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Abstract: I analyse the effects of downstream competition when there is bargaining between downstream firms and upstream agents (firms or unions). When bargaining is over a uniform input price, a decrease in the intensity of competition (or a merger) between downstream firms may raise consumer surplus and overall welfare. When bargaining is over a two-part tariff, a decrease in the intensity of competition reduces downstream profits and upstream utility and raises consumer surplus and overall welfare. In both cases, standard welfare results of oligopoly theory can be reversed: less competition can be unprofitable for firms and/or beneficial for consumers and society as a whole.

Keywords: Competition, mergers, union-firm bargaining, bilateral oligopoly, welfare.

JEL classification: D43, L13, J50.

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1. Introduction.

The traditional view that competition among firms is beneficial for welfare has recently been challenged by a number of theoretical studies. One line of research has focused on models of semi-collusion (see, for instance, Fershtman and Gandal 1994; Brod and Shivakumar 1999; Fershtman and Pakes 2000). This work has shown that when (i) firms can collude on a short-run decision variable such as price or output but not on long-run decision variables and (ii) collusion on the short-run decision variable increases the firms' incentives to make cost-reducing or quality-enhancing investments, then the welfare gains from these investments may more than compensate for the welfare losses due to the reduction of output.

A second line of research has explored the links between the intensity of price competition and market structure (Selten 1984, Sutton 1991, Symeonidis 2002a). This literature has emphasised that an increase in the intensity of competition generally leads to a more concentrated market structure. Although these studies have not been mainly concerned with welfare results, a natural implication is that welfare may be higher when competition is not intense. This will happen if the welfare gain due to the increase in product variety more than compensates for the welfare loss caused by the fall in output.

Finally, a third literature, starting with Horn and Wolinsky (1988), has examined the effects of buyers' countervailing power and/or downstream mergers in vertically related industries or in the presence of unions. Most of these studies have found that an increase in buyers' countervailing power or a downstream merger will reduce the prices charged by suppliers, although the welfare effects are less clear. For instance, von Ungern-Sternberg (1996), Dobson and Waterson (1997) and Chen (2003) have found that, when all the downstream firms bargain with a single supplier, countervailing power will have positive effects for consumers only when downstream competition is strong. Among those papers that allow for more than one upstream agents, Ziss (1995) has found that a downstream merger between duopolists will lead to higher industry output when upstream suppliers set two-part tariffs, while Lommerud et al. (2005a, 2005b, 2006) have shown that certain types of mergers among a subset of downstream firms in an oligopoly where uniform input prices are set by upstream agents will reduce input prices and may also increase social welfare.[1]

The present paper extends the literature on the effects of competition in vertically related industries or in the presence of unions in a number of ways. I construct a model which is not restricted to the effects of mergers but analyses more generally the welfare effects of changes in the intensity of competition between downstream firms in the presence of upstream suppliers or unions. In particular, I allow for more general forms of cooperation between downstream firms, including cross-ownerships and imperfect cooperation. Second, I allow for bargaining between downstream firms and their respective upstream agents (firms or unions). My definition of bargaining covers the special cases where one or the other of the parties has all the bargaining power and effectively chooses unilaterally the input price or two-part tariff. Third, I analyse a range of bargaining

[1] There is also a related literature on the effects of upstream mergers in vertically related industries. This again begins with Horn and Wolinsky (1988) and includes Ziss (1995), Chen and Ross (2003), O'Brien and Shaffer (2005), and Milliou and Petrakis (2005). On the other hand, Inderst and Wey (2002, 2003) and Inderst and Shaffer (2004) focus primarily on the effects of mergers in vertically related industries on innovation and product variety.

structures, including bargaining over a uniform input price and bargaining over a two-part tariff. Finally, I provide a comprehensive analysis of welfare results.

In my benchmark model, two downstream firms compete in a horizontally differentiated product market. Prior to that, each of the two firms bargains with its respective upstream agent and the bargaining process is represented by the asymmetric Nash bargaining solution. Two important assumptions of the model are that each downstream firm and its upstream agent are locked into bilateral relations and that there is no cooperation at the bargaining stage. The first of these assumptions is discussed more extensively in the concluding section. The second is consistent with the idea (explored in the semi-collusion literature) that competition is often less intense in short-run decision variables than in long-run decision variables (see section 2 for details). Note that cooperation at the bargaining stage will be even harder to achieve when the downstream firms are located in different countries.

In this context the bargained input prices depend, among other things, on the competitive regime facing downstream firms. More specifically, irrespective of whether bargaining is over a linear tariff or a two-part tariff, the bargained input price is lower the lower the intensity of competition between downstream firms. Moreover, when bargaining is over a uniform input price, downstream profits are higher, upstream utility lower and, under certain circumstances, consumer surplus and total welfare higher under joint profit maximisation than in the Cournot-Nash equilibrium. When bargaining is over a two-part tariff, the positive welfare effects of joint profit maximisation by downstream firms are even more pronounced. In this case we obtain a complete reversal of the standard results of oligopoly theory: less intense competition between downstream firms reduces both their profits and the utility of the upstream agents, and it increases consumer surplus and social welfare.

Note that although joint profit maximisation will be usually described in this paper as an extreme case of 'soft' competition among firms, it can also be seen as the result of a merger or strategic alliance between the downstream firms, provided that both varieties of the product are produced[2] and the upstream agents remain independent and each locked into relations with one of the formerly independent downstream firms (see Lommerud et al. 2005a, 2006). However, an important implication of interpreting joint profit maximisation as the result of a merger is that the payoff that the downstream firm seeks to maximise in the bargaining stage of the game needs to be modified to the extent that the merger is assumed to occur prior to the bargaining stage. I discuss in the concluding remarks (and elaborate in the Appendix) this version of the model and compare it with the benchmark model. It turns out that a downstream merger between duopolists can be beneficial for consumers and for society as a whole when bargaining is over linear tariffs (but not when bargaining is over two-part tariffs).

Some of the themes that I analyse here are also explored in a number of other papers. Ziss (1995) has shown that under certain conditions a downstream merger will lead to higher output when upstream suppliers set two-part tariffs. However, there is no bargaining in his model and no analysis of the profitability effects of such a merger. I examine these issues in detail and I also provide results for a range of bargaining structures and a continuum of competitive regimes. In fact, my results differ from those obtained by Ziss because of the introduction of

[2] See Inderst and Shaffer (2004) for a model where a downstream merger leads to a reduction in product variety.

bargaining. Lommerud et al. (2005a, 2006) find that a merger among a subset of downstream firms leads to lower input prices and may increase social welfare. However, they do not consider bargaining over input prices in their model and do not analyse two-part tariffs: input suppliers unilaterally set a linear tariff.[3] Moreover, since they are primarily interested in the profitability effect of mergers, they restrict their analysis to cases that involve a merger among *a subset* of downstream firms. My approach differs from theirs in several important ways. I analyse a range of bargaining structures, including bargaining over a uniform input price and bargaining over a two-part tariff – and I find that profitability and welfare effects are very different in the two cases. Moreover, since my focus is more generally on the effects of changes in the intensity of competition in an industry rather than just on mergers, I compare various competitive regimes that affect symmetrically *all* firms in the downstream industry. Finally, I provide a more extensive and systematic analysis of welfare results.[4]

The paper is structured as follows. Section 2 examines the case of bargaining over a uniform input price, while in section 3 I introduce two-part tariffs. In both cases, I identify conditions under which standard welfare results of

[3] Lommerud et al. (2005a) discuss the case of 'efficient' bargaining in the working paper version of their paper. For reasons that I discuss below, I focus instead on bargaining over linear or two-part tariffs.

[4] Bergès-Sennou and Caprice (2004) examine the effect of joint profit maximisation in the product market on wages and employment (but not on welfare) in a model where firms also compete for skilled workers in the labour market. They show that joint profit maximisation in the product market leads to higher wages for skilled workers. My approach is very different. Instead of assuming that firms compete in the labour market, I use a bargaining framework to model the interaction between upstream agents and downstream firms.

oligopoly theory are reversed, i.e. conditions under which less competition reduces profits and/or increases consumer surplus and total welfare. The final section concludes.

2. The benchmark model with bargaining over the input price.

Consider an industry with two firms, each producing and selling to consumers one variety of a differentiated product. Preferences are described by the utility function of a representative consumer[5]

$$U = \alpha(x_1 + x_2) - \beta(x_1^2 + x_2^2) - \beta\sigma x_1 x_2 + M. \tag{1}$$

The x_i's are the quantities demanded of the different varieties of the product in question, while $M = Y - p_1 x_1 - p_2 x_2$ denotes expenditure on outside goods. The parameter σ, $\sigma \in (0,2)$, is an inverse measure of the (exogenous) degree of horizontal product differentiation: in the limit as $\sigma \to 0$ the goods become independent, while in the limit as $\sigma \to 2$ they become perfect substitutes. Finally, α and β are positive scale parameters.

