PROFIT-SHARING, BERTRAND COMPETITION AND MONOPOLY UNIONS: A NOTE

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No 612

WARWICK ECONOMIC RESEARCH PAPERS

DEPARTMENT OF ECONOMICS

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October 27, 2001

Abstract

This paper studies a strategic aspect of profit-sharing in an oligopolistic industry with a monopoly union. Whenever a uniform profit share exists in the industry, we show that a union that values the per worker remuneration positively, may have incentives to reduce industry employment, decreasing thus total output and causing total profits to increase. Thus, we show that profit-sharing may lead to higher profits for such an industry even if productivity effects are absent.(JEL L42, J33, J51)

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1 Introduction:

Recent empirical work suggests that profit-sharing in one form or another is a widespread practice. Smith[12] reports that for the U.K., 21% of companies had at least one all-employee scheme. Blanchflower and Oswald [2] found that in 1984, 40% of the workers in the private manufacturing and non-manufacturing sector (U.K.) were eligible to participate in a profit-sharing scheme, and regarding actual participation they found that 25% of workers were involved in a share-ownership scheme, 20% in a profit-sharing scheme and 15% in value-added bonus schemes. Freeman and Weitzman[7] observe that the Japanese bonus system has the essential features of profit sharing, and is often cited as one main reason why Japanese firms face a less adverserial relationship with their employees as compared to American firms.

Given the prevalence of such schemes one is naturally led to ask the question: why are profit-sharing schemes adopted by industries? There have been some recent attempts to answer this question: some of the theoretical literature on profit-sharing includes e.g. Weitzmann[16, 17, 18], who in a series of macro-theoretic papers advocated profit-sharing schemes to help increase aggregate employment. The interdependence of firms is neglected in this model, the market being monopolistically competitive. Fung[8], Stewart[14] and Bensaid and Gary-Bobo[1], on the other hand, use strategic considerations in profit-sharing at the *firm* level, as the driving force of their models. In Bensaid and Gary-Bobo, for example, profit-sharing contracts are viewed as a means of strategic commitment. It is shown that with Cournot competition in the product market, profit-sharing by a firm is a best response to both the wage system and profit sharing by other firms, but all firms lose when they adopt such schemes. Employment increases and output prices decrease. In contrast we study the effects of a uniform profit share in an oligopolistic industry that has a single union.

Indeed, recent evidence on profit sharing (see e.g. Cable and Wilson[3]), suggests that the introduction of profit sharing will not necessarily have productivity enhancing effects unless there are accompanying changes in other dimensions of organisational design. Wadhwani and Wall[15],also support this conclusion for a sample of manufacturing firms in the UK. In the absence of such productivity enhancing effects of profit sharing would firms adopt such schemes? Our paper answers this question in the affirmative if the setting is an oligopolistic industry with a single union. Moreover we show that in such a framework profit-sharing schemes have negative effects on employment and that these negative effects are exacerbated by having a minimum wage in the industry.

We assume that there is a uniform profit share in the industry. This is quite reasonable if there is a common (say monopoly) union at the industry level[1]. We do not model the emergence of this profit-share but take it as exogenously given. The union decides on total employment, given the profit-share (since we deal with symmetric firms, and a uniform profit-share, this is the same as deciding firm level employment). In our model we let the union unilaterally decide employment, though this is not necessary to the results. This can be viewed as a special case of the Sequential Bargaining procedure modelled by Manning([10]). If we assume that the industry has delegated employment decisions to the union rather than bargaining over employment, then this can be viewed as the second stage of a sequential bargaining procedure, with, however the first stage (wage bargaining) given exogenously. All that is neededfor our results is that the union have some

[1]There is evidence that profit-sharing and centralized negotiations are institutions that co-exist in many countries. Indeed, in Japan, although the formal insitutions of bargaining are at the company level, there are effective mechanisms, namely highly co-ordinated employer's organizations, that ensure a high degree of centralisation in wage setting (Soskice [13]). For similar reasons we may expect centralisation in the setting of profit-shares.

bargaining power in setting employment given the wage and profit-share fixed prior to this by the firms.

The main result is that under some plausible conditions (Bertrand) firms can make higher profits through the introduction of such a profit-sharing scheme.

