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ON CENTRALIZED BARGAINING IN A SYMMETRIC OLIGOPOLISTIC INDUSTRY

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Abstract

In this paper we study interactions between labor and product markets, in an imperfectly competitive industry with centralized wage bargaining. Firms jointly bargain with the union over wages and then compete in prices or quantities. We show that the negotiated wage is independent of the number of firms, the degree of substitutability of firms' products, and the type of market competition, in a broad class of industry specifications, including the standard symmetric linear demand system-linear one factor (labor) technology. This result is robust to various union objectives. Thus, unions are better-off as the market becomes more competitive because aggregate employment increases. Finally, motivated by the wage independence property, we propose that the bargained wage in a Bertrand homogenous market be taken as the limit of that of a differentiated market as the degree of substitutability goes to one.

Key Words:
Oligopoly, Trade Unions, Centralized Bargaining, Wage Structure.

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1 Introduction:

> Unions are fundamentally organizations that seek to create or capture monopoly rents available in an industry. These rents could come from product market imperfections or from regulation of the industry.
>
> Ashenfelter,O. and Layard, R. (Handbook of Labor Economics, 1986)

Most of the existing literature on collective bargaining focuses on the impact of unionization of the labor market on different variables of economic performance, such as profitability, employment, wage structure, productivity etc. An important issue they address is how different bargaining institutions affect these variables in various countries or industries within a country. In these studies the product market structure is typically assumed to be fixed. A complementary issue arising in this context is how product market parameters, such as industry concentration, the degree of product differentiation and the type of market competition, affect the negotiated wage, employment and other variables of economic performance. In this paper we develop a theoretical model to analyze the effects of the product market specification on negotiated wages. We restrict attention to the case of industry-wide centralized bargaining.

In the empirical literature there is evidence of substantial wage differentials among industries that appear to be stable over time (Krueger & Summers (1988)). Layard *et al.* (1991) attribute these differentials mainly to firm specific factors (such as the size of firms in the industry, their productivity and profitability). These factors do not seem to be of less importance when bargaining is centralized or when product markets are more competitive. Dickens & Katz (1987) detect some link between wages and industry concentration, which however is not robust to the inclusion of controls for labor quality. Rose (1987) reports that deregulation of the US trucking industry was accompanied by a significant reduction of wage differentials. On the other hand, deregulation of the airline industry in the US did not appear to be accompanied by significant wage reductions (Card (1989)). Further, Hirsch & Connolly (1987), and Hirsch (1990) find no evidence that union rent seeking is more effective in highly concentrated industries or among firms with large market share. Lewis (1986) provides evidence that union wage premiums are typically smaller in highly concentrated industries. The evidence as it stands seems therefore to be rather inconclusive on the link between product market specification and wages. We intend, as a first step, to explore this link by means of a theoretical model.

In particular, this paper analyzes interactions between labor and product markets, in an n-firm oligopolistic industry with centralized wage bargaining. In the first stage firms jointly bargain with the union over wages, thereafter each firm chooses its employment level (Right-to-Manage). Finally, firms compete in prices, or quantities, in the product market. Firms are endowed with identical one factor (labor) technologies. The union's objective function depends both on wages and aggregate employment, and is assumed to be log-linear in employment. This subsumes a large class of union objectives used in the literature[1]. A specific type of differentiated industry with linear demands is introduced to capture the effects of product substitutability on the negotiated wage. We employ the Generalized Nash Bargaining solution to obtain the negotiated wage, assuming that the firms and the union take into account the consequences of their decision for employment and product market competition.

There is a popular conception of unions as entities that attempt to extract rents from firms[2]. If this view were correct, one would expect to see higher wages, ceteris paribus, when markets are "more" imperfect (e.g. if the number of firms is smaller, or firms' products are poorer substitutes). Is this in fact true? We show that, contrary to this belief, the negotiated wage is independent of the number of firms, the degree of substitutability of firms' products, and the type of market competition, in a broad class of industry specifications, including the standard linear symmetric demand system - linear one factor technology one. These results are robust with respect to various specifications of union's objectives. This independence of the negotiated wage implies that increases in the intensity of competition are reflected only in increases in aggregate industry employment. In a related work, Ulph & Ulph (1989) illustrate situations where the negotiated wage is independent of the product price. As a result, sectorial shifts in demand and labor productivity are entirely absorbed by employment adjustments.