The inverse demand function for variety i is given by

$$p_i = \alpha - 2\beta x_i - \beta\sigma x_j \tag{2}$$

in the region of quantity spaces where prices are positive, and the demand function is

$$x_i = \frac{2(\alpha - p_i) - \sigma(\alpha - p_j)}{\beta(2-\sigma)(2+\sigma)} \tag{3}$$

[5] This is a standard quadratic utility function and it has previously been used, sometimes with small variations, by Spence (1976), Dixit (1979), Vives (1985), Shaked and Sutton (1990), Sutton (1997, 1998), and Symeonidis (2002a, 2002b), among others.

in the region of prices where quantities are positive. Let firm i have marginal cost of production w_i, where $w_i < \alpha$. In particular, assume that only one input, L, is used in the production of variety i and has a unit price equal to w_i. This input can be labour, in which case w_i is the wage rate; or it can be an intermediate product sold by upstream manufacturers to downstream manufacturers; or it can be the final product, in which case the downstream firms are distributors. In any case, there are constant returns to scale, so that $x_i = L_i$.

Competition in the industry is described by a two-stage game as follows.[6] At stage 1, each downstream firm i forms a bargaining unit with an upstream agent (firm or union) and bargains over w_i. Although each bargain is independent, there is also interaction at this stage: the set of w_i that we obtain is the outcome of a non-cooperative Nash equilibrium between the two bargaining units. At stage 2, the downstream firms compete in quantities given the values of w_i from stage 1. In what follows I derive the pure strategy subgame-perfect equilibrium of this game. Note that the bargaining covers only the input price, not the level of output (or employment) of the downstream firm. This is a common assumption in the bilateral oligopoly literature as well as in models of union-firm bargaining (as it is consistent with much of the empirical evidence). The case of bargaining over both

[6] See also Horn and Wolinsky (1988), Dowrick (1989), Dobson (1997), Petrakis and Vlassis (2000) and Naylor (2002), among others. Correa-Lopez and Naylor (2004) compare Cournot and Bertrand equilibria of this game when bargaining is over linear tariffs. Inderst and Wey (2002, 2003) and Milliou et al. (2003) allow for a more complex bargaining process between downstream and upstream firms. All these papers analyse models with a similar structure to the one presented here (i.e. multistage oligopoly games with a bargaining stage followed by a product market competition stage), but none of them examines the welfare effects of the intensity of competition among (downstream) firms.

input price and output is discussed briefly in my concluding remarks. I also assume in this section that the input prices are linear tariffs. Two-part tariffs are discussed in section 3.

Two different ways of modelling the intensity of competition between downstream firms will be used below. The first is standard and involves comparing the joint monopoly outcome with the Cournot-Nash equilibrium of the second-stage subgame. The second is an attempt to allow for a continuum of degrees of competition and involves assuming that at the second-stage subgame each firm maximises the sum of its own profit and a fraction λ of the profit of its rival. The parameter λ, $\lambda \in [0,1]$, is an inverse measure of the intensity of competition, with $\lambda = 0$ corresponding to the Cournot-Nash equilibrium and $\lambda = 1$ corresponding to joint profit maximisation. Intermediate values of λ could represent imperfect collusion – and may be justified by reference to some implicit dynamic model of collusion, a reduced-form representation of which is the quantity competition subgame of the present model.[7] The parameter λ was named 'coefficient of cooperation' by Cyert

[7] For instance, a well-known result in oligopoly theory states that any individually rational and feasible payoff vector can be sustained as an equilibrium of an infinitely repeated game if the players are sufficiently patient. Alternatively, one can assume that firms always achieve the highest level of collusion that is sustainable given a number of exogenous parameters; under this interpretation, a fall in λ might correspond to a lower critical discount factor in an infinitely repeated game. See, for instance, Dal Bo (2002) for a model of a repeated game where the level of collusive prices and profits increases with the discount factor. Note also that the parameter λ is free from some of the theoretical problems encountered in other approaches to modelling the intensity of competition by way of a reduced-form parameter, such as the conjectural variations approach.

and deGroot (1973) and has been used in oligopoly models also by Shubik (1980), Brod and Shivakumar (1999) and Symeonidis (2000), among others.

What also justifies the use of λ as a reduced-form competition parameter is its properties in the final-stage subgame: it can be checked that the equilibrium price, price-cost margin and profit in the second-stage subgame increase and the equilibrium quantity falls as λ rises (the intensity of competition decreases). These properties contrast with the properties of σ, which has often been used as a measure of competition. It can be checked that a fall in σ, i.e. an increase in the degree of product differentiation, increases *both* the equilibrium price and the equilibrium quantity in the second-stage subgame.[8]

Since the main focus of the present paper is on comparing welfare properties of different competitive regimes, I will keep things simple by taking these regimes as exogenous. The exogeneity of λ is not an unreasonable assumption, given the well-known multiplicity of possible equilibria in models of infinitely repeated games. Moreover, the exogeneity assumption is justifiable in various empirical contexts – for instance when significant changes in the intensity of competition occur as a result of exogenous institutional changes such as economic integration or the introduction of effective cartel policy.

There is also an alternative interpretation of λ: it can be thought of as a measure of the degree of cross-ownership, with the case $\lambda = 1$ corresponding to a full merger. A positive value for λ can also result from a strategic alliance between the downstream firms. This interpretation, however, is not a trivial change, since it affects

[8] This property of σ in the present model may be driven by the fact that there are aggregate demand effects related to the degree of horizontal product differentiation, and does not necessarily hold for alternative specifications of demand.

the behaviour of the downstream firm during the bargaining process. I discuss this version of the model in the concluding section (and I provide details of the results in the Appendix).

At the second-stage subgame, then, firm i chooses x_i to maximise $\Pi_i = \pi_i + \lambda\pi_j$, where

$$\pi_i = (p_i - w_i)x_i = (\alpha - 2\beta x_i - \beta\sigma x_j - w_i)x_i\,, \tag{4}$$

and the parameter λ, $\lambda \in [0,1]$, can be thought of either as a continuous measure of the intensity of competition or as a discreet parameter that can take only two values, namely $\lambda = 0$ and $\lambda = 1$. Solving the system of the two first-order conditions and using also the inverse demand function we obtain the Cournot-Nash equilibrium values of x_i and p_i in the second-stage subgame as functions of w_i and w_j:

$$\begin{aligned} \hat{x}_i &= \frac{4(\alpha - w_i) - \sigma(1+\lambda)(\alpha - w_j)}{\beta[4 - \sigma(1+\lambda)][4 + \sigma(1+\lambda)]} \\ \hat{p}_i &= w_i + \frac{[8 - \sigma^2\lambda(1+\lambda)](\alpha - w_i) - 2\sigma(1-\lambda)(\alpha - w_j)}{[4 - \sigma(1+\lambda)][4 + \sigma(1+\lambda)]}. \end{aligned} \tag{5}$$

in the region of w spaces where $\hat{x}_i \geq 0$, $\hat{p}_i \geq 0$, $i = 1,2$ (this is satisfied as long as w_i and w_j are not too dissimilar). Note that if w_i and w_j were too dissimilar, then the inefficient firm would have zero sales and the other firm would make monopoly profit. However, this case is not relevant as a potential equilibrium of the game: a bargaining unit would not choose a level of w at stage 1 of the game that resulted in zero output in the second stage.[9] It can be seen that $\hat{x}_i$ is decreasing in w_i and increasing in w_j. Also, $\hat{p}_i$ is increasing in both w_i and w_j.

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[9] If the efficiency difference between the two firms is too large, joint profit maximisation does not necessarily benefit the inefficient firm. I will assume that, in

At stage 1 of the game, the downstream firm *i* and the upstream agent (firm or union) *i* form a bargaining unit and set w_i so as to maximise the Nash product

$$\Omega_i = [(w_i - w_0)\hat{x}_i]^{\varphi}[(\hat{p}_i - w_i)\hat{x}_i]^{1-\varphi}. \qquad (6)$$

The parameter $\varphi \in [0,1]$ is a measure of the bargaining power of the upstream agent relative to that of the downstream firm. It depends on the relative degrees of impatience and risk aversion of the two parties, so it is taken here as exogenous. Thus the value $\varphi = 1$ corresponds to the case where an upstream agent chooses w_i to maximise its utility (and there is effectively no bargaining), while $\varphi = 0$ corresponds to the case where w_i is set by the downstream firm. The interpretation of w_o depends on the identity of the upstream agent: it is either the wage that the union would obtain in a competitive non-unionised labour market or the unit cost of the upstream firm. The utility of the upstream agent is given by $U_i = (w_i - w_0)x_i$. Recall that $x_i = L_i$ in this model. Hence when the upstream agent is a union, it aims to maximise the total rent (or the wage bill if $w_o = 0$). When the upstream agent is a firm, it aims to maximise its profit.[10]

Note that the downstream firm's payoff in the Nash product is its own second-stage profit, i.e. cooperation between downstream firms does not extend to

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the event that the profit is lower under joint profit maximisation than in the Cournot-Nash equilibrium for one of the firms, a side payment will be made at stage 2 of the game to ensure that no firm loses out from joint profit maximisation. This will not affect the derivation of the symmetric equilibrium in the two-stage game.

