitability with efficient bargaining at plant level with 'weak' unions ($\gamma = 0.25$), under Cournot competition.

In a similar way, we can use (42) and (43) to show that $\pi_m^C - 2\pi_3^C = 0$ for different combinations of $\theta, b, \gamma \in \langle 0, 1 \rangle$, see Figure 7 and 8 where we have plotted $\pi_m^C = 2\pi_3^C$ in a (θ, b) -diagram for $\gamma = 1/4$ and $\gamma = 3/4$, respectively. ■

First, note that the results are analogous to the case with a monopoly union model. In particular, a merger is profitable if the products are sufficiently differentiated. However, now the bargaining strength plays a role. This is illustrated in Figure 6 and 7, where the profitability of a merger is plotted for 'weak' and 'strong' unions, respectively.

A 'strong' union implies that the unions have captured a large share of the profit potential in a firm. Since a merger lowers the profit potential for the merging firm, it is the unions that suffer most from a merger. This explains why the profitability of the merger is increasing in the unions' bargaining strength.

As shown in Lemma 7, a merger triggers a wage reduction for the merging firms and a wage increase for the non-merging firm. This explains why a merger can be more profitable for an insider than for an outsider. But, again, the unions' relative bargaining strength now play a role. This is illustrated in Figure 8 and 9. The areas to the left of the curves in Figures 8 and 9 constitute the set of parameter values for which a merger is more profitable for an insider than for the outsider when the unions' relative bargaining strength is 'weak' and 'strong', respectively. We see that the set of (θ, b) -values for which a merger is more profitable for the insiders than for the outsider increases with the relative union power. The reason is that the strong unions in the merging firms incur a large loss due to a reduction in profit potential following a merger, thereby preventing the merging firms from suffering a loss due to the

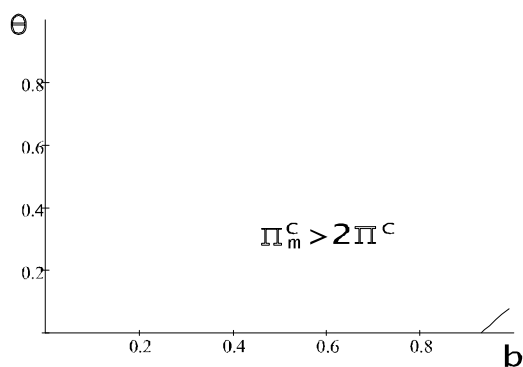


Figure 7: Merger profitability with efficient bargaining at plant level with 'strong' unions ($\gamma = 0.75$), under Cournot competition.

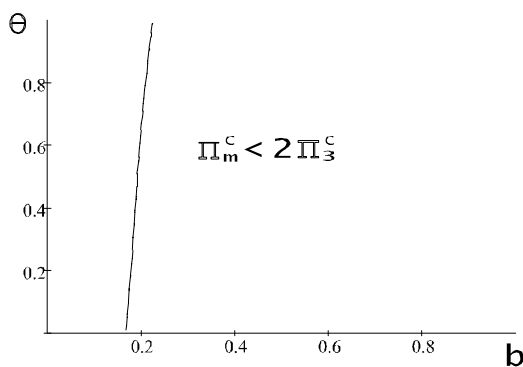


Figure 8: Insider versus outsider profitability of a merger with efficient bargaining at plant level with 'weak' unions ($\gamma = 0.25$), under Cournot competition.

merger.