[1] See section 4.

[2] E.g. see quote at the beginning of the introduction. See also Layard, R., Nickell, S., and Jackman, R.(1991) page 189.

It is well-known that the negotiated wage in a homogenous Bertrand market with constant returns to scale is indeterminate. The Nash product is not well defined in this case, since firms' profits are zero for any wage. Motivated by the above wage independence property, we propose that the negotiated wage in a Bertrand homogenous market be taken as the limit of that of a differentiated market as the degree of substitutability goes to one.

The organization of the paper is as follows. Section 2 presents the model and provides the conditions under which the wage independence property holds. Section 3 shows that these conditions are satisfied in a linear symmetric demands-linear one factor (labor) industry. Section 4 discusses the robustness of these results to different union objectives and provides an example to show the necessity of our assumptions. In section 5 we propose a solution for the Bertrand homogenous goods market. Finally, Section 6 concludes.

2 The Model:

There are n firms, all of which have identical log-linear one factor (labor) technologies:

$$x_i(l_i) = (A.l_i)^{\frac{1}{B}} \qquad i = 1, \ldots\ldots, n \tag{1}$$

$$A > 0, \quad B \geq 1$$

where x_i is firm i's output and l_i is the labor used by firm i. The n firms and the union collectively bargain over the wage w, following which each firm chooses its employment level, l_i (Right-to-Manage, Nickell (1982)). Finally, firms compete in the product market. The nature of market competition is not specified at this stage. Firms can compete by choosing only quantities, or prices, (as is assumed in the next section), or their strategy space may include other variables, too.

The union's objective is to maximize a function of the wage, w, and the aggregate employment, L:

$$U(w, L) = u(w).L^r \tag{2}$$

where $r \in \Re_+$ measures the relative importance given to employment, and $u(.)$ is an increasing concave function of the wage. This objective stems from a large variety of union welfare functions used in the literature after taking account of its outside option (see Section 4).

The negotiated wage is obtained with the use of the generalized Nash Bargaining solution where a parameter b, $0 \leq b \leq 1$, represents the exogenously given bargaining power of the union. In the limit as $b = 1$, the union unilaterally sets the wage, while if $b = 0$ firms set the wage. Let $\Pi^*(w; K)$ represent the firms' aggregate "indirect" profits, and $L^*(w; K)$ the aggregate employment level, for a given negotiated wage, w, with K being a list of parameters characterizing the market. A generalized Nash bargain then solves:

$$Max._w[U(w, L^*(w; K)]^b[\Pi^*(w; K)]^{1-b}$$

Restricting attention to symmetric market equilibria, we have that $\Pi^*(w; K) = n\pi^*(w; K)$, and $L^*(w; K) = nl^*(w; K)$, where $\pi^*(w; K)$, and $l^*(w; K)$, are a firm's equilibrium profits, and employment, respectively. Log-linear technology (1) then implies that $l^*(w; K) = (x^*(w; K))^B/A$, where $x^*(w; K)$ is a firm' s output in equilibrium.

Given (2), the negotiated wage is determined according to:

$$Max._w[u(w)\{nx^*(w; K)^B/A\}^r]^b[n\pi^*(w; K)]^{1-b} \tag{3}$$

A priori, we could expect the wage emerging from this maximization exercise to depend on all the factors affecting the union's welfare or the firms' profits. In particular, it is interesting to ask whether an increase in industry concentration, or in the firms' market power will lead to a higher negotiated wage. In view of the prevailing interest in the problem of unemployment, this question may have an even greater significance for employment policy. The following proposition gives the conditions under which the negotiated wage is independent of a list of market parameters .

