THE EFFECTS OF ENTRY IN BILATERAL OLIGOPOLY

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The effects of entry in bilateral oligopoly

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Abstract

We show that a firm's profits under Cournot oligopoly can be increasing in the number of firms in the industry if wages are determined by (decentralised) bargaining in unionized bilateral oligopoly. The intuition for the result is that increased product market competition following an increase in the number of firms is mirrored by increased labor market rivalry which induces (profit-enhancing) wage moderation. Whether the product or labor market effect dominates depends both on the extent of union bargaining power and on the nature of union preferences. A corollary of the results derived is that if the upstream agents are firms rather than labor unions, then profits are always decreasing in the number of firms, as in the standard Cournot model. We also show that if bargaining is centralized then there is no wage moderation effect and wages are the same independent of the number of firms, as in the standard model with exogenous factor costs.

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1. Introduction

In the standard Cournot model of oligopoly, each firm's profits decrease as the number of firms competing in the product market increases. This fundamental result in microeconomics was formally established by Seade (1980a). One important implication, for example, is that incumbent firms have an unambiguous incentive to deter entry by new firms. In this paper, we show that when firms' costs (wages) are determined by bargaining between (downstream) firms and (upstream) labor unions in unionised bilateral oligopoly, then the relationship between profits-per-firm and the number of firms depends on the relative bargaining power and on union preferences. If unions are relatively powerful and place sufficient weight on wages relative to employment, then an increase in the number of firms in the market can raise the profits of each firm, reversing the standard Cournot result. The basic model we develop considers decentralized bargaining between a firm and a labor union. But as Booth (1995) and others have argued, the bargaining model is likely to be relevant wherever workers can exert bargaining power, whether or not they are formally organized into labor unions. For example, as Lindbeck and Snower (1988) have shown, 'insider' power is likely to prevail even in the absence of organized unions.

One implication of this result is that firms in unionized bilateral oligopoly do not necessarily have incentives to deter entry: a duopolist's profits can exceed those of a monopolist, for example. A corollary of this is that the presence of unions might be associated with an *increase* rather than a *decrease* in product market competition. Thus, the model identifies a mechanism to counter that analysed in the classic model of Williamson (1968), according to which unions are associated with inhibiting product market competition. A second corollary of our model is that when the bilateral oligopoly is characterized by upstream profit-maximising firms – rather than by utility-maximising labor unions – the profits of each downstream firm are necessarily falling in the number of firms, as in the standard model. This is because the firm-firm bilateral oligopoly can be characterized as a special case of the union-firm bilateral oligopoly, in which we can show that the upstream agent's preferences are such that the implicit weight on the bargained price is not sufficient to cause profits to increase with entry.

As far as we are aware, our finding that each Cournot firm's profit can increase with the number of firms is a new result. Naylor (2002) shows conditions under which industry profits are increasing with the number of firms in the market, but does not address the issue of the individual firm's profit level. It is less surprising that industry profits can increase with the number of firms as such a result is consistent with falling profits-per-firm. In the related literature on unionized oligopoly, Dowrick (1989) develops a framework in which unions act as the upstream agent and shows how the bargained wage varies with market size, but does not focus on the relationship between profits and the number of firms. Horn and Wolinsky (1988) examine a differentiated oligopoly with upstream agents (unions) and downstream firms, but assume a duopolistic market.[1] In the literature on unions and entry deterrence, the usual approach builds on Williamson's (1968) insight that incumbent firms might collude with unions to enforce industry-wide wage premia in order to deter entry. Unions are seen as an employer instrument to preserve product market power. In the model we outline below, it emerges that in the presence of unions firms might have reduced incentives to deter entry: in other

[1] Similarly, Naylor (1999) considers unionized oligopoly in the context of international trade and economic integration, but does not allow the number of firms to vary.

words, in contrast to the Williamson insight, unions might have a *pro*-competitive impact within an imperfectly competitive product market. Bughin (1999) compares firms' and unions' preferences over bargaining scope and finds that entry deterrence is an influence on the choice of bargaining agenda.

The rest of this paper is organized as follows. In Section 2, we outline the basic model and in Section 3 we examine how firms' profits vary with the number of firms. Section 4 addresses the issue of firm-firm rather than union-firm bilateral oligopoly. Section 5 examines the sensitivity of the results to assumptions regarding the level at which wage bargaining takes place. Section 6 closes the paper with conclusions and further remarks.