5.2 Bertrand

If the mode of competition is Bertrand, wages and profits in the symmetric pre-merger Nash equilibrium is given by

$$w^B = \frac{\theta\gamma(1-b)}{(2-\gamma+\gamma b-2\gamma\theta b)} \quad (44)$$

$$\pi^B = \frac{(1-b)(1+b)(1-\gamma\theta)(1-\gamma)}{(1+2b)(2-\gamma+\gamma b-2\gamma\theta b)^2} \quad (45)$$

The post-merger outcome with efficient bargaining at plant level under Bertrand competition is the outcome of the following simultaneous

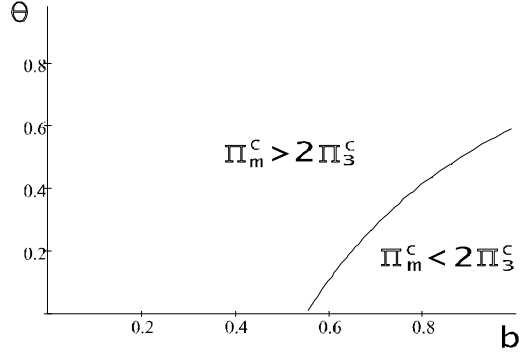


Figure 9: Insider versus outsider profitability of a merger with efficient bargaining at plant level with a 'strong' union ($\gamma = 0.75$), under Cournot competition.

maximization problem:

$$\max_{w_1, p_1} \left((w_1)^\theta (l_1)^{1-\theta} \right)^\gamma \left((p_1 - w_1) l_1 + (p_2 - w_2) l_2 - (p_2 - w_2) \widehat{l}_2 \right)^{1-\gamma} \quad (46)$$

$$\max_{w_2, p_2} \left((w_2)^\theta (l_2)^{1-\theta} \right)^\gamma \left((p_1 - w_1) l_1 + (p_2 - w_2) l_2 - (p_1 - w_1) \widehat{l}_1 \right)^{1-\gamma} \quad (47)$$

$$\max_{w_3, p_3} \left((w_3)^\theta (l_3)^{1-\theta} \right)^\gamma \left((p_3 - w_3) l_3 \right)^{1-\gamma} \quad (48)$$

where \widehat{l}_1 is the direct demand for good 1 when only goods 1 and 3 are produced, and \widehat{l}_2 is the direct demand for good 2 when only goods 2 and 3 are produced.

The equilibrium levels of wages and profits are given by:

$$w_1^B = w_2^B = \frac{(1-b)(\gamma\theta b - \gamma - 2\gamma b + 3b + 2)\gamma\theta}{\psi} \quad (49)$$

$$w_3^B = \frac{(1-b)(2 + 2b^2 - 3\gamma b + 4b + \gamma\theta b - \gamma - 2\gamma b^2)\gamma\theta}{\psi} \quad (50)$$

$$\pi_m^B = \frac{2(1-\gamma)(1-\gamma\theta)(1-b)(b+1)^2(\gamma\theta b - \gamma - 2\gamma b + 3b + 2)^2}{(2b+1)\psi^2} \quad (51)$$

$$\pi_3^B = \frac{(1-\gamma\theta)(1-b)(1+b)(1-\gamma)\nu^2}{(2b+1)\psi^2} \quad (52)$$

where

$$\begin{aligned} \nu &= 2\gamma b^2 - 2b^2 + 3\gamma b - 4b - \gamma\theta b + \gamma - 2 \\ \psi &= \gamma^2 + 5\gamma^2 b^2 \theta + 2\gamma^2 b^3 \theta - 2\gamma^2 \theta^2 b^2 - \gamma^2 b^2 - 2b^3 \gamma^2 + 2\gamma^2 b + \gamma^2 b \theta \\ &\quad - 6\gamma\theta b^2 - 8\gamma b + 4b^3 \gamma - 2\gamma\theta b - 2\gamma\theta b^3 - 4\gamma + 4 + 2b^2 + 8b - 2b^3 \\ &> 0 \end{aligned}$$

Then we have the following result:

Lemma 8 $w_3^B > w^B > w_1^B = w_2^B$

Proof From (44) and (50), $w_3^B > w^B$ reduces to

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

which is true for $b, \theta, \gamma \in \langle 0, 1 \rangle$. From (44) and (49), $w^B > w_1^B = w_2^B$ reduces to $\frac{\gamma\theta b(1-b)(1-\gamma)(2+2b+2\gamma b^2-\gamma-\gamma b-2\gamma\theta b^2-2b^2)}{\psi(2+\gamma b-\gamma-2\gamma\theta b)} > 0$, which is also true for $b, \theta, \gamma \in \langle 0, 1 \rangle$. ■

As was the case for Cournot competition, the results with an efficient bargaining model mirror the results with a monopoly union model. However, with Bertrand competition we know that a merger would increase the profit potential for the merger participants. On the other hand, a merger triggers rivalry between the two unions. The result in the Lemma shows that the latter effect dominates. The non-merging firm, though, experiences an increase in profit potential. This explains why the non-merging firm's wage increases following a merger.

Proposition 6 *Under Bertrand competition and efficient bargaining at plant level, a merger is always profitable for the participants. Furthermore, a merger is always more profitable for the insiders than for the outsiders if $\gamma > 1 - \frac{1}{3}\sqrt{2} \approx 0.53$. For $\gamma < 0.53$ a merger is more profitable for a participant than for the outsider if products are sufficiently differentiated.*

Proof From Lemma 1 and Lemma 8, the first part of the Proposition is trivial.

From (51) and (52) $\pi_m^B - 2\pi_3^B$ reduces to

$$\frac{2b(1-\gamma)(1-\gamma\theta)(1-b)(1+b)D}{(2b+1)\gamma^4 E^2} > 0$$

where $D = -5\gamma^2 b + 2\gamma - 8\gamma^2 b^2 - \gamma^2 - 7b^2 + 2\gamma\theta b + \gamma^2 \theta^2 b^2 + 2\gamma\theta b^2 - 3b + 10\gamma b + 16\gamma b^2 - 4b^3 - 4b^3 \gamma^2 + 8\gamma b^3$. We see that $\pi_m^B > 2\pi_3^B$ iff $D > 0$. A

closer inspection of D reveals that D is decreasing in b and increasing in θ . Setting $b = 1$ and $\theta = 0$ yields $D = -18\gamma^2 + 36\gamma - 14$, and solving for γ yields $\gamma = 1 - \frac{1}{3}\sqrt{2} \approx 0.53$. Thus if $\gamma > 0.53$, then $D > 0$ for $b, \theta \in (0, 1)$. ■

Given the results in Lemma 8, the results in the Proposition is straight forward to understand. The changes in wages triggered by the merger are the driving force behind the changes in profits for insiders and outsiders following a merger.

Summing up the analysis for efficient bargaining, we see that the strength of the union matters for how much the wage drops. However, in broad terms the results mirror those from the monopoly unions. There is – with plant-specific unions – a tendency that wages drop when the number of firms in an oligopoly drops. This makes mergers more profitable than in the absence of unions, and it may become more profitable to be an insider to the merger than an outsider, contrary to what standard theory predicts.

6 Conclusions

In this paper we have shown that unions matter for the profitability of a merger, and that even union structure is of large importance. While plant-specific unions 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 unions.

Our results suggest that firms considering to merge in a unionized oligopoly should be concerned about how the unions respond to a possible merger. The existence of plant-specific unions is an argument in favour of a merger, from firms' point of view. In contrast to the received literature, there is no free-rider problem. On the contrary, each merging firm may gain more than a non-merging firm and there are thus incentives to merge rather than wait and hope that other firms should merge.

This paper has not contained a welfare theoretic analysis that could guide anti-trust policy. We here only offer some intuitive speculations. On the one hand, with plant-specific unions there will be a tendency to lower wages. The price increase following a merger then is dampened, making the merger less of a problem from a competition policy viewpoint. On the other hand, the wage decrease can trigger a higher number of profitable mergers that harm competition. For firm-specific unions, the arguments are reversed.

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.¹³ 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.

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¹³Cremieux *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 (1993) find no or only limited evidence of a link between takeovers and wages.

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