Proposition 1: The Independence Property:
Let there be n identical firms, each with log-linear one factor (labor) technology, bargaining with a single union. If a firm's equilibrium output and "indirect" profit functions [3] *are multiplicatively separable (m-separable) in*

[3] We make the standard assumptions to ensure that these functions are differentiable.

wages and a list of parameters K, and if the union's objective function is m-separable in wages and in employment and is log-linear in employment, then the negotiated wage emerging from centralized bargaining is independent of the list of parameters K, and the number of firms, n.

Proof: Let a firm's equilibrium output and "indirect" profit functions be represented as:

$$x^*(w;K) = \psi(w)\phi(K) \tag{4}$$

$$\pi^*(w;K) = \Psi(w).\Phi(K) \tag{5}$$

Note, that (3) is equivalent to

$$\underset{w}{Max}\ b\left[\ln u(w) + r\ln n + rB\ln x^*(w;K) - r\ln A\right] + (1-b)\left[\ln n + \ln \pi^*(w;K)\right]$$

Substituting for $\pi^*(w;K)$ and $x^*(w;K)$, and taking the first order condition (assuming the second order condition is satisfied), we get:

$$\frac{b.u'(w)}{u(w)} + \frac{Bbr\psi'(w).}{\psi(w)} + \frac{(1-b).\Psi'(w)}{\Psi(w)} = 0 \tag{6}$$

Clearly, therefore, the solution of this equation for w does not depend on K or on n. .

◇

The intuition behind this result is as follows. The Generalized Nash bargaining solution requires that the negotiated wage be such that the percentage decrease in the firms' "indirect" profits due to a wage increase, weighted by the firms' bargaining power, is equal to the percentage increase in union's welfare, weighted by its bargaining power . Given the form of union's objective (2), the latter can be decomposed into the percentage increase of wage-related welfare, $u(w)$, and the percentage decrease of employment-related welfare, L^r. Clearly, the percentage increase of wage-related union welfare is independent of the number of firms and the list of parameters, K. On the other hand, our separability assumption ensures that the percentage decrease in aggregate profits, $n\pi^*(w;K)$, and the percentage decrease of employment-related union's welfare, $(nl^*(w;K))^r = (n[x^*(w;K)]^B/A)^r$, are also independent of n and K. This in turn implies that the negotiated wage does not depend on the number of firms, n, or the list of parameters, K.

A natural question that arises is what types of industries (or economies) would satisfy the conditions of Proposition 1 and what are the parameters included in the list K. In the next section we show that symmetric linear demands-linear one factor technology economies where firms compete in prices, or in quantities, in the product market is an interesting class of economies that do satisfy those conditions.

3 Linear Demand-Linear Technology Economies

Interestingly, it turns out that a class of industry (or economy) specifications that is used extensively in the literature does in fact satisfy the conditions of Proposition 1. In addition, we show that in these economies, the negotiated wage is independent of the *type of competition,* too. Let us now describe the specific features of these economies.

As before, there are n identical firms in the market, each endowed with a linear one factor (labor) technology which is given by (1) with $B = 1$. Firms face a symmetric linear demand system, which is a generalization of Dixit (1979) :

$$P_i(x_i, x_{-i}) = a - x_i - \gamma x_{-i} \qquad x_{-i} = \Sigma_{j \neq i} x_j \quad i, j = 1, ..., n \qquad (7)$$

In fact, these are the demand functions of a representative consumer whose utility depends on a vector of consumption goods $x = (x_1, x_2, ..., x_n)$ and the numeraire good m. It is given by $W(x) + m$[4]with:

$$W(x) = a(\sum_i x_i) - \frac{(\sum_i x_i^2 + 2\gamma \sum_{i \neq j} x_i x_j)}{2} \quad j = 1, .., n$$

where γ represents the degree of substitutability between any pair of goods i and j. The higher the γ, the higher is the degree of substitutability between i and j. When γ tends to zero, each firm virtually becomes a monopolist; when γ tends to one, all goods are almost perfect substitutes.