2. The Model

We follow Horn and Wolinsky (1988) in supposing that the upstream agents are firm-specific trade unions bargaining with firms over the wage rate. We analyze a non-cooperative two-stage game in which n identical firms produce a homogeneous good. In the first stage (the labor market game), each firm independently bargains over its wage with a local labor union: bargaining is decentralized. The outcome of the labor market game is described by the solution to the n union-firm pairs' sub-game perfect best-reply functions in wages. In the second stage (the Cournot product market game), each firm sets its output – given pre-determined wage choices from stage 1 – to maximize profits. We proceed by backward induction.

(i) *Stage 2: the product market game*

Let linear product market demand be written as:

$$p = a - bX \ , \tag{1}$$

where $X = \sum_{i=1}^{n} x_i$. Profit for the representative firm i can be written as:

$$p_1 = \left[a - b\sum_{i=1}^{n} x_i - w_i \right] x_i \ , \tag{2}$$

where w_i is the outcome of the wage bargain for union-firm pair *i*. In this short-run analysis, we exclude non-labor costs. We also assume a constant marginal product of labor, and set this as a numeraire.

Under the Cournot-Nash assumption, differentiation of (2) with respect to x_i yields the first-order condition for profit maximization by firm *i*, from which it is straightforward to derive firm *i*'s best-reply function in output space as:

$$x_i = \frac{1}{2b}\left[a - w_i - b\sum_{\substack{j=1 \\ j\neq i}}^{n} x_j \right] \ . \tag{3}$$

Solving across the n first-order conditions, the n best-reply functions can be re-written as sub-game perfect labor demand equations. From equation (3) for example, the expression for firm *i*'s labor demand is

$$x_i = \frac{1}{(n+1)b}\left[a - nw_i + \sum_{\substack{j=1 \\ j\neq i}}^{n} w_j \right] . \tag{4}$$

It is useful to express firm *i*'s profits in terms of the vector of all firms' wages. Substituting (4) in (2), we obtain

$$p_i = \frac{1}{(n+1)^2 b}\left[a - nw_i + \sum_{\substack{j=1 \\ j\neq i}}^{n} w_j\right]^2 . \tag{5}$$

From (5), it follows that in symmetric equilibrium, with $w_i = w$,

$$p_i = \frac{1}{(n+1)^2 b}[a-w]^2 \ , \ \forall i , \tag{6}$$

where w is the outcome of the Stage 1 wage-bargaining game. We note that if w is set exogenously at the competitive level, $\overline{w}$, or if unions have no bargaining power, then, with $w = \overline{w}$ in (6), the firm's profits are falling in n, the number of firms in the industry, as

$$\frac{dp_i}{dn} = -\frac{2}{(n+1)^3 b}[a-\overline{w}]^2 < 0 , \tag{7}$$

which is the standard Cournot oligopoly result.

(ii) *Stage 1: the labor market game*

We assume that the representative trade union i bargaining with firm i, has the objective described by the Stone-Geary utility function:

$$U_i = [w_i - \overline{w}]^{2a} x_i^{2(1-a)} , \tag{8}$$

where $\overline{w}$ denotes the wage which would obtain in a competitive non-unionised labor market. We choose the quadratic form for the Stone-Geary utility as this captures the special case of rent maximisation if $a = 1/2$.[2] Under the assumption of a right-to-manage model of Nash-bargaining over wages, we write the maximand as:

[2] This form will be convenient for comparison with the case of firm-firm bilateral oligopoly considered in Section 4 below.

$$B_i = U_i^{b} p_i^{1-b} \ , \tag{9}$$

where we assume that disagreement payoffs are zero. b represents the union's Nash-bargaining power in the asymmetric wage bargain.

Substituting (4), (6) and (8) in (9) yields

$$B_i = \frac{1}{(n+1)^{2(1-ab)} b^{1+b-2ab}} [w_i - \overline{w}]^{2ab} \left[a - nw_i + \sum_{\substack{j=1 \\ j \neq i}}^{n} w_j \right]^{2(1-ab)} . \tag{10}$$

The first order condition derived from the Nash maximand, (10), is

$$\frac{\partial B_i}{\partial w_i} = \frac{2[w_i - \overline{w}]^{2ab-1}}{(n+1)^{2(1-ab)} b^{1+b-2ab}} \left[a - nw_i + \sum_{\substack{j=1 \\ j \neq i}}^{n} w_j \right]^{1-2ab} \left\{ ab \left[a - nw_i + \sum_{\substack{j=1 \\ j \neq i}}^{n} w_j \right] - (1 - ab) n [w_i - \overline{w}] \right\}$$

$$= 0 \ , \tag{11}$$

from which it follows that, in symmetric sub-game perfect equilibrium,

$$w = w_i = \overline{w} + \frac{ab}{ab + n(1 - ab)} [a - \overline{w}] \ . \tag{12}$$