[10] A more general utility function for the upstream agent would take the form $U_i = (w_i - w_0)^{2(1-\gamma)} x_i^{2\gamma}$, where $\gamma \in [0,1]$. When the upstream agent is a union, γ denotes the relative strength of union preferences for employment over wages. I set γ = ½ for simplicity in what follows, however the main results of this section carry through to the more general case, as I discuss briefly in footnote 16.

the bargaining stage. The justification for this is the fact that the outcome of the bargaining process is difficult to modify in the short or medium term and normally takes the form of a contract or agreement that is renegotiated at infrequent time intervals. Thus reaction lags are relatively long, which makes cooperation between downstream firms at the bargaining stage difficult to sustain (this is essentially the standard argument in most of the semi-collusion literature). Moreover, the disagreement payoffs are equal to zero for both upstream agents and downstream firms, which implies that in the event of a breakdown of negotiations within bargaining unit i, the downstream firm i has no stake in the profit of downstream firm j. These assumptions seem fairly uncontroversial when the downstream firms are separate entities and λ is interpreted as a degree of competition parameter. If λ is interpreted as a measure of cross-ownership, these assumptions are not valid in general, although the results turn out to be similar to the benchmark results for the case of linear tariffs.

I also assume that bargaining is decentralised (i.e. each downstream firm bargains separately with an upstream agent) and do not allow for cooperation between bargaining units. Decentralised bargaining seems an obvious modelling choice for the case where the upstream agents are firms. Even in the case of unions, decentralised bargaining has long been predominant in several countries (such as the UK), while a trend toward more decentralised bargaining structures has been observed in recent years in many other countries. The justification for the lack of cooperation between bargaining units is essentially the same as for the lack of cooperation between downstream firms at the bargaining stage.[11]

[11] Joint profit maximisation by bargaining units would be equivalent to centralised bargaining (i.e. the case where the entire downstream industry bargains with the entire

The first-order condition for the choice of w_i by bargaining unit i can be written, after some manipulation, as:

$$\varphi(\hat{p}_i - w_i)\hat{x}_i + (\hat{p}_i - w_i)(w_i - w_0)\frac{\partial \hat{x}_i}{\partial w_i} + (1-\varphi)(w_i - w_0)\hat{x}_i \frac{\partial(\hat{p}_i - w_i)}{\partial w_i} = 0\,. \tag{7}$$

As pointed out above, the values of w_i and w_j that we obtain at stage 1 of the game are the outcome of a non-cooperative Nash equilibrium between the two bargaining units. In other words, w_i is the Nash solution to the bargaining problem between downstream firm i and its upstream agent given that both expect the input price w_j to be agreed between downstream firm j and its upstream agent. Solving for the (symmetric) equilibrium we obtain:

$$w^* = w_0 + \frac{\varphi(2+\sigma\lambda)\left[4-\sigma(1+\lambda)\right](\alpha - w_0)}{K}, \tag{8}$$

where

$$K = \varphi(2+\sigma\lambda)\left[4+4\varphi-\sigma\varphi(1+\lambda)\right] + (1-\varphi)\left\{2(2-\sigma)+(2-\sigma\lambda)\left[2+\sigma(1+\lambda)\right]\right\} > 0. \tag{9}$$

From equation (8) we obtain

$$\frac{\partial w^*}{\partial \lambda} = \frac{-2\sigma\varphi\left\{4\varphi\gamma(2+\sigma\lambda)^2 + \sigma(1-\varphi)\left[8\lambda+\sigma(1+\lambda)^2\right]\right\}(\alpha - w_0)}{K^2}, \tag{10}$$

which is negative for all $\sigma\in(0,2)$, $\varphi\in(0,1]$. This establishes our first result:

Proposition 1. *When downstream firms and upstream agents bargain over a uniform input price and $\varphi\in(0,1]$, the input price decreases in λ. For $\varphi = 0$, the input price is independent of λ and equal to w_o.*

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upstream industry or an industry-wide union). It is known that the competitive regime facing downstream firms has no effect on equilibrium outcomes under fairly general conditions when firms participate in centralised bargaining prior to competing in the downstream market (see Dowrick 1989, Dhillon and Petrakis 2002).

Recall that the value $\lambda = 0$ corresponds to the Cournot-Nash equilibrium, while $\lambda = 1$ corresponds to joint profit maximisation. Hence Proposition 1 implies that the input price is generally higher in the Cournot-Nash equilibrium than under joint profit maximisation by downstream firms.

Proposition 1 holds for any values of $\varphi \in (0,1]$, even when the upstream agents have all the bargaining power ($\varphi = 1$). This may seem counterintuitive. One might think that since joint profit maximisation by downstream firms increases downstream profit, it should allow upstream agents to appropriate a larger rent through a higher input price. This argument, however, fails to take into account the way joint profit maximisation changes the incentives of the parties during the negotiations through its effect on the marginal returns of a change in the input price.

To understand the intuition for Proposition 1, it is necessary to examine the way changes in the input price affect upstream utility and downstream profit.[12] Consider first the downstream firm's incentives during the negotiations. A unit increase in w_i always decreases the equilibrium profit of downstream firm i when starting from a symmetric equilibrium with $w_i = w_j$. Moreover, the effect of a unit change in w_i on profit is larger (in absolute value) the higher the value of λ, i.e. $\frac{\partial}{\partial \lambda}\left|\frac{\partial \hat{\pi}_i}{\partial w_i}\right| > 0 \ \ at \ \ w_i = w_j = w.$ This result is driven by the fact that an increase in the input price of one downstream firm shifts production to the other downstream firm and this effect is stronger when downstream competition is not intense. Thus

[12] See Correa-López and Naylor (2004) and Lommerud et al. (2005a) for a related argument, and Symeonidis (2000) for an analogous mechanism in the context of a vertical differentiation model.

each downstream firm has a stronger incentive to avoid a high input price and will be more resistant to any increase in w proposed by its upstream agent the higher the value of λ (assuming that the downstream firm has some bargaining power, i.e. for $\varphi \neq 1$; if the downstream firm has no bargaining power, then the mechanism just described is not relevant). This contributes to input prices being lower the higher the value of λ.

Consider next the upstream agent's point of view. An increase in w_i raises the utility of the upstream agent for any given level of output. However, the higher the value of λ, the lower the level of output, and therefore the lower the effect of a unit increase in w_i on the utility of the upstream agent. As a result, the upstream agent will be less keen to achieve a high w the higher the value of λ. Furthermore, an increase in w_i reduces the equilibrium output of downstream firm i and thus decreases the utility of its upstream agent. Now the effect of a unit change in w_i on output is larger (in absolute value) the higher the value of λ, i.e. $\frac{\partial}{\partial \lambda}\left|\frac{\partial \hat{x}_i}{\partial w_i}\right| > 0$. For this reason too each upstream agent will be more reluctant to propose an increase in w the higher the value of λ. These mechanisms reinforce the mechanism working through the effect of w on downstream profit. As a result, input prices are lower the higher the value of λ.

Proposition 1 raises the possibility that the welfare effects of competition are different in the present model than in a standard oligopoly model where input prices are taken as exogenous. Equilibrium consumer surplus, aggregate downstream profit, and aggregate upstream agent utility are, respectively, given as

$$CS^* = 2\alpha x^* - 2\beta(x^*)^2 - \beta\sigma(x^*)^2 - 2p^* x^* \qquad (11)$$

$$\Pi^* = 2(p^* - w^*)x^* \qquad (12)$$

and

$$U^* = 2(w^* - w_0)x^*, \tag{13}$$

where x^* and p^* are the equilibrium values of x and p in the two-stage game and are given by equations (5) after setting $w_i = w_j = w^*$:

$$x^* = \frac{\alpha - w^*}{\beta[4+\sigma(1+\lambda)]}, \qquad p^* = w^* + \frac{(\alpha - w^*)(2+\sigma\lambda)}{4+\sigma(1+\lambda)}. \tag{14}$$

The next result shows that consumer surplus may be higher or lower at the Cournot-Nash equilibrium than under joint profit maximisation:

Proposition 2. *Suppose that downstream firms and upstream agents bargain over a uniform input price and the products are close substitutes. Then consumer surplus is higher under joint profit maximisation by downstream firms than at the Cournot-Nash equilibrium if upstream agents have significant bargaining power. Consumer surplus is higher at the Cournot-Nash equilibrium than under joint profit maximisation if upstream agents have little bargaining power.*

Proof. See the Appendix.

Note that Proposition 2 holds when σ is close to 2. On the other hand, it is easy to check that in the limit as $\sigma \to 0$ (i.e. as the products become independent), consumer surplus is always higher at the Cournot-Nash equilibrium than under joint profit maximisation.[13] For intermediate values of σ, numerical results suggest that Proposition 2 holds as long as the products are not too differentiated.