As the following proposition shows, the negotiated wage in these economies satisfies the Independence property:

[4]Note that this utility function subsumes a preference for variety. It is decreasing in γ and increasing in the number of product varieties n.

Proposition 2: *Let there be n identical firms, with linear one factor (labor) technology, bargaining with a single union. If firms face symmetric linear demands, and if the union's objective function is m-separable in wages and in employment and is log-linear in employment, then the negotiated wage emerging from centralized bargaining is independent of the degree of product differentiation, γ, the number of firms, n, and also of whether firms compete in prices, or quantities*[5].

In the next subsection, we first solve for the negotiated wage in a Cournot market for a general union objective (2). Then we derive the closed form solution for a more specific union objective to illustrate our main result.

3.1 Cournot Competition:

Let us derive a firm's equilibrium output and profits in the Cournot market. In the last stage of the game, firm i solves:

$$Max._{x_i}(a - x_i - \gamma x_{-i})x_i - \frac{w}{A}x_i \tag{8}$$

given some wage level w, and given the rival firms' output choices x_{-i}. The first order condition (foc) are:

$$a - 2x_i - \gamma x_{-i} = \frac{w}{A} \tag{9}$$

Then a firm's output in the symmetric equilibrium is:

$$x^*(w) = \frac{a - \frac{w}{A}}{2 + \gamma(n-1)} \tag{10}$$

[5]Note that the type of market competition can be viewed as a market parameter, α, according to the Conjectural Variations approach (Bowley (1924)). In Cournot Competition a firm i perceives its rivals' outputs to be unaffected by changes in its own output. In Bertrand Competition, firm i conjectures that, in response to a change in its own output, its rivals will adjust their outputs in a compensatory way to leave their market prices unchanged. In general, these conjectures can be represented by a linear expectation function: $\Delta x_j^e = \alpha \Delta x_i, j \neq i, j = 1, ..., n$. Then $\alpha = 0$ corresponds to Cournot Competition, and $\alpha = \frac{-1}{n-1}$ corresponds to Bertrand Competition with homogenous goods. The differentiated Bertrand case, as well as the collusive (joint profit maximization) case can be accomodated by choosing appropriate values of α. In fact, it can be shown that our results hold for a wide spectrum of values of α.

Our linear one factor technology assumption implies that its optimal choice of labor is:

$$l^*(w) = \frac{x^*(w)}{A} \tag{11}$$

Finally, a firm's equilibrium profits are given by:

$$\pi^*(w) = [x^*(w)]^2 = \frac{(a - \frac{w}{A})^2}{(2 + \gamma(n-1))^2} \tag{12}$$

Observe that both, the optimal output and "indirect" profits, are inversely related to the degree of product differentiation, γ, and to the number of firms, n[6]. This is also true for the price-cost margin (from foc (9)). Note too, that the equilibrium output and profits satisfy the conditions of Proposition 1, i.e. they are m-separable in wages and the list of parameters $K = (\gamma, n)$. Proposition 1 then implies that the negotiated wage is independent of γ and n. Further, (6) applied to this case gives:

$$-\frac{2(1-b)}{aA - w} + \frac{bu'(w)}{u(w)} - \frac{br}{aA - w} = 0 \tag{13}$$

The negotiated wage is the solution of this implicit equation. Therefore, it is independent of both, the number of firms and the product differentiation. To illustrate, consider $u(w) = w - w_0$, where w_0 may be interpreted as the best alternative wage. Then from (13) the negotiated wage is:

$$w^* = \frac{aAb + [2 + b(r-2)]w_0}{2 + b(r-1)} \tag{14}$$

Obviously, this wage coincides with the negotiated wage in the homogenous n-firm Cournot market. It, also, coincides with the wage bargain struck between a monopoly and its union. Note, that the negotiated wage increases

[6]As γ increases, the size of all markets shrinks due to the representative consumer's preference for variety. As n increases, the demand for a firm's good shifts in due to the availability of a larger number of substitutes. Further, as γ increases (or n increases), the intensity of competition increases. As a result, a firm's profits decrease with both, γ and n. On the other hand, a firm's output decreases with γ, because the market size effect dominates the competition effect. Also, as n increases, the substitutability effect dominates the competition effect, leading to lower per firm output.

with the size of market a, the efficiency of the technology A, the best alternative wage w_0, and the union' s bargaining power b, while it decreases as the union cares relatively more about employment.