From substitution of (12) in (4), we can represent symmetric equilibrium output by

$$x_i = x = \frac{n(1 - ab)}{(n+1) b [ab + n(1 - ab)]} [a - \overline{w}] . \tag{13}$$

Substituting (12) in (6) gives equilibrium firm profits of

$$p_i = p = \frac{(1 - ab)^2 n^2}{(n+1)^2 [ab + n(1 - ab)]^2 b} [a - \overline{w}]^2 . \tag{14}$$

It follows from Seade (1980a, 1980b) that the Cournot product market equilibrium characterized in (13) and (14) satisfies sufficient conditions for stability. For the linear demand case considered here, the sufficient conditions are that $b > 0$ and $n > 0$. The difference between our model and that of Seade (1980a) is that in our model costs are not exogenous, but are the result of strategic bargaining in the Stage 1 game. In the next section of the paper, we consider comparative static properties of the model.

3. Firm profits and the number of firms

We now investigate how the profits of each firm in sub-game perfect Nash equilibrium vary with the number of firms in the market. We establish Proposition 1.

Proposition 1 Profits-per-firm increase in the number of firms if unions care sufficiently about wages and have sufficient bargaining power.

Proof Differentiating (14) with respect to n, we obtain

$$\frac{\partial p_i}{\partial n} = \frac{2(1-ab)^2 n}{(n+1)^3 [ab + n(1-ab)]^3 b} [ab - n(n+2)(1-ab)][a-w]^2 , \qquad (15)$$

which is non-negative – implying that firm profits are non-decreasing in the number of firms – if the following condition is satisfied:

$$\frac{ab}{1-ab} \geq n(n+2) . \qquad (16)$$

From (16), it is clear that firm profits are more likely to be increasing in the number of firms the larger are both a and b and the smaller is n. If the product of a and b is close to unity – for example, if wages are set by monopoly unions $(b=1)$ with an objective function close to wage rate maximisation – then the value of n over which firm profits are increasing in the number of firms is potentially large. In reality, the product of a and b is likely to be much less than one. In the special case of a rent-maximising union and symmetric Nash wage-bargaining, for example, both a and b are equal to one-half and hence the product is just one-quarter. In that case, condition (16) requires that $n(n+2)$ is less than one-third for firm profits to rise with n, which is clearly not satisfied for $n \geq 1$.

We proceed by re-writing (14) as

$$p_i = p = \frac{(1-d)^2 n^2}{(n+1)^2 [d + n(1-d)]^2 b} [a - \overline{w}]^2, \tag{17}$$

where d denotes the product of a and b, and evaluating (17) for various values of n.

For $n = 1$, $$p_{i|n=1} = \left\{ \frac{(1-d)}{2} \right\}^2 \frac{[a-\overline{w}]^2}{b}. \tag{18}$$

For $n = 2$, $$p_{i|n=2} = \left\{ \frac{2(1-d)}{3[2-d]} \right\}^2 \frac{[a-\overline{w}]^2}{b}. \tag{19}$$

For $n = 3$, $$p_{i|n=3} = \left\{ \frac{3(1-d)}{4[4-3d]} \right\}^2 \frac{[a-\overline{w}]^2}{b}. \tag{20}$$

For $n = 4$, $$p_{i|n=4} = \left\{ \frac{4(1-d)}{5[5-4d]} \right\}^2 \frac{[a-\overline{w}]^2}{b}. \tag{21}$$

From comparison of (18) and (19), it follows that the profits of each duopolist exceed that of a monopolist if $d > 2/3$. That is,

$$p_{i|n=2} > p_{i|n=1} \text{ if } d > \hat{d}_2 = 2/3, \tag{22}$$

where $\hat{d}_2$ is the critical value of d such that the profit of each of two firms under n-firm Cournot oligopoly (with n=2) is just equal to the profit level associated with the case of monopoly, in which $n = 1$. Similarly, we can show by successive pair-wise comparisons of (19), (20) and (21) that