[13] To show this, note first that for $\sigma = 0$, $CS^*(\lambda = 0) = CS^*(\lambda = 1)$. Then take the derivative of $CS^*(\lambda = 0) - CS^*(\lambda = 1)$ with respect to σ and evaluate it at $\sigma = 0$. The resulting expression is positive, hence $CS^*(\lambda = 0) > CS^*(\lambda = 1)$ for σ close to 0.

The intuition for Proposition 2 should be clear in light of Proposition 1. The total effect of a change in λ on consumer surplus is $\frac{dCS}{d\lambda} = \frac{\partial CS}{\partial \lambda} + \frac{\partial CS}{\partial w^*}\frac{\partial w^*}{\partial \lambda}$. The first term on the right-hand-side captures the direct effect of a change in the intensity of competition on consumer surplus, while the second term captures the indirect effect working through the change in the input price. It is straightforward to check that $\frac{\partial CS}{\partial \lambda}$ < 0 and $\frac{\partial CS}{\partial w^*}$ < 0, and we also know that $\frac{\partial w^*}{\partial \lambda}$ ≤ 0, so the total effect can be ambiguous. As it turns out, when the products are not too differentiated (σ is close to 2) and the upstream agents have significant bargaining power (φ is large), the indirect positive effect of less intense competition on consumer surplus dominates the direct negative effect.[14]

I now consider the effect of competition on the aggregate downstream profit. For any given input price, aggregate downstream profit is higher the lower the intensity of competition – a standard result in oligopoly models with fixed input prices and number of varieties. Since the equilibrium input price in the present model is generally lower the lower the intensity of competition, and a lower input price raises downstream profit, it is clear that the standard result will be reinforced:

Proposition 3. *When downstream firms and upstream agents bargain over a uniform input price, the aggregate profit of the downstream firms increases in* λ *for all* $\lambda \in [0,1)$.

Proof. See the Appendix.

[14] The reason is that $w^*(\lambda = 0) - w^*(\lambda = 1)$ is larger when σ and φ are large.

It is easy to check that the sum of consumer surplus and aggregate downstream profit will be higher under joint profit maximisation than at the Cournot-Nash equilibrium when φ is large and the products are not too differentiated.

Next, I examine the effect of the competitive regime on the utility of the upstream agents. The effect of a change in λ on aggregate upstream agent utility can be decomposed into three different effects as follows:

$$\frac{\partial U^*}{\partial \lambda} = 2x^* \frac{\partial w^*}{\partial \lambda} + 2(w^* - w_0)\frac{\partial x^*}{\partial \lambda} + 2(w^* - w_0)\left(\frac{\partial x^*}{\partial w^*}\frac{\partial w^*}{\partial \lambda}\right). \tag{15}$$

The first term stands for the effect of a change in λ on the equilibrium input price w^*. As we know from Proposition 1, this effect is negative (or, in a special case, zero). The second term captures the direct effect of a change in λ on the equilibrium level of output x^*. This term is also negative, since output is lower the higher the value of λ for any given level of w. The third term captures the indirect effect of a change in λ on x^* that works through the change in the input price. Since we have $\frac{\partial x^*}{\partial w^*} < 0$ and $\frac{\partial w^*}{\partial \lambda} \leq 0$, this term is positive or zero. However, this effect is a second-order one, and $\partial U^*/\partial \lambda$ is negative in the present model:

Proposition 4. *When downstream firms and upstream agents bargain over a uniform input price and $\varphi \in (0,1]$, the aggregate upstream agent utility decreases in λ. For $\varphi = 0$, the upstream agent utility is independent of λ (and equal to zero).*

Proof. See the Appendix.

Finally, overall welfare is given by $W^* = CS^* + \Pi^* + U^*$. We obtain:

Proposition 5. *Suppose that downstream firms and upstream agents bargain over a uniform input price and the products are close substitutes. Then total welfare is higher under joint profit maximisation by downstream firms than at the Cournot-*

Nash equilibrium if upstream agents have significant bargaining power. Total welfare is higher at the Cournot-Nash equilibrium than under joint profit maximisation if upstream agents have little bargaining power.

Proof. See the Appendix.

Note that Proposition 5 holds when σ is sufficiently large. On the other hand, it is easy to check that in the limit as $\sigma \to 0$, welfare is always higher at the Cournot-Nash equilibrium than under joint profit maximisation.[15] [16]

3. Bargaining over two-part tariffs.

The assumption that input prices are linear tariffs may be somewhat restrictive, especially when the upstream agents are firms, given that uniform price contracts are generally inefficient and upstream firms are less constrained than unions by institutional or other factors when specifying a contract with downstream firms. This does not invalidate the approach adopted in the previous section since uniform price contracts are widely observed in practice. Still, one would want to

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[15] To show this, note first that for $\sigma = 0$, $W^*(\lambda = 0) = W^*(\lambda = 1)$. Then evaluate the derivative of $W^*(\lambda = 0) - W^*(\lambda = 1)$ with respect to σ at $\sigma = 0$. The resulting expression is positive, hence $W^*(\lambda = 0) > W^*(\lambda = 1)$ for σ close to 0.

[16] Propositions 1, 3 and 4 still hold when the upstream agent's utility function takes the form $U_i = (w_i - w_0)^{2(1-\gamma)} x_i^{2\gamma}$, for $\gamma \in [0,1)$ (when $\gamma = 1$, $w^* = w_o$). Propositions 2 and 5 are modified in this case in the sense that consumer surplus is now higher under joint profit maximisation than at the Cournot-Nash equilibrium when φ and σ are sufficiently large *and* γ is small, while total welfare is higher under joint profit maximisation when φ and σ are large *and* γ takes intermediate values.

When firms set prices rather than quantities in the second-stage subgame, propositions 1, 3 and 4 still hold, but propositions 2 and 5 do not: consumer surplus and overall welfare are always higher the lower the value of λ.

analyse how the results described in the previous section might change when one allows for non-linear price contracts between upstream agents and downstream firms. Although this analysis may seem more relevant when the upstream agents are firms (especially when there are close relationships between downstream firms and upstream suppliers, which is the case examined in this paper), it is also possible to interpret this case as a union-firm bargain, where there is a "lump-sum" payment to the union or a non-monetary benefit such as an improvement in working conditions which has a monetary equivalent in the form of a fixed fee.

In this section I extend the basic model of the previous section to allow for bargaining over two-part tariffs. The structure of demand is the same as in the previous section, but the profit function of downstream firm i is now given by $\pi_i = (p_i - w_i)x_i - F_i$, where $F_i \geq 0$ is a lump sum transfer from downstream firm i to its upstream agent.[17] At stage 2 of the two-stage game, the downstream firms compete in quantities given the unit input prices and fixed fees set at stage 1.[18] I allow for different degrees of competition in the second-stage subgame. At stage 1, each downstream firm i bargains independently over w_i and F_i with an upstream agent. The values of w_i and F_i are chosen so as to maximise

$$\Omega_i = \left[(w_i - w_0)\hat{x}_i + F_i\right]^{\varphi}\left[(\hat{p}_i - w_i)\hat{x}_i - F_i\right]^{1-\varphi}, \tag{16}$$

taking as given the values of w_j and F_j (that is, w_i, w_j, F_i and F_j are the outcome of a non-cooperative Nash equilibrium between the two bargaining units).

[17] There are similarities between the two-part tariff case examined here and the literature on managerial incentives in oligopoly (see Fershtman and Judd 1987, Sklivas 1987).

[18] The main results of this section (propositions 6 and 7) are robust to price-setting by downstream firms.

In this context, although the objective of each party in the negotiations within a bargaining unit is to maximise its own profit and there is no cooperation at the bargaining stage, there are two instruments at the disposal of downstream firms and upstream agents. Hence w_i will be chosen to maximise the joint profit of the bargaining unit (and will therefore be independent of φ), while the fixed fee will be determined by the respective bargaining power of the parties. Solving for the (symmetric) equilibrium, we obtain:

$$w^{**} = w_0 - \frac{(\alpha - w_0)\sigma[\sigma + \lambda(4+\sigma)]}{16 + 4\sigma - \sigma^2(1+\lambda)} \tag{17}$$

$$F^{**} = \frac{4(\alpha - w_0)^2[8\varphi + 4\lambda\sigma + \sigma^2(1-\varphi)(1+\lambda)]}{\beta[16 + 4\sigma - \sigma^2(1+\lambda)]^2} \tag{18}$$

Straightforward calculations yield:

$$\frac{\partial w^{**}}{\partial \lambda} = \frac{-32\sigma(2+\sigma)(\alpha - w_0)}{[16 + 4\sigma - \sigma^2(1+\lambda)]^2} < 0 \tag{19}$$

and

$$\frac{\partial F^{**}}{\partial \lambda} = \frac{4\sigma[4(16+\lambda\sigma^2) + 4\sigma(8-\varphi\sigma) + (1-\varphi)\sigma^3(1+\lambda)](\alpha - w_0)^2}{\beta[16 + 4\sigma - \sigma^2(1+\lambda)]^3} > 0, \tag{20}$$

for all $\sigma \in (0,2)$, $\lambda \in [0,1]$ and $\varphi \in [0,1]$. Hence:

Proposition 6. *When downstream firms and upstream agents bargain over two-part tariffs, the unit input price decreases and the fixed fee increases in λ.*

The intuition for the first part of Proposition 6 is similar to that already discussed for the case of bargaining over a uniform input price. In particular, both the downstream firm and the upstream agent within each bargaining unit will be more reluctant to propose or accept increases in w the higher the value of λ because of the effect this will have on their joint profit. As a result, the unit input price will be lower the higher the value of λ. On the other hand, the level of the fixed fee has no effect on output, and its effect on upstream utility and downstream profit is independent of the competitive regime. The reason for the positive effect of λ on F is that a decrease in the intensity of competition generates more rents overall (through both a direct market power effect and an indirect effect due to the lower unit input price) and the upstream agents can then appropriate more of those rents through a higher fixed fee.