3.2 Bertrand Competition:

We turn next to a Bertrand differentiated market. Let $\gamma < 1$. Inverting the system of inverse demand functions in (7) we obtain the demand system:

$$D_i(p_i, p_{-i}) = \frac{a(1-\gamma) - [1+\gamma(n-2)]p_i + \gamma p_{-i}}{[1+\gamma(n-1)](1-\gamma)} \tag{15}$$

for $i = 1, 2, ..., n$ and $p_{-i} = \Sigma_{i \neq j} p_j$
Then, given the negotiated wage w and its rivals' prices p_{-i}, firm i solves:

$$Max._{p_i}(p_i - \frac{w}{A})D_i(p_{i,}p_{-i})$$

The first order conditions are:

$$a(1-\gamma) - [1+\gamma(n-2)]p_i + \gamma p_{-i} = (p_i - \frac{w}{A})[1+\gamma(n-2)] \tag{16}$$

In the symmetric equilibrium, we get:

$$p^* = \frac{a(1-\gamma) + [1+\gamma(n-2)]\frac{w}{A}}{2+\gamma(n-3)} \tag{17}$$

A firm's output in equilibrium is then:

$$x^*(w) = \frac{(a - \frac{w}{A})[1+\gamma(n-2)]}{[1+\gamma(n-1)][2+\gamma(n-3)]} \tag{18}$$

and its indirect profits are:

$$\pi^*(w) = \frac{(a-\frac{w}{A})^2[1+\gamma(n-2)](1-\gamma)}{[2+\gamma(n-3)]^2[1+\gamma(n-1)]} = \frac{\{x^*(w)\}^2[1+\gamma(n-1)](1-\gamma)}{[1+\gamma(n-2)]} \tag{19}$$

Here too, optimal output, indirect profit and price-cost margin are decreasing in γ and in n (except if $n = 2$, in which case output initially decreases and then increases with γ)[7]. Moreover, both output and profit functions satisfy the separability property of Proposition 1.

Note, that (6) applied to the Bertrand case reduces to the same equation as in the Cournot case (see (13)):

$$-\frac{2(1-b)}{aA-w}+\frac{bu'(w)}{u(w)}-\frac{rb}{aA-w}=0$$

The negotiated wage is again independent of the number of firms n, and the degree of product differentiation γ. Moreover, it is the same in both, Cournot and Bertrand markets for a general $u(w)$. Thus, it is independent of the type of competition. If, in addition, $u(w) = w - w_0$, the negotiated wage is given, as before, by (14).

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3.3 Discussion.

If we were to use the logic of the quote at the beginning of the introduction, we would be lead to expect that the higher the surplus an industry creates, the higher should be the negotiated wage. If rents available in the industry are directly related to the degree of product differentiation, the degree of industry concentration, or the type of competition, why do we get the wage independence result? Using the intuition of Section 2, we need to understand why e.g. the percentage decrease (due to a wage increase) in a monopolist's output and profits is of similar magnitude as those of a single firm in an (almost) homogenous Cournot, or Bertrand industry.

Let us consider the Cournot market first. A wage increase, by increasing the marginal cost of all the firms in the industry, has two effects on a specific firm's output. A negative direct effect, i.e. the firm decreases its output as it is facing now a higher marginal cost. And a positive strategic effect, i.e. the firm increases its output in response to its rival firms' decreasing their outputs. The strategic effect is stronger, hence the (negative) overall effect is weaker, the higher is n,or the higher is γ (since competition becomes stronger). As we have seen, in these cases a firm' s output is lower, too. Thus, a firm's percentage decrease in output remains invariant to γ and n.