$$p_{i|n=3} > p_{i|n=2} \text{ if } d > \hat{d}_3 = 6/7, \tag{23}$$

and that

$$p_{i|n=4} > p_{i|n=3} \text{ if } d > \hat{d}_4 = 12/13. \tag{24}$$

Indeed, it can be demonstrated that the critical level of d is always less than one: implying that for sufficiently high d, an increase in n always leads to an increase in firm profits. We can show this by evaluating (17) at the value of $n = N$ and at the value of $n = N + 1$ and comparing. It is straightforward to show that the value of the individual firm's profits when $n = N + 1$ exceeds profits when $n = N$ if and only if $d > \hat{d}_n$, where $\hat{d}_n$ is strictly less than unity $\forall n$. In reality, however, d is unlikely ever to be sufficiently high that firm profits increase in n over and above the values considered explicitly in conditions (22) through (24). The implication of this is that profits-per-firm will be maximized when the oligopolistic industry consists of only a small number of firms. The novelty of our result is that this number is not necessarily equal to one.

Figure 1 plots (18) through (21) in (p_i, d)-space and uses (22) through (24) to demonstrate the critical values of d at which the maximal values of profits-per-firm shift with the number of firms.

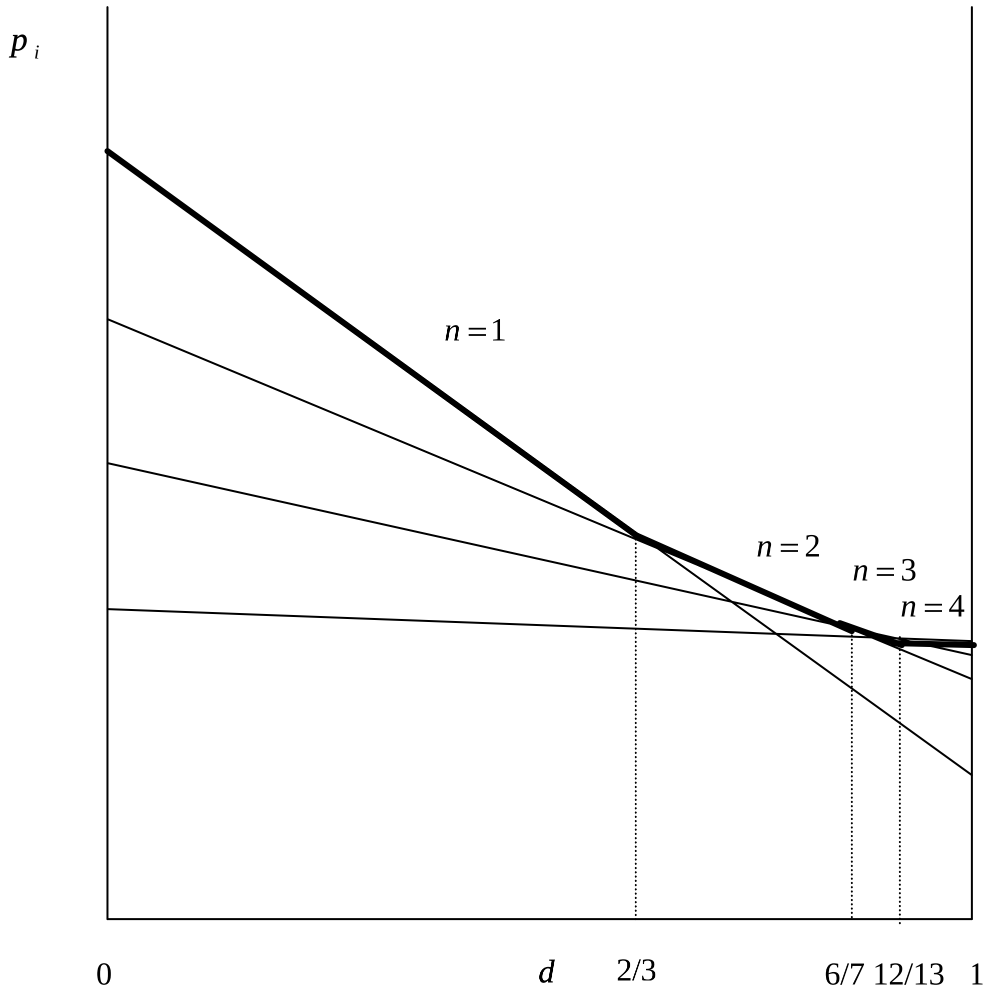

Figure 1 Profits-per-firm against d, for selected n.