Equilibrium consumer surplus, aggregate downstream profit, and aggregate upstream utility are, respectively, given as

$$CS^{**} = 2\alpha x^{**} - 2\beta(x^{**})^2 - \beta\sigma(x^{**})^2 - 2p^{**}x^{**} \tag{21}$$

$$\Pi^{**} = 2(p^{**} - w^{**})x^{**} - 2F^{**} \tag{22}$$

and

$$U^{**} = 2(w^{**} - w_0)x^{**} + 2F^{**}, \tag{23}$$

where p^{**} and x^{**} are given by equations (5) after setting $w_i = w_j = w^{**}$:

$$x^{**} = \frac{\alpha - w^{**}}{\beta[4 + \sigma(1+\lambda)]}, \qquad p^{**} = w^{**} + \frac{(\alpha - w^{**})(2 + \sigma\lambda)}{4 + \sigma(1+\lambda)}. \tag{24}$$

Note that consumer surplus, total profit ($\Pi^{**} + U^{**}$) and total welfare ($CS^{**} + \Pi^{**} + U^{**}$) are independent of F^{**} and hence also of φ. This is due to the fact that (i) changes in fixed costs have no effect on marginal costs or quantities produced at equilibrium, and (ii) marginal costs are independent of the relative bargaining power of upstream agents and downstream firms because the use of two-part tariffs leads to joint profit maximisation by each bargaining unit.

The welfare effects of a change in the intensity of competition are, in principle, ambiguous when downstream firms bargain with upstream agents over two-part tariffs. Take, first, consumer surplus. Although this is independent of the fixed fee, it is a function of the input price. The total effect of a change in λ on consumer surplus is the sum of a direct effect and an indirect effect, the latter working through the change in the input price. The former effect is negative, while the latter is positive, so the total effect is potentially ambiguous. If the effect of λ on the equilibrium input price is sufficiently strong, consumer surplus will increase when competition is less intense.

The aggregate downstream profit depends not only on output sold and the unit input price w, but also on the fixed fee F. For any given input price and fixed fee, aggregate downstream profit is always higher when competition is less intense – a standard result in oligopoly theory. Moreover, the equilibrium unit input price falls as λ rises in the present model, and a lower input price raises downstream profit, thus reinforcing the standard result. However, the equilibrium fixed fee rises as λ rises, and a higher fixed fee reduces downstream profit, thus working against the standard result. Hence the overall effect of a change in λ on downstream profit can be ambiguous, depending on the relative strength of the direct effect and the two indirect effects mentioned above. If the effect working through the fixed fee is sufficiently strong, the standard result of oligopoly theory will be reversed.

Finally, consider the effect of a change in the competitive regime on upstream utility. This effect can be decomposed into four different effects as follows:

$$\frac{\partial U^{**}}{\partial \lambda} = 2x^{**}\frac{\partial w^{**}}{\partial \lambda} + 2(w^{**} - w_0)\frac{\partial x^{**}}{\partial \lambda} + 2(w^{**} - w_0)\left(\frac{\partial x^{**}}{\partial w^{**}}\frac{\partial w^{**}}{\partial \lambda}\right) + 2\frac{\partial F^{**}}{\partial \lambda}. \quad (25)$$

The first three terms are already familiar and their signs are the same as in the previous section. The fourth term captures the (positive) effect of a change in λ on F^{**}. The overall effect of a change in λ on U^{**} is potentially ambiguous.

As it turns out, all these effects are unambiguous in the present model. Moreover, they are the *opposite* of those obtained from standard oligopoly models with exogenous marginal costs and number of varieties. In particular:

Proposition 7. *When downstream firms and upstream agents bargain over two-part tariffs and $\varphi \in (0,1)$:*

(i) *The aggregate downstream profit and the aggregate upstream utility both decrease in λ.*

(ii) *Consumer surplus, the sum of consumer surplus and aggregate downstream profit, and total welfare all increase in λ.*

Proof. From equations (17), (18), (21), (22), (23) and (24) we obtain:

$$CS^{**} = \frac{16(2+\sigma)(\alpha - w_0)^2}{\beta\left[16+4\sigma-\sigma^2(1+\lambda)\right]^2} \tag{26}$$

$$\Pi^{**} = \frac{8(1-\varphi)\left[8-\sigma^2(1+\lambda)\right](\alpha - w_0)^2}{\beta\left[16+4\sigma-\sigma^2(1+\lambda)\right]^2} \tag{27}$$

$$U^{**} = \frac{8\varphi\left[8-\sigma^2(1+\lambda)\right](\alpha - w_0)^2}{\beta\left[16+4\sigma-\sigma^2(1+\lambda)\right]^2}. \tag{28}$$

It is easy to check that:

$$\frac{\partial CS^{**}}{\partial \lambda} > 0, \; \frac{\partial \Pi^{**}}{\partial \lambda} < 0, \; \frac{\partial (CS^{**}+\Pi^{**})}{\partial \lambda} > 0, \; \frac{\partial U^{**}}{\partial \lambda} < 0 \text{ and}$$

$$\frac{\partial (CS^{**}+\Pi^{**}+U^{**})}{\partial \lambda} > 0, \tag{29}$$

for all $\sigma \in (0,2)$, $\lambda \in [0,1]$ and $\varphi \in (0,1)$. □

Note that when $\varphi = 1$, Π^{**} is always equal to zero and all the other results are the same as above. When $\varphi = 0$, U^{**} is always equal to zero and all the other results are the same as above.

In summary, we obtain a complete reversal of the standard results of oligopoly theory. Less intense competition in the downstream market reduces both downstream profit and upstream utility.[19] It is worth emphasising that this is true for downstream profit as well, as it is the opposite of what we have obtained in section 2 for the case of linear tariffs. Moreover, less intense competition in the downstream market increases consumer surplus, the sum of consumer surplus and downstream profit, and total welfare. Although these results have been derived here in the context of a duopoly with linear demand, the mechanisms that drive them are much more general.

Why do the welfare effects of downstream competition depend on whether bargaining is over a two-part tariff or a linear tariff? Two remarks are in order. First, the introduction of a fixed fee implies that there is an additional indirect effect of a decrease in the intensity of competition between downstream firms on downstream profit (but not on consumer surplus), working through the change in the fixed fee. This effect – which is absent when bargaining is over a linear tariff – is negative, since a larger fixed fee decreases the profit of the downstream industry and the fixed fee is larger the higher the value of λ. This is the reason why downstream profit decreases in λ when bargaining is over a two-part tariff (Proposition 7), even though it increases in λ when bargaining is over a linear tariff (Proposition 3).

Second, the introduction of a fixed fee implies that each bargaining unit can be more efficient in its choice of a unit input price. In particular, the equilibrium unit input price is lower than it would have been in the absence of the fixed fee (in fact, it

[19] A similar result is often found in models of semi-collusion. Of course, downstream firms would prefer less intense competition once the bargaining with the upstream agents is over: for given two-part tariffs, downstream profit increases in λ.

is lower than w_0). A lower input price increases consumer surplus, everything else being equal. It follows that the indirect effect of a change in λ on consumer surplus working through the change in the unit input price is stronger when bargaining is over a two-part tariff than when it is over a linear tariff. Now recall that this indirect effect is the reason why less intense competition between downstream firms may cause consumer surplus to rise in a bargaining framework. Hence consumer surplus always increases in λ when there is bargaining over a two-part tariff (Proposition 6), although it may increase or decrease in λ when there is bargaining over a linear tariff (Proposition 2).

4. Concluding remarks.

I have analysed the welfare effects of changes in the intensity of competition between downstream firms when there is bargaining between downstream firms and upstream agents (firms or unions) over a linear tariff or over a two-part tariff. There was no scope for innovation or productivity improvements in the present model, so the focus was on static welfare results. I have then identified circumstances where a reduction in the intensity of competition may have unexpected welfare implications, such as a reduction in profit and/or an increase in consumer surplus and total welfare.

While joint profit maximisation has been described here as an extreme case of 'soft' competition among firms, it could also be seen as the result of a merger or strategic alliance between downstream firms. More generally, an alternative interpretation of the parameter λ is as a measure of the degree of cross-ownership in the downstream market, with $\lambda = 1$ corresponding to a full merger. This interpretation changes the payoffs at the bargaining stage of the game to the extent that the degree of cross-ownership must be specified before the bargaining stage.