The rest of the paper is organised as follows: Section 2 introduces a simple example of a symmetric Bertrand Oligopoly with linear demand and constant returns to scale one factor technology that illustrates the main result. The next section then extends the result to generalised demand, generalised union objective functions and one factor technology functions with Bertrand firms. Section 4 concludes with some references to related literature and policy implications.

2 Linear Demand, CRS and Bertrand Competition

We consider n identical firms facing a competitive situation. These firms produce perfectly substitutable commodities for which the inverse market demand function is given by:

$$P(x) = A - x \tag{1}$$

where $A > 0$, is a constant and x represents total output in the industry. Let L denote the total employment in the industry, π the total industry profits, $0 < \theta < 1$ the profit share, and w_0 the reservation wage. As mentioned earlier, we assume wage and profit share to be exogenously given, and we do not model the process of wage and profit share bargaining. For an illustration of our main point we first assume a specific union objective function given by:

$$U(r, L) = (r(L) - w_0)L \tag{2}$$

where $r(L) = w + \theta\frac{\pi}{L}$. Hence, the union cares not only about its rents from their workers' salaries, but also about its share from the industry profits, i.e.

$$U(r, L) = (w - w_0)L + \theta\pi(L) \tag{3}$$

All firms in the industry possess the same constant returns to scale technology, and thus total output given by:

$$x = BL \tag{4}$$

with $B > 0$ is the productivity of labor. Our first proposition establishes the conditions under which firms can make positive profits when profit sharing co-exists with a centralised union which selects aggregate employment.
We assume $(w - w_0) > 0$.
Proposition 1: Let the inverse demand function be linear (1), the union's objective function be (2) above and the technology be one factor constant returns to scale (4). Bertrand firms make positive profits whenever $(w-w_0) < \theta B(A - \frac{w}{B})$.
Proof: Given w and θ, the union chooses L to maximise $U(r, L)$. The first order condition is,

$$w - w_0 = -\theta\frac{d\pi}{dL}$$

implying that:

$$L^* = \frac{A}{2B} + \frac{w(1-\theta) - w_0}{2\theta B^2} \tag{5}$$

and $\pi^* = [(A - BL^*)B - w)]L^*$. Note that $L^* \geq L_m = (A - \frac{w}{B})\frac{1}{2B} > 0$ (since $w - w_0 \geq 0$), where L_m is the employment level that maximizes industry profits. Thus, for profits to be positive, we need:

$$(A - BL^*)B - w > 0 \tag{6}$$

Substituting for L^* in the above two conditions gives the result. Note that the second order condition is satisfied, since $\frac{d^2U}{dL^2} = \theta\frac{d^2\pi}{dL^2} = -2\theta B^2 < 0$.