Consider now Figure 2 which represents (22) through (24) in (a, b)-space to depict the combinations of a and b which produce iso-profit contours for successive increments in the value of n. In Region A, for example, all combinations of a and b lie below the iso-profit schedule which satisfies (18) and (19) simultaneously. In this region, then, a monopolist's profits always dominate the profits-per-firm associated with any alternative value of n, $n>1$. Conversely, in Region B, each firm in a duopoly market earns profits which exceed those of the monopolist. Finally, Region C represents combinations of a and b such that profits-per-firm are maximized when there are three firms competing in the Cournot oligopoly.

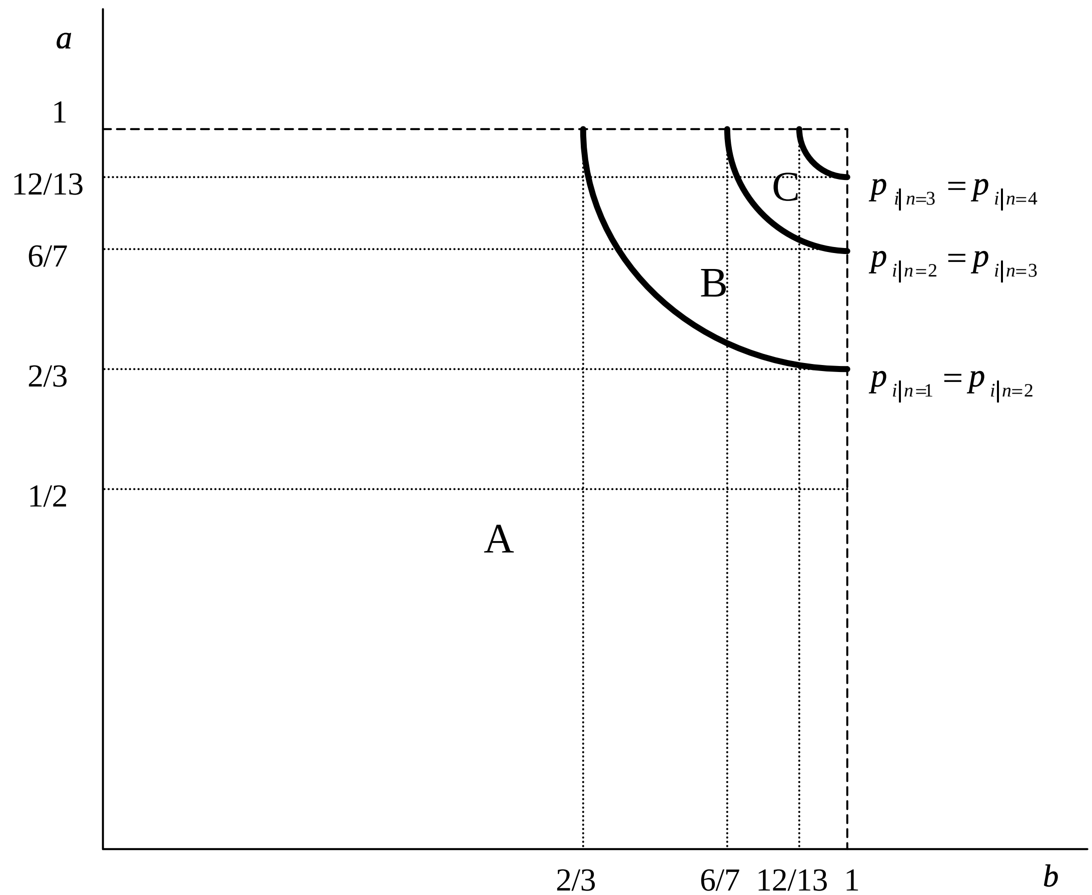

Figure 2 Iso-profits curves for successive increments in n.

What is the intuition for our result that the profits-per-firm increase in the number of firms in the market if $d = ab$ is sufficiently high and n sufficiently low? In the standard oligopoly model, an increase in the number of firms unambiguously reduces profits-per-firm through increased product market competition which reduces product price. We can see this mechanism working in the model of bilateral oligopoly developed in this paper. We substitute (4) in (1) and solve for the equilibrium: this gives

$$p = \frac{1}{n+1}(a + nw), \tag{25}$$

where w is given by (12). From (24), it follows that

$$\frac{dp}{dn} = \frac{n}{n+1}\frac{dw}{dn} - \left[\frac{a-w}{(n+1)^2}\right]. \tag{26}$$

Assuming that $\frac{dw}{dn} \leq 0$, as we demonstrate below, it follows from (26) that $\frac{dp}{dn}$ must be negative: an increase in n leads to a fall in product price.