In particular, at the bargaining stage the downstream firm's payoff in the Nash product is no longer its own second-stage profit and the disagreement payoff for the downstream firm is no longer zero.[20] As shown in the Appendix, all the results in section 2 (on linear tariffs) are robust to this change of interpretation, although the results in section 3 (on two-part tariffs) are not.[21] In other words, a (profitable) merger between the downstream firms in a vertical duopoly may raise consumer surplus and total welfare when bargaining is over linear tariffs.

I have not analysed in this paper the case where not only the input price but also the level of output (or employment) is determined through bargaining. However, it is clear that the input price cannot be lower under joint profit maximisation by downstream firms than at the Cournot-Nash equilibrium in this case. When the input price and the level of output are set simultaneously rather than sequentially, the choice of input price is not complicated by strategic considerations, so the mechanism I have described in this paper to provide intuition for Proposition 1 (and other results) is no longer relevant. Instead, *w* is now higher the lower the intensity of competition simply because there are then more rents to be shared between upstream agents and downstream firms for any given level of *w*.

[20] For instance, when bargaining is over linear tariffs, at stage 1 of the game the downstream firm *i* and the upstream agent *i* choose w_i to maximise the Nash product $\Omega_i = \left[(w_i - w_0)\hat{x}_i\right]^{\varphi}\left[(\hat{p}_i - w_i)\hat{x}_i + \lambda(\hat{p}_j - w_j)\hat{x}_j - \lambda(\overline{p}_j - w_j)\overline{x}_j\right]^{1-\varphi}$, taking the value of w_j as given, where $\hat{p}_i$, $\hat{x}_i$, $\hat{p}_j$ and $\hat{x}_j$ are given in equations (5) and $\overline{p}_j$ and $\overline{x}_j$ are the price and output of good *j* in the case of a bargaining conflict between the downstream firm *i* and upstream agent *i*.

[21] Note that although Proposition 1 still holds under this alternative interpretation, the intuition is now somewhat different: the result hinges to a large extent on a standard countervailing power effect.

Furthermore, output is lower the less intense the competition for essentially the same reason as in the standard oligopoly model with exogenous costs, namely because bargaining units can boost joint profits by restricting output for any given level of w. These effects imply that the effect of competition on consumer surplus and overall welfare will be similar to the standard welfare results of oligopoly theory.

An important assumption of the model is that a downstream firm and its upstream agent are already locked into bilateral relations when they bargain over the input price. This assumption is fairly uncontroversial when the upstream agents are unions (see the discussion in Horn and Wolinsky 1988). One way to justify this assumption when the upstream agents are firms is to assume that, prior to reaching an agreement on price, the two parties have already made some relation-specific investments that prevent them from breaking up. It is not unreasonable to assume that these investments might represent very long-run decisions, while decisions about the bargained input price are easier to reverse in the medium term.[22] If so, the structure of the game analysed in the present paper is valid whatever the identity of the upstream agent.

Although some of the specific welfare results of the present model may be due to its particular structure and the functional forms used, many of the economic mechanisms than underlie these results are far more general. For instance, the fact that the bargained input price is lower when competition is less intense is crucial but it is not specific to the linear demand system or even to the presence of bargaining. A lower input price under joint profit maximisation will also obtain when downstream

[22] Even when a basic input price is specified in a long-term contract between an upstream and a downstream firm prior to any relation-specific investment being made, the contract needs to allow for some flexibility, so discounts and even the basic input price are likely to be subject to regular renegotiation.

firms are facing an upward-sloping supply curve for their input under conditions of perfect competition in the input market. Joint profit maximisation by downstream firms would then result in a lower level of output, thus reducing the demand for inputs and therefore also the input price. Within a bargaining framework, Dowrick (1989) has argued that the effect of collusion among firms on wages is ambiguous because of two opposing effects: on the one hand, collusion increases profit margins and hence the ability of unions to push for higher wages; on the other hand, collusion reduces output and increases competition among unions for shares in employment, and this tends to push wages down.

Moreover, the fact that the bargained input price is lower when competition is less intense is not specific to the particular way the intensity of competition has been modelled in this paper, although it is not a general property either. For instance, an alternative way of modelling an increase in the intensity of competition is through an increase in the number of firms in a Cournot (or Bertrand) oligopoly. It is easy to check that in the present model the equilibrium bargained unit input price can be increasing in the number of firms when bargaining is over two-part tariffs (but not in the case of linear tariffs – see also Naylor 2002).[23]

Clearly, there are a number of mechanisms that could lead to input prices being lower when competition is less intense and the present paper has simply formalised this idea through the use a reduced-form measure of competition. The

[23] In the Cournot case, this will occur when products are not too differentiated and the number of firms not too small. For instance, for $\sigma = 1$ the input price increases in the number of firms whenever there are at least 5 firms in the market. However, the indirect negative effect of competition on consumer surplus and welfare working through the change in the input price is always dominated by the direct positive effect when competition is modelled in this way.

empirical evidence supports this result. In particular, while the evidence on the effects of mergers on wages is somewhat mixed, most studies find a negative effect (see Lommerud et al. 2006 for a brief review). Moreover, Symeonidis (2007) examines the effects of collusion across UK manufacturing industries in the 1950s and 1960s and finds no evidence of any overall effect on wages of manual or non-manual workers. On the whole, then, the empirical evidence is consistent with the view that less intense competition may reduce wages in certain circumstances or in some industries. It follows that there are circumstances where less intense competition will be beneficial for consumers and for society as a whole, at least in the absence of any significant positive effects of competition on innovation or productivity. The aim of the present paper was to shed more light on the conditions under which we may need to qualify the conventional economic wisdom on the welfare effects of competition.

APPENDIX 1

Proof of Proposition 2. From equations (8), (11) and (14) we obtain

$$CS^*\Big|_{\lambda=0} = \frac{16(2+\sigma)(2-\varphi)^2(\alpha-w_0)^2}{\beta(4+\sigma)^2(8-\varphi\sigma)^2} \tag{A1}$$

and $$CS^*\Big|_{\lambda=1} = \frac{[4-\sigma(1-\varphi)-2\varphi]^2(\alpha-w_0)^2}{4\beta(2+\sigma)(4-\sigma)^2}. \tag{A2}$$

Define $\Delta CS^* = CS^*\Big|_{\lambda=0} - CS^*\Big|_{\lambda=1}$. The sign of ΔCS^* can be positive or negative depending on the values of σ and φ. It is easy to check that $\Delta CS^*(\sigma = 2) = \dfrac{(112-184\varphi+55\varphi^2)(\alpha-w_0)^2}{144\beta(4-\varphi)^2} < 0$ for all $\varphi\in(0.8,1]$. By continuity, $\Delta CS^* < 0$ when $\sigma \to 2$ and φ is large enough, while $\Delta CS^* > 0$ when $\sigma \to 2$ and φ is small. □

Proof of Proposition 3. The total effect of a change in λ on downstream profit is given by $\dfrac{d\Pi}{d\lambda} = \dfrac{\partial\Pi}{\partial\lambda} + \dfrac{\partial\Pi}{\partial w^*}\dfrac{\partial w^*}{\partial\lambda}$. It is easy to check that $\dfrac{\partial\Pi}{\partial\lambda} > 0$ for $\lambda\in[0,1)$, $\dfrac{\partial\Pi}{\partial w^*} < 0$, and we also know that $\dfrac{\partial w^*}{\partial\lambda} < 0$ for $\varphi\in(0,1]$. Hence $\dfrac{d\Pi}{d\lambda} > 0$ for $\lambda\in[0,1)$. (When $\lambda = 1$ and $\varphi = 0$, $\dfrac{d\Pi}{d\lambda} = 0$.) □

Proof of Proposition 4. Rearranging the expression in (15), we obtain:

$$\frac{\partial U^*}{\partial\lambda} = 2(w^*-w_0)\frac{\partial x^*}{\partial\lambda} + 2\left[x^* + (w^*-w_0)\frac{\partial x^*}{\partial w^*}\right]\frac{\partial w^*}{\partial\lambda}. \tag{A3}$$

Since $\dfrac{\partial x^*}{\partial\lambda} < 0$ and $\dfrac{\partial w^*}{\partial\lambda} < 0$ for all $\varphi\in(0,1]$, we only need to show that the term in brackets is positive in order to prove that $\partial U^*/\partial\lambda < 0$. Let H denote that term. Using (8) and (14) we obtain

$$H = \frac{L(\alpha-w_0)}{2\beta[4+\sigma(1+\lambda)]K}, \tag{A4}$$

where $K > 0$ is given by equation (9) and

$$L = (1-\varphi)\{16+\lambda\sigma[4-\sigma(1+\lambda)]\} + \varphi\sigma(1+\lambda)(2+\sigma\lambda) > 0. \tag{A5}$$

Hence H is positive for all $\sigma\in(0,2)$, $\lambda\in[0,1]$, $\varphi\in(0,1]$. When $\varphi = 0$, equation (8) gives $w = w_o$, and hence $U^* = 0$. □