[7]Similar arguments hold as in the Cournot case. See previous footnote. If, however, $n = 2$, as γ decreases, the competition effect dominates at first and then the preference for variety effect, thus producing the inverted bell shaped output curve.

A similar property can be shown to hold for a firm's indirect profits. When γ is close to zero, (i.e. the local monopoly case), the size of the strategic effect is negligible. Thus, an increase in w causes a relatively large decrease in the local monopolist's profits. While when γ is close to one, the strategic effect is strong enough to partially offset the direct effect, thus resulting to a smaller decrease in profits. Note, that the local monopolist's profits are higher compared to a firm's in an almost homogeneous industry. Thus, the percentage decrease in profits due to a wage increase does not vary with the degree of product differentiation. A similar explanation goes through for n as well, since $n = 1$ corresponds to the monopoly case and a sufficiently large n replicates an almost perfectly competitive industry.

Let us next consider the Bertrand industry. As previously, a wage increase has two effects on a firm's output. The negative direct effect results from an increase in a firm's price, and thus a decrease in its output, due to its higher marginal cost. The positive strategic effect stems from the firm increasing its output as a response to an increase in its rivals' prices. Here too, the size of the strategic effect is smaller, the softer is the competition, that is, the lower is γ, or the smaller is n. Contrary to the Cournot case, however, the direct effect on output is increasing in γ . For $n > 2$, the strategic effect is sufficiently strong to imply, as before, that the decrease in output is larger for values of the parameters where the output produced per firm is larger.[8] Hence, the observed invariance of the percentage decrease in output (as the wage increases) with the degree of product differentiation and the number of firms. Finally, invariance of the percentage decrease in profits with γ and n follows from a reasoning similar to the Cournot case.

It remains to explain why, for fixed values of γ and n, the percentage decrease in output and profits, as the wage increases, is the same under Cournot and Bertrand competition . For γ close to zero, the firm is a local monopolist, thus the type of competition has little effect on output, profits or variations in these variables due to changes in wage. For the remaining cases, first observe that a firm's profits under Cournot are higher than under Bertrand, while the opposite is true for its output. Both, the direct and the

[8]This is also true for $n = 2$, but only for low values of γ. For high values of γ, the direct effect offsets the (relatively weak) strategic effect, resulting to an inverted bell shaped output variation as γ increases. The output, too, behaves the same way (see footnote 7), thus resulting to the invariance of the percentage changes in output with respect to γ for $n = 2$.

strategic, effects of a wage increase on output, are stronger in the Bertrand case. To see why the direct effect is stronger, consider the case of almost perfectly substitutable goods. Even a small increase in a Bertrand firm' s marginal cost causes it to lose all its market share, while a Cournot firm loses only a small part of it. A Bertrand industry being more competitive than a Cournot industry, the strategic effect is obviously stronger in the former. It turns out, in addition, that the total effect on output is also stronger under Bertrand, thus explaining the invariance of the percentage decrease in output to the type of competition. Finally, the invariance of the percentage decrease in profits to the type of competition can be illustrated in the case of almost perfect substitutes. While a Bertrand firm's price-cost margin hardly changes as a result of an increase in wage, that of a Cournot firm decreases substantially. Thus, the resulting decrease in profits is much larger for a Cournot firm.

Note, that our independence result has important implications for employment policy. We have seen that an increase in γ, or n, leads to a decrease in per firm output. At the industry level, however, we find that they have different impacts. A higher degree of substitutability among goods leads to lower industry output, and thus to lower aggregate employment. While an increase in the number of firms (or product varieties) leads to higher industry output, and employment. Any change of these parameters is absorbed solely by aggregate employment variations, since the negotiated wage remains constant. Thus, unions do better in a less concentrated market, but not in a market where products are better substitutes. Finally, unions welfare is higher in a Bertrand industry than in a Cournot, since in both the wages are equal, while aggregate employment is higher in the Bertrand market.