In addition to the profit-reducing effect of the fall in product price, however, the increase in the number of firms competing in the market also induces unions to moderate their wage demands. Dowrick (1989) established this effect in a model closely related to ours. We can see the result simply by differentiating (12) with respect to n, which yields

$$\frac{dw}{dn} = -\frac{a\,b(1-a\,b)}{[a\,b + n(1-a\,b)]^2}(a - \overline{w}) \leq 0\,. \tag{27}$$

Furthermore, this wage moderation effect captured in (27) is increasing in the product $a\,b$. It is readily shown from (27) that $d^2w/dndd < 0$. At one extreme, for example if $a\,b = 0$, then there is no wage moderation effect associated with an increase in the number of firms: that is, there can be no wage moderation effect if unions exert no influence on the wage, as is implied by $a\,b = 0$.

Thus, the presence of unions with influence over wages induces a (profit-enhancing) wage moderation effect to accompany the (profit-damaging) price-reducing effect of an increase in n. Which effect dominates depends both on the product ab – as shown in (27) – and on the size of n itself. To see this, consider (26) once more. As n becomes very large, the fraction $n/(n+1)$ tends to one, implying that $\frac{dp}{dn}$ tends to equal $\frac{dw}{dn}$ *minus* the diminishing but positive term in square brackets. Hence, for sufficiently large n the absolute size of the price effect dominates that of the wage effect. For small enough n, however, the fraction $n/(n+1)$ in (26) is sufficiently less than one that $\frac{dw}{dn}$ exceeds $\frac{dp}{dn}$ and the wage moderation effect dominates, causing an increase in n to raise profits-per-firm for sufficiently high values of a and b. This result that profits-per-firm might be increasing in the number of firms is distinct from but closely related to the Horn and Wolinsky (1988) result that the merger of a downstream duopoly can lower profit through its effects on bargained input prices.

Output per firm

An implication of Seade (1980a) is that under linear demand, output-per-firm will fall with entry into simple Cournot oligopoly. In our model with strategically determined wages, we can demonstrate that proposition 2 holds.

Proposition 2 If profits-per-firm increase with entry, then so does output-per-firm.

Proof

From (13), it follows that in equilibrium

$$\frac{dx}{dn} = -\frac{(1-d)}{(n+1)^3 b[d + (1-d)n]^2}\left[n^2(1-d) - d\right][a - \overline{w}], \tag{28}$$

which is positive if

$$n^2 < \frac{d}{1-d}. \tag{29}$$

A sufficient condition for (29) to be satisfied is that (16) is satisfied, where we recall that $d = ab$. This establishes the proposition.

Entry deterrence incentives

Following Williamson (1968), unions have been characterized as a potential instrument with which incumbent firms can deter further market entry. In the standard Cournot oligopoly model, with profits-per-firm unambiguously decreasing in the number of firms in the market, there is an unambiguous incentive for firms to attempt to restrict entry. This was the explicit focus of the analysis of Seade (1980a) in establishing the nature of the relationship between the number of firms and profits-per-firm in the standard Cournot oligopoly model. But in the bilateral unionized oligopoly framework we have developed in the current paper, the very presence of unions with influence over wages leads to the possibility that, at least for small n, profits-per-firm increase with n. Thus, if (decentralised) unions have sufficient influence over wages, a single-firm monopolist might have incentives to encourage rather than to deter entry by one or more firms. Alternatively, the presence of influential unions might induce an incumbent monopolist toward a multi-divisional structure with distinct plants operating *as if* in competition with one another.

In the current paper, we analyse the effects of entry in the presence of labor unions following the standard assumption that firms are identical. As Seade (1980a) observes, with a non-homogeneous industry entry cannot be interpreted simply as an increase in firm numbers: it becomes necessary to model the nature of the marginal firm and its entry/exit decision. We do not address the issue of industry non-homogeneity in this paper.

4. Firms as upstream agents

Suppose that the upstream agent is not a utility-maximising trade union but is a profit-maximising firm with the objective function

$$p_{Ui} = (w_i - \overline{w})x_i \,, \tag{28}$$

where $\overline{w}$ represents the upstream firm's fixed input price and w_i now denotes the price of the intermediate product sold by upstream firms to their downstream firm pair. Bargaining is still assumed to be locally decentralized with an equal number of upstream and downstream agents.[3] Then the firm-firm Nash bargain over the intermediate product price solves

$$B_i^F = p_{Ui}^{b} p_i^{1-b} \,. \tag{29}$$

Formally, this problem is equivalent to that described in equations (10) through (14) above, with the implicit value of a set at one-half. Hence, even in the extreme case in which upstream firms have all the bargaining power, so that b =1, the implicit value of the product $d = ab$ is never greater than one-half. Hence, it is always less than the critical value, $\hat{d}_2$, above which profits-per-duopolist exceed those of a monopolist. Proposition 3 follows.