Proof of Proposition 5. From equations (8), (11), (12), (13) and (14) we obtain

$$W^*\Big|_{\lambda=0} = \frac{8(2-\varphi)(24+4\varphi+4\sigma-2\varphi\sigma-\varphi\sigma^2)(\alpha-w_0)^2}{\beta(4+\sigma)^2(8-\varphi\sigma)^2} \tag{A6}$$

and

$$W^*\Big|_{\lambda=1} = \frac{(48-16\varphi-4\varphi^2-24\sigma+12\varphi\sigma+4\varphi^2\sigma+3\sigma^2-2\varphi\sigma^2-\varphi^2\sigma^2)(\alpha-w_0)^2}{4\beta(2+\sigma)(4-\sigma)^2}. \tag{A7}$$

Define $\Delta W^* = W^*\Big|_{\lambda=0} - W^*\Big|_{\lambda=1}$. The sign of ΔW^* can be positive or negative depending on the values of σ and φ. It is easy to check that $\Delta W^*(\sigma = 2) = \frac{(80-104\varphi+5\varphi^2)(\alpha-w_0)^2}{144\beta(4-\varphi)^2} < 0$ for all $\varphi\in(0.8,1]$. By continuity, $\Delta W^* < 0$ when $\sigma \to 2$ and φ is large enough, while $\Delta W^* > 0$ when $\sigma \to 2$ and φ is small. □

APPENDIX 2

An alternative interpretation of the parameter λ is as a measure of the degree of cross-ownership in the downstream market, with $\lambda = 1$ corresponding to a full merger. This interpretation changes the payoffs in the bargaining stage of the game to the extent that the degree of cross-ownership must be specified before the bargaining stage. (I assume that the degree of cross-ownership is determined exogenously; it can, of course, be endogenised, but this is beyond the scope of this Appendix.) In particular, at the bargaining stage the downstream firm's payoff in the Nash product can no longer be its own second-stage profit and the disagreement payoff for the downstream firm can no longer be zero.

Linear tariffs. More specifically, if λ represents the degree of cross-ownership in the downstream market and bargaining is over linear tariffs, the final stage of the game is as before, while at stage 1 of the game the downstream firm *i* and the upstream agent *i* choose w_i to maximise the Nash product

$$\Omega_i = \left[(w_i - w_0)\hat{x}_i\right]^{\varphi}\left[(\hat{p}_i - w_i)\hat{x}_i + \lambda(\hat{p}_j - w_j)\hat{x}_j - \lambda(\overline{p}_j - w_j)\overline{x}_j\right]^{1-\varphi}, \tag{A8}$$

taking the value of w_j as given, where $\hat{p}_i$, $\hat{x}_i$, $\hat{p}_j$ and $\hat{x}_j$ are given in equations (5) and $\overline{p}_j = w_j + \dfrac{\alpha - w_j}{2}$, $\overline{x}_j = \dfrac{\alpha - w_j}{4\beta}$ are the price and output of good *j* in the case of a bargaining conflict between the downstream firm *i* and upstream agent *i*. (In the case of full merger, the merged firm bargains simultaneously with each upstream agent.) I still assume here that each upstream agent is locked into relations with one downstream firm – and in the case of a full merger, with one of the divisions of the merged firm. For example, the upstream agents could be unions organised at plant level. The difference with the case examined in section 2 of the paper is that the downstream firm now seeks to maximise its aggregate second-stage profit minus its disagreement payoff.

The first-order condition for the choice of w_i by bargaining unit *i* can be written as:

$$\varphi\left[(\hat{p}_i - w_i)\hat{x}_i + \lambda(\hat{p}_j - w_j)\hat{x}_j - \frac{\lambda(\alpha - w_i)^2}{8\beta}\right]\left[(w_i - w_0)\frac{\partial \hat{x}_i}{\partial w_i} + \hat{x}_i\right]$$
$$+(1-\varphi)(w_i - w_0)\hat{x}_i\left[(\hat{p}_i - w_i)\frac{\partial \hat{x}_i}{\partial w_i} + \hat{x}_i\frac{\partial(\hat{p}_i - w_i)}{\partial w_i} + \lambda(\hat{p}_j - w_j)\frac{\partial \hat{x}_j}{\partial w_i} + \lambda\hat{x}_j\frac{\partial(\hat{p}_j - w_j)}{\partial w_i}\right] = 0. \quad \text{(A9)}$$

Solving for the (symmetric) equilibrium we obtain:

$$w^* = w_0 + \frac{\varphi[4 - \sigma(1+\lambda)](\alpha - w_0)}{8 - \varphi\sigma(1+\lambda)}. \quad \text{(A10)}$$

From equation (A10) we obtain

$$\frac{\partial w^*}{\partial \lambda} = \frac{-4\varphi\sigma(2-\varphi)(\alpha - w_0)}{[8 - \varphi\sigma(1+\lambda)]^2}, \quad \text{(A11)}$$

which is negative for all $\sigma \in (0,2)$, $\varphi \in (0,1]$. Hence:

Proposition A1. *When downstream firms and upstream agents bargain over a uniform input price and $\varphi \in (0,1]$, the input price decreases in the degree of cross-ownership λ. For $\varphi = 0$, the input price is independent of λ and equal to w_o.*

Proposition A1 mirrors Proposition 1, but the intuition is now somewhat different. In particular, the result now hinges to a large extent on a standard countervailing power effect. Compare, for simplicity, the case $\lambda = 0$ with the case $\lambda = 1$. A merged downstream firm has an incentive to force the unit input price down to increase its profit. And, crucially, it is able to do so because it can play one upstream agent against the other in the negotiations. As for the upstream agents, they are unable to resist a low w even though this is detrimental to their profits. On the other hand, when the downstream firms are independent, they still benefit from a lower unit input price but they cannot afford to put too much pressure on their respective upstream agents – and hence these are in a better position to resist a low w.

Welfare results can be easily obtained using equations (11)-(14) of the main text together with (A10). As it turns out, they are similar to those derived in section 2. Consider, first, consumer surplus:

Proposition A2. *Suppose that downstream firms and upstream agents bargain over a uniform input price and the products are close substitutes. Then consumer surplus is higher under a merger between downstream firms than when downstream firms are independent if upstream agents have significant bargaining* *power. Consumer surplus is higher when downstream firms are independent than under a merger if upstream agents have little bargaining power.*

Proof. From equations (11), (14) and (A10) we obtain

$$CS^*\Big|_{\lambda=0} = \frac{16(2+\sigma)(2-\varphi)^2(\alpha-w_0)^2}{\beta(4+\sigma)^2(8-\sigma\varphi)^2} \tag{A12}$$

and $$CS^*\Big|_{\lambda=1} = \frac{(2-\varphi)^2(\alpha-w_0)^2}{\beta(2+\sigma)(4-\sigma\varphi)^2}. \tag{A13}$$

Define $\Delta CS^* = CS^*\Big|_{\lambda=0} - CS^*\Big|_{\lambda=1}$. The sign of ΔCS^* can be positive or negative depending on the values of σ and φ. It is easy to check that $\Delta CS^*(\sigma = 2) = \frac{(112-184\varphi+55\varphi^2)(\alpha-w_0)^2}{144\beta(4-\varphi)^2} < 0$ for all $\varphi \in (0.8,1]$. By continuity, $\Delta CS^* < 0$ when $\sigma \to 2$ and φ is large enough, while $\Delta CS^* > 0$ when $\sigma \to 2$ and φ is small. □

Note that Proposition A2 holds when σ is close to 2. On the other hand, for σ close to 0, consumer surplus is always higher when downstream firms are independent than under a merger between downstream firms.

The next result is straightforward:

Proposition A3. *When downstream firms and upstream agents bargain over a uniform input price, the aggregate profit of the downstream firms increases in the degree of cross-ownership λ for all $\lambda \in [0,1)$.*

The effect of a change in λ on upstream agent utility can again be decomposed into three different effects as shown in equation (15). We obtain:

Proposition A4. *When downstream firms and upstream agents bargain over a uniform input price and $\varphi \in (0,1]$, the aggregate upstream agent utility decreases in the degree of cross-ownership λ. For $\varphi = 0$, the upstream agent utility is independent of λ (and equal to zero).*

Proof. Rearranging the expression in (15), we obtain:

$$\frac{\partial U^*}{\partial \lambda} = 2(w^*-w_0)\frac{\partial x^*}{\partial \lambda} + 2\left[x^* + (w^*-w_0)\frac{\partial x^*}{\partial w^*}\right]\frac{\partial w^*}{\partial \lambda}. \tag{A14}$$

Since $\frac{\partial x^*}{\partial \lambda} < 0$ and $\frac{\partial w^*}{\partial \lambda} < 0$ for all $\varphi \in (0,1]$, we only need to show that the term in brackets is positive in order to prove that $\partial U^*/\partial \lambda < 0$. Let J denote that term. Using (A10) and (14) we obtain

$$J = \frac{[8(1-\varphi)+\varphi\sigma(1+\lambda)](\alpha - w_0)}{2\beta[4+\sigma(1+\lambda)][8-\varphi\sigma(1+\lambda)]}, \tag{A15}$$

which is positive for all $\sigma\in(0,2)$, $\lambda\in[0,1]$ and $\varphi\in(0,1]$. When $\varphi = 0$, equation (A10) gives $w = w_o$, and hence $U^* = 0$. □