4 Different Union Objectives & the Necessity of our assumption:

In this section we show that most of union objective functions used in the literature fit in our specification (2). First, the union objective coincides with the welfare of its median member (Booth (1984), Grossman (1983)). Let $v(w)$ be the median member' s utility from the wage w. Let $v(w_0)$ be his utility from a reference wage w_0. This can be interpreted as the unemployment benefits or an alternative wage from some inferior job. Let M be the number of union members. Then the median member expects to find a job with probability $\frac{L}{M}$. Thus, his expected utility is:

$$\frac{L}{M}v(w) + (1 - \frac{L}{M})v(w_0) \tag{20}$$

The union objective is then to maximize its median member's utility above the reference utility, i.e.

$$U(w, L) = \frac{L}{M}(v(w) - v(w_0))$$

Let $u(w) = [v(w) - v(w_0)]/M$. Then it is a special case of (2).

Second, the union maximizes its members' total excess utility. If all members are identical and each has a utility of wage $v(w)$, and $v(w_0)$ for the best alternative wage, we get the utilitarian union objective function (Oswald (1982)) with identical workers. That is,

$$U(L, w) = L[v(w) - v(w_0)] \tag{21}$$

which again is a special case of (2).

Finally, consider a general form of the union objective function that has been used in the empirical work (Dertouzos and Pencavel (1981), Pencavel (1984)). This is a modified version of a Stone Geary Utility function :

$$U(w, L) = \alpha(w - w_0)^m(L - L_0)^\beta \tag{22}$$

If the union's minimum acceptable employment, L_0, is normalized to zero, and $m \leq 1$ this objective function also fits our specification (2).

4.1 An Example to show the necessity of our assumption:

We saw that the wage independency property holds only if the union's objective is of the type specified in (2). To get some insight on the role of the union's objective for the wage invariance to the market parameters, we consider a case where the assumption (2) is *not* satisfied. Let:

$$U(w, L) = w(1 + \frac{L}{2})$$

Assume a Bertrand differentiated goods industry. Then the negotiated wage solves:

$$Max._w[(x^*(w)^2 X(\gamma,n)]^{1-b}[w(1+\frac{L^*(w)}{2})]^b$$

where $x^*(w)$ is given in (18). This is equivalent to maximizing:

$$(1-b)[2\ln x^*(w) + \ln X(\gamma,n)] + b[\ln w + \ln\{1+\frac{nx^*(w)}{2A}\}]$$

where $X(\gamma,n) = \frac{[1+\gamma(n-1)](1-\gamma)}{1+\gamma(n-2)}$. Let $Y(\gamma,n) = \frac{1+\gamma(n-2)}{[1+\gamma(n-1)][2+\gamma(n-3)]}$. Then the first order condition is:

$$-\frac{2(1-b)}{aA-w} + \frac{b}{w} = \frac{b}{2A^2/nY(\gamma,n) + (aA-w)} \quad (23)$$

The LHS of (23) is decreasing, while the RHS is increasing, in w. Further, the LHS is independent of, while the RHS shifts with, γ and n. Hence, the negotiate wage depends on both, the product substitutability γ, and the number of firms n. Finally, it can be easily checked that the negotiated wage depends on the type of competition, too.

5 A proposed Solution:

The Nash Bargaining solution cannot be used to derive the negotiated wage in the case of centralized bargaining in a homogeneous Bertrand industry. The firms' profits are always zero, regardless of the wage rate, so that the Nash product is not well defined. Motivated by the wage independence property, we propose that the negotiated wage in a homogeneous Bertrand industry should be the limit of the solution of a differentiated Bertrand market as the parameter of differentiation, γ, goes to 1. Indeed, in the class of industries studied in section 3 (i.e. symmetric linear demand-linear one factor technology industries) and under various union objectives, we have found that the negotiated wage is independent of the parameter of differentiation, γ, for all $\gamma < 1$ in the Bertrand case. It is then reasonable to think that the negotiated wage in the homogenous market ($\gamma = 1$) coincides with that of any other differentiated Bertrand market.