Proposition 3 Profits-per-firm in the downstream industry are never higher than in the case of monopoly when upstream and downstream agents are both characterised as profit-maximising firms.

Proof From condition (22) – see also the graphic representations in Figures 1 and 2 – it follows that the critical threshold value of d, $\hat{d}_2$, exceeds the maximum of d associated with the case in which upstream agents are profit-maximising firms.

5. Centralisation of wage bargaining

In the basic union-firm model outlined in Section 3, we assumed explicitly that wage bargaining occurs at the decentralized level of the individual union-firm pair. The extent to which wage bargaining is decentralized or is centralized at either the industry or economy-wide level varies across countries and over time. The classic macroeconomic work of Calmfors and Driffill (1988) has exploited variation across countries in the level at which wage bargaining takes place in order to infer the nature of a relationship between the level of centralization and a country's macroeconomic performance. It has been argued that industry-level wage bargaining produces the worst possible outcome because it fails to internalize potential adverse externalities associated with union-firm wage bargaining. In contrast, it is argued that both fully decentralized bargaining and

[3] This assumption is more plausible in the union-firm case where the existence of the union can be thought of as arising as an institutional response to the existence of the firm. A similar story to explain a one-to-one matching between the number of upstream and downstream agents in the case of firm-firm bargaining is less convincing.

fully centralized bargaining force bargaining agents to internalize wage externalities and hence yield efficient outcomes.

Consider the basic model of Section 3, but incorporating the assumption that all unions and firms negotiate jointly over the level of wages. Then the Nash maximand defined in (9) becomes

$$B_i^C = \left(\sum U\right)^b \left(\sum p\right)^{1-b}, \tag{30}$$

where $\sum p$ is the sum of the individual firms' profits – given by (6) – and $\sum U$ is the sum over the unions' utility functions – given by (8). In the Nash maximand, it is assumed that all bargained wages will be equal: thus, $w_i = w$ by assumption. Substituting this and the sum over (4), (6) and (8) in (30) yields the Nash centralised wage-bargaining maximand:

$$B_i^C = \frac{1}{(n+1)^{2ab+2(1-b)} b^{1+b+2ab}} \left[w - \overline{w}\right]^{2ab} \left[a - w\right]^{2ab+2(1-b)}. \tag{31}$$

The first order condition derived from the centralized-bargaining Nash maximand is then

$$\frac{\partial B^C}{\partial w} = \frac{2\left[w - \overline{w}\right]^{2ab-1}}{(n+1)^{2ab+2(1-b)} b^{1+b+2ab}} \left[a - w\right]^{2(a-1)b+1} \left\{a b\left[a - w\right] - \left(1 + a b - b\right)\left[w_i - \overline{w}\right]\right\}$$

$$= 0, \tag{32}$$

from which it follows that, in symmetric equilibrium,

$$w = w_i = \overline{w} + \frac{a b\left[a - \overline{w}\right]}{1 + 2a b - b}. \tag{33}$$

This establishes Proposition 4.

Proposition 4 Under centralized bargaining, the wage is independent of of n, the number of firms in the industry.

It follows from proposition 4 that in the case of centralized bargaining, there is no wage moderation effect associated with an increase in n. This lies behind Calmfors-Driffill (1988) and related analyses (see also Moene, Wallerstein and Hoel, 1993). It also follows from (33) that with perfect competition and decentralized bargaining, unions have no effect on wages: all wage externality effects are internalized. To see this within our model, let n become very large: then the bargained wage given by (14) tends to the competitive non-union level, $\overline{w}$. With centralized (industry-level) bargaining, in contrast, even with large n, the wage will be set above the competitive level, as shown in (33). Under decentralized bargaining, a wage externality arises only with the introduction of imperfect competition, represented by a falling and finite value of n. Increasing n is associated with increasingly internalizing the negative wage externality: which is just an alternative interpretation of what we have previously referred to as the wage moderation effect of increasing the number of firms in competition.

6. Conclusions

In this paper, we have developed a simple model of a unionized oligopoly in order to demonstrate that the standard cornerstone Cournot result that profits-per-firm are falling in the number of firms in the product market is not necessarily valid when firms' input prices are determined endogenously through bargaining with upstream agents (labor unions). We have shown that if wage bargaining is decentralized (that is, firm-specific), then profits-per-firm will increase with the number of competing firms if unions care sufficiently about wages, relative to employment, and possess sufficient bargaining power. One corollary of this result is that if unions do possess sufficient influence over wages, it is no longer clear that incumbent firms will have an incentive to deter market entry. Wage bargaining in the model is interpreted as firm-specific bargaining with labor unions. To the extent that non-union labor also possesses bargaining power, the model is likely to be of wider significance.

The intuition for our result is that when wages are determined endogenously through bargaining, an expansion in the number of firms has a wage moderation effect which offsets the detrimental effect on firm profits associated with competitive reductions in product price. The more workers care about wages and the more powerful they are in bargaining, the greater is this wage moderation effect. We have shown that the conditions necessary for unions (as the upstream agent) to have the (unintended) effect of translating an increase in firm numbers into an increase in firm profits are not satisfied when the upstream agents are profit-maximising firms. We have also shown that the result holds only if union-firm bargaining is decentralized. Under centralized (industry-wide) bargaining, there is no wage moderation effect associated with an increase in the number of firms: this is because the bargained wage is independent of firm numbers under industry bargaining.

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Figure 1 Profits-per-firm against d, for selected n.

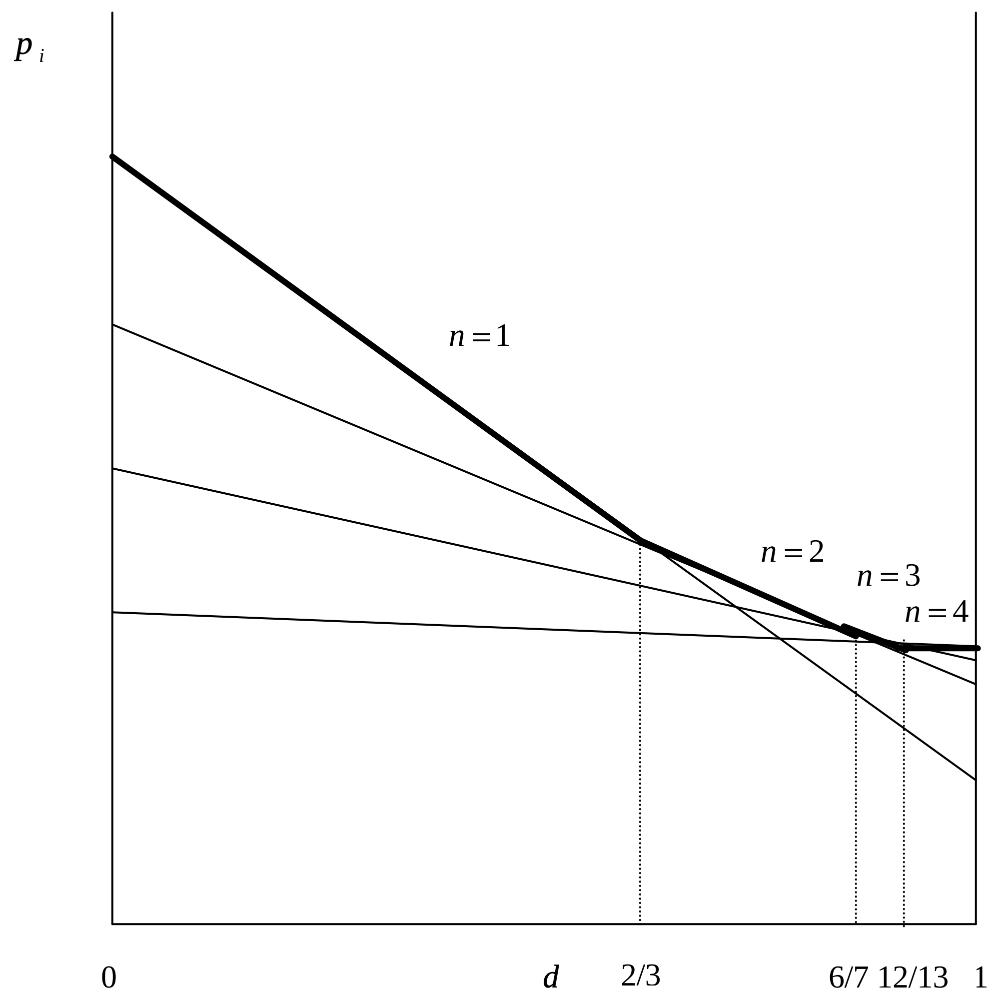

Figure 2 Iso-profits curves for successive increments in n.