Finally, overall welfare can be higher or lower under a downstream merger:

Proposition A5. *Suppose that downstream firms and upstream agents bargain over a uniform input price and the products are close substitutes. Then total welfare is higher under a merger between downstream firms than when downstream firms are independent if upstream agents have significant bargaining power. Total welfare is higher when downstream firms are independent than under a merger if upstream agents have little bargaining power.*

Proof. From equations (11)-(14) and (A10) we obtain

$$W^*\Big|_{\lambda=0} = \frac{8(2-\varphi)(24+4\varphi+4\sigma-2\varphi\sigma-\varphi\sigma^2)(\alpha-w_0)^2}{\beta(4+\sigma)^2(8-\varphi\sigma)^2} \tag{A16}$$

and $$W^*\Big|_{\lambda=1} = \frac{(2-\varphi)(6+\varphi-2\varphi\sigma)(\alpha-w_0)^2}{\beta(2+\sigma)(4-\varphi\sigma)^2}. \tag{A17}$$

Define $\Delta W^* = W^*\Big|_{\lambda=0} - W^*\Big|_{\lambda=1}$. The sign of ΔW^* can be positive or negative depending on the values of σ and φ. It is easy to check that $\Delta W^*(\sigma = 2) = \frac{(80-104\varphi+5\varphi^2)(\alpha-w_0)^2}{144\beta(4-\varphi)^2} < 0$ for all $\varphi\in(0.8,1]$. By continuity, $\Delta W^* < 0$ when $\sigma\to 2$ and φ is large enough, while $\Delta W^* > 0$ when $\sigma\to 2$ and φ is small. □

Proposition A5 holds when σ is sufficiently large. On the other hand, for small values of σ, consumer surplus is always higher when downstream firms are independent than under a merger between downstream firms.

Two-part tariffs. Now consider bargaining over two-part tariffs and let λ denote the degree of cross-ownership in the downstream market. The final stage of the game is as before, while at stage 1 each downstream firm i bargains independently over w_i and F_i with an upstream agent, taking as given the values of w_j and F_j. (If $\lambda = 1$, the merged firm bargains simultaneously with each upstream agent.) The Nash product is

$$\Omega_i = [(w_i - w_0)\hat{x}_i + F_i]^{\varphi}\left[(\hat{p}_i - w_i)\hat{x}_i - F_i + \lambda\left((\hat{p}_j - w_j)\hat{x}_j - F_j\right) - \lambda\left((\bar{p}_j - w_j)\bar{x}_j - F_j\right)\right]^{1-\varphi}, \tag{A18}$$

where $\bar{p}_j = w_j + \dfrac{\alpha - w_j}{2}$ and $\bar{x}_j = \dfrac{\alpha - w_j}{4\beta}$ are the price and output of good *j* in the case of a bargaining conflict between the downstream firm *i* and upstream agent *i*.

In this context, w_i will be chosen to maximise the sum of the profit of the upstream agent *i* and the aggregate profit of the downstream firm *i* minus the disagreement payoff of the downstream firm:

$$(w_i - w_0)\hat{x}_i + F_i + (\hat{p}_i - w_i)\hat{x}_i - F_i + \lambda\big((\hat{p}_j - w_j)\hat{x}_j - F_j\big) - \lambda\big((\bar{p}_j - w_j)\bar{x}_j - F_j\big). \quad \text{(A19)}$$

Moreover, the value of the fixed fee will be determined by the respective bargaining power of the parties. Solving for the symmetric Nash equilibrium, we obtain:

$$w^{**} = w_0 - \frac{\sigma^2(1-\lambda)(1+\lambda)^2(\alpha - w_0)}{16 + 4\sigma(1+\lambda) - \sigma^2(1-\lambda)(1+\lambda)^2} \quad \text{(A20)}$$

$$F^{**} = \frac{2\big[16\varphi + 2\sigma^2(1-\lambda)(1+\lambda)^2 - \varphi\sigma^2(2-\lambda)(1+\lambda)^2\big]\,(\alpha - w_0)^2}{\big[16 + 4\sigma(1+\lambda) - \sigma^2(1-\lambda)(1+\lambda)^2\big]^2}. \quad \text{(A21)}$$

It is easy to check that

$$w^{**}\Big|_{\lambda=0} - w^{**}\Big|_{\lambda=1} = \frac{-\sigma^2(\alpha - w_0)}{16 + 4\sigma - \sigma^2} < 0 \quad \text{(A22)}$$

and

$$F^{**}\Big|_{\lambda=0} - F^{**}\Big|_{\lambda=1} = \frac{\sigma\big[32\sigma(2+\sigma) + \varphi(256 + 96\sigma - 32\sigma^2 - 10\sigma^3 + \sigma^4)\big]\,(\alpha - w_0)^2}{8\beta(2+\sigma)(16 + 4\sigma - \sigma^2)^2} > 0 \quad \text{(A23)}$$

for all $\sigma \in (0,2)$ and $\varphi \in [0,1]$. Hence:

Proposition A6. *When downstream firms and upstream agents bargain over two-part tariffs, the unit input price is lower and the fixed fee higher when downstream firms are independent than under a merger between downstream firms.*

This is the opposite of the result obtained in section 3 (Proposition 6) and also the opposite of the result obtained for the case of linear tariffs above (Proposition A1). The intuition is as follows. First, note that under two-part tariffs the unit input price is set below w_0, so each upstream agent is effectively subsidising the downstream firm (and using the fixed fee to compensate for this subsidy). Now a decrease in w_i leads to a decrease in the output of product *j*. This implies a decrease in the subsidy provided by upstream agent *j* to the downstream firm. Under a merger this effect is internalised, but with independent downstream firms it is not. As a result, the downstream firm is less keen to push for a reduction in the unit input price when λ = 1 than when λ = 0. It turns out that this effect dominates all others when the parties set the level of the unit input price that maximises expression (A19).[24] Furthermore, since the fixed fee F is used to transfer profit from the downstream industry to the upstream agents, F is lower when w is higher and vice versa.

Since a merger between downstream firms increases the unit input price and reduces the fixed fee, it is not surprising that the welfare implications are similar to the standard results of oligopoly theory:

Proposition A7. *When downstream firms and upstream agents bargain over two-part tariffs and $\varphi\in(0,1)$:*

- *(i) The aggregate downstream profit increases in the degree of cross-ownership λ.*
- *(ii) Consumer surplus, the aggregate upstream utility and total welfare decrease in the degree of cross-ownership λ.*

Proof. From equations (21)-(24), (A20) and (A21), we obtain:

$$\frac{\partial CS^{**}}{\partial\lambda}=\frac{-32\sigma(2+\sigma)\left[4-\sigma(1-2\lambda-3\lambda^2)\right]\,(\alpha-w_0)^2}{\beta\left[16+4\sigma(1+\lambda)-\sigma^2(1-\lambda)(1+\lambda)^2\right]^3}<0\,; \tag{A24}$$

$$\frac{\partial U^{**}}{\partial\lambda}=\frac{-4\varphi\sigma(\alpha-w_0)^2\Phi}{\beta\left[16+4\sigma(1+\lambda)-\sigma^2(1-\lambda)(1+\lambda)^2\right]^3}, \tag{A25}$$

where $\Phi=128+16\sigma(1+4\lambda+3\lambda^2)-4\sigma^2(1+\lambda)^3+\sigma^3(1+\lambda)^3(1-8\lambda+3\lambda^2)>0$;

$$\frac{\partial\Pi^{**}}{\partial\lambda}=\frac{4\sigma(\alpha-w_0)^2\Psi}{\beta\left[16+4\sigma(1+\lambda)-\sigma^2(1-\lambda)(1+\lambda)^2\right]^3}, \tag{A26}$$

where $\Psi=2\sigma(1-\lambda)\left[4+\sigma(1+\lambda)^2\right]\left[4-\sigma(1+\lambda)(1-3\lambda)\right]+\varphi\Phi>0$;

$$\frac{\partial W^{**}}{\partial\lambda}=\frac{-8\sigma\left[4-\sigma(1-2\lambda-3\lambda^2)\right]\left[8+\sigma\lambda(4-\sigma)-\sigma^2(1-\lambda^2-\lambda^3)\right](\alpha-w_0)^2}{\beta\left[16+4\sigma(1+\lambda)-\sigma^2(1-\lambda)(1+\lambda)^2\right]^3}<0\,. \tag{A27}$$

□

[24] However, there is no reason why this effect should dominate in a model with more general functional forms. Note that although $w^{**}(\lambda=0)<w^{**}(\lambda=1)$, the sign of $\frac{\partial w^{**}}{\partial\lambda}$ is ambiguous.

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