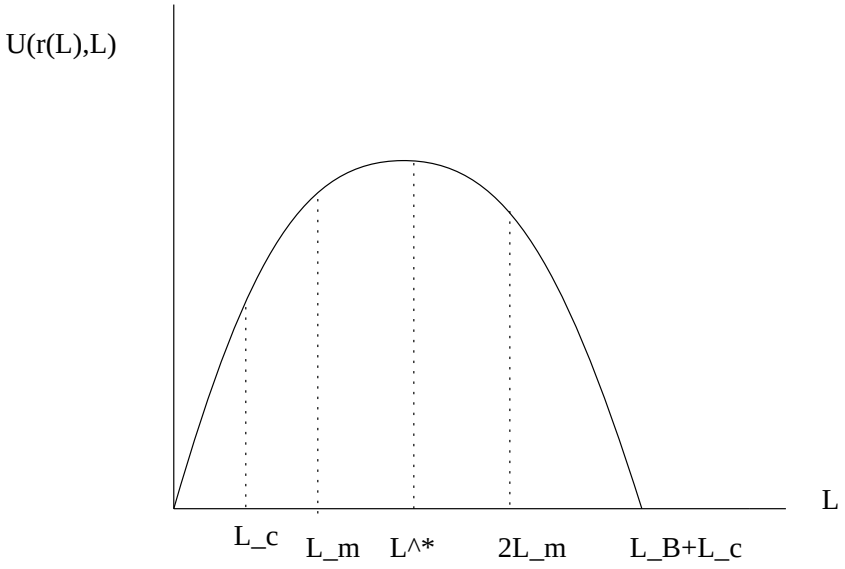

Figure 1: Linear Demand-Wage bill Objective Function

□

The intuition is as follows. Let L_B represent the Bertrand level of employment and L_m the monopoly level of employment.Observe that (as in figure 1), $L_B = \frac{1}{B}(A - \frac{w}{B}) = 2L_m$. The condition $\theta(AB - w) > (w - w_0)$ is satisfied iff $L_B > L^*$ or $L_B > \frac{(w-w_0)}{\theta B^2}$. Thus, if the Bertrand level of employment (at which industry profits are zero) is more than a certain critical level $L_c = \frac{(w-w_0)}{\theta B^2}$, then the union gains from restraining employment. This is easy to understand from the unions objective function given by (3) above. There is a negative direct effect of restraining employment, since the union values employment and an indirect positive effect through higher profits. Observe that $\frac{dU}{dL} = (w - w_0) + \theta\frac{d\pi}{dL}$, and $\frac{d\pi}{dL}$, is positive until $L = L_m$ and then decreases for $L > L_m$. However, the direct effect of changes in employment on union utility is measured by $(w - w_0)$ and $\frac{dU}{dL}$ may still be positive for $L > L_m$ if the direct effect on employement measured by $(w - w_0)$ is high enough. Hence the larger is $(w - w_0)$ the larger is L^* compared to L_m, and

the lower the profits compared to monopoly level. If $(w - w_0)$ is too large, i.e.the union puts a high weight on employment in its objective function, $L^* = L_B$ and the firm makes zero profits. The firm makes the monopoly level of profits iff $L_m = L^*$ iff $(w - w_0) = 0$. I.e. if the union does not value employment (as in Insider objective function models), then Bertrand firms can achieve the monopoly profits through this delegation scheme. In the figure above, we assume $(w - w_0) > 0$, thus $L_m = \frac{1}{2}L_B$, and $L^* = L_m + \frac{L_c}{2}$ and $L^* = \frac{L_B}{2} + \frac{L_c}{2}$.Finally, union utility is zero at $L = L_B + L_c$.

3 The Generalised Result

In this section, we derive the general conditions for firms to make positive profits under Bertrand competition. We now use a generalised objective function for the union:

$$U(r(L), L) \tag{7}$$

with the first derivatives, U_r and U_L both strictly positive, and $0 < \theta < 1$. The inverse demand function is

$$P(x) \text{ with } P'(x) < 0 \tag{8}$$

and the one factor technology is given by

$$x(L) \text{ with } x'(L) > 0 \tag{9}$$

Let $\frac{d^2U}{dL^2} = U_{LL}$, $\frac{d^2U}{dr^2} = U_{rr}$, and L_u denote argmax$\{U(r(L), L)\}$. As before r denotes remuneration per employee, including wage and profit per employee. Assume $\frac{d^2\pi}{dL^2} < 0, U_{LL} \leq 0, U_{rL} \geq 0$. Let $\eta = \frac{d\pi}{dL}\frac{L}{\pi}$ denote the elasticity of profits with respect to employment.

Proposition 2: Let the the union's objective function be given by (7), the one factor (labour) technology by (9), and the inverse demand function be given

by (8). Then, Bertrand firms make strictly positive profits iff

$$\frac{U_L}{U_r} > -\theta \frac{\frac{d\pi}{dL}}{L_u} \tag{10}$$

Proof: The first order conditions for maximisation of U are:

$$U_r r'(L) + U_L = 0 \tag{11}$$

Let the solution to (11) be given by $L^* = L_u$, and the corresponding profits be denoted by π_u. Then L_u satisfies:

$$U_r[\frac{\theta}{L_u}\frac{d\pi}{dL} - \frac{\theta \pi_u}{{L_u}^2}] + U_L = 0 \tag{12}$$

i.e. π_u satisfies:

$$\pi_u = \frac{L_u^2}{U_r \theta}[U_r \frac{\theta}{L_u}\frac{d\pi}{dL} + U_L] \tag{13}$$

at the solution. We can write this as:

$$\pi_u = \frac{L_u^2 U_L}{U_r \theta(1-\eta)} \tag{14}$$

Since $\pi > o$, for any $L < L_B$, the condition (14) is equivalent to requiring $L < L_B$. Given our assumptions $U_L > 0$ and $U_r > 0$, it is sufficient then that $(1-\eta) > 0$. Note that η is defined as long as $L \neq L_B$. If $L_u \leq L_m$ then $\eta \geq 0$. So if $L < L_m$, we need $\eta < 1$. Observe that the union is interested not in total profits but in per worker profits, hence the total change in utility due to a marginal increase in employment consists of two effects: one is a direct one which increases utility due to the increase in employment and the other is indirect and is the effect of increased employment on $\frac{\pi}{L}$. When $L_u < L_m$ an increase in employment does increase profits but not necessarily $\frac{\pi}{L}$ and it is this ratio that depends on the elasticity at L. Thus if elasticity is high, then a small increase in employment has a large increase in profits and the union would then want to increase employment till the maximum $\frac{\pi}{L}$ is reached.

Thus, we can say that L_u is at least as high as the L at which this ratio is maximised. But it could be less than the monopoly level, and the condition on elasticity then is satisfied trivially, as the profit function is concave. For any $L_m < L_u < L_B$, $\eta < 0$, hence again the condition is satisfied. Thus, as long as $L_u < L_B$, the conditions are satisfied.

The special case of linear demand and the specific wage bill objective function discussed in Section 1 fits in with this result since (10) is equivalent to the condition $(w - w_0) < \theta B(A - \frac{w}{B})$.

Finally, We need to verify that the second order conditions are satisfied:

$$\frac{d^2U}{dL^2} = U_{rL}r'(L) + U_r r''(L) + U_{LL} < 0 \tag{15}$$

where $r'(L) = \frac{\theta}{L_u}\frac{d\pi}{dL} - \frac{\theta\pi_u}{L_u^2}$, and $r''(L) = \frac{\theta}{L_u}\frac{d^2\pi}{dL^2} - \frac{2}{L_u}r'(L)$. Note that at $L = L_u$, $r'(L) < 0$ (from (11)). Thus the SOC's are satisfied if:

$$r'(L)(U_{rL} - 2\frac{U_r}{L_u}) < -\frac{\theta}{L_u}U_r\frac{d^2\pi}{dL^2} - U_{LL} \tag{16}$$

These are satisfied under our assumptions.

□

Suppose we let employment be decided by bargaining between an industry wide employer's federation and the union. We could e.g. model this using the Nash bargaining product, as in the second stage of a two stage bargaining procedure a la Manning ([10]). Then the model here can be interpreted as a special case of the Nash bargaining solution where the union is delegated the employment decision. But this intuition will carry through to the more general model as well, i.e. Bertrand firms could make positive profits if the union is made to care about profits through a profit sharing scheme. Similarly the results are conjectured to hold for other types of competion as well, but this would require us to compute the reservation level of profits to make sure that the participation constraint for the firms and unions is satisfied.

4 Conclusion

Bonus payments in Japan constitute an average of greater than twenty percent of annual earnings of Japanese workers (Hashimoto [9]). Moreover the documented higher productivity of American workers compared to Japanese raises a question as to why firms would go in for such bonus schemes, if higher productivity does not result. Among other reasons why this may happen, our paper is an attempt to answer exactly this type of question.

We showed in this paper that oligopolistic industries may exploit the institutions of profit-sharing and monopoly unions to collude in the presence of anti-trust legislation. The bounds of collusion will be set by the objectives of the union: the more it values employment the lower will be the profits achieved by the firms. Clearly in the situation we have outlined, the union has sufficient incentive to allocate labor to induce capacity constraints, thus doing away with any need for monitoring by the firms.

While the model is not strictly applicable to Cournot firms, it can in principle easily be extended to incorporate them as well as to incorporate asymmetric oligopolies, though in the latter it is only total employment that is determinate but not its' allocation between firms. In a related paper ([6]), we show that firms can use "bonus schemes" which specify a bonus that workers receive if profits are above a certain level. Given that employment decisions are delegated to a union, Bertrand firms can credibly commit to choosing monopoly prices.

The idea that unions can be used for strategic interaction between firms is not new: most papers however concentrate on the issue of barriers to entry. Dewatripont ([5]) e.g. considers an example where an incumbent firm facing potential entry signs labor contracts which commit it to excessive post-entry output. Similarly, in a case described by Williamson ([19]), *United Mine Workers v Pennington*, the main issue was a contract between the union and

a multi-employer bargaining unit to charge a uniform wage rate to