Using the example of the previous section, we now illustrate our proposed solution. As we saw, the negotiated wage depends on the degree of product differentiation γ. From equation (23), and for $n = 2$ we get,

$$-\frac{2(1-b)}{aA-w}+\frac{b}{w}=\frac{b}{A^2(1+\gamma)(2-\gamma)+(aA-w)} \qquad (24)$$

The solution of (24), $w^*(\gamma)$, is continuous in γ. Hence we can take the limit of $w^*(\gamma)$ as $\gamma \longrightarrow 1$, to derive the negotiated wage in the homogenous Bertrand market.

6 Conclusion:

In this paper we provide sufficient conditions under which the wage emerging from centralized bargaining between a union and the firms in an industry is independent of a number of market parameters. Indeed, we show that in an oligopolistic product market where identical firms face symmetric linear demands for their differentiated goods, and are endowed with linear one-factor (labor) technologies, the negotiated wage is independent of the industry concentration, the degree of product differentiation, and the type of market competition. Moreover, this wage independence property is robust under a broad class of union objectives.

This result has some interesting implications for employment policy. We show that changes in market parameters that affect the level of competition among firms have beneficial effects on industry employment. In particular, it is possible to increase employment by encouraging the entry of new firms, e.g. through deregulation of the industry, or even subsidizing entry costs.

A number of testable hypotheses can emerge from our theoretical results. First, is the wage independence property. The latter is supported by Hirsch & Connoly (1987), and Hirsch (1990) who find no evidence that union rent seeking is more effective in highly concentrated industries, or among firms with large market shares. The independence property further suggests that union/non-union differentials are independent of market parameters (such as substitutability among goods, industry concentration, and the intensity of competition), if non-union wage is to be taken as the best alternative wage. So far, evidence is mixed on the issue. According to Lewis (1986), union wage premiums are typically smaller in highly concentrated industries.

However, Steward (1990) concludes that wage differentials are positive in industries with market power, but zero in perfectly competitive markets. Second, the union effect on profits is more deleterious among firms with low market shares. This is in accordance with Clark (1984). Third, the union effect on price-cost margin is less negative in highly concentrated industries. This is along the lines of Domowitz *et al.* (1986) who find little evidence that price-cost margins are more negative in highly concentrated industries. Finally, there is no link between wages and profits. This is in contrast to Pugel (1980), and Carruth & Oswald (1989) who detect some link between wage and profits.

It is known that the negotiated wage in a Bertrand homogenous market with identical firms and constant marginal costs is indeterminate, profits for the firms being 0 for any wage rate. We propose that a reasonable way to solve this indeterminacy is that the negotiated wage of the homogenous market be the limit of the wage of a differentiated market as the degree of substitutability goes to one. The independence property discussed above then implies that the negotiated wage in the homogenous Bertrand market coincides with that of the differentiated market, if the firms, in addition, face linear symmetric demands.

The Dixit-Stiglitz (DS,1977) monopolistic competition model has been used extensively in the literature (Macroeconomics, International Trade and Growth) to capture the effects of imperfectly competitive markets. While this model performs well when the number of firms in the industry is large (e.g. when entry costs are low and goods are poor substitutes), it does not capture the strategic effects in a concentrated industry. Indeed it ignores the price index effect of individual pricing decisions. The Yang and Heijdra (1993) variant solves this problem, but loses much of the simplicity of the original solution. (Note, however, that this need not happen in a general equilibrium model if income effect is taken into account (d' Aspremont *et al.* (1994))). In contrast, the symmetric linear demands-one factor (labor) technology oligopolistic product market model takes into account all strategic effects. Moreover, if the wage bargaining is centralized this model retains the simplicity of the DS model. We suggest, therefore, that it can be a reasonable alternative to the DS model.

We have provided in this paper sufficient conditions for the independence property to hold in the context of linear one-factor technology, and identical firms. What alternative specifications of demand systems give rise to multiplicatively-separable output and "indirect" profit functions? Does the negotiated wage remain rather independent of the market parameters if the technology is non-linear (e.g. Cobb-Douglas), or firms are not identical? These questions remain open for further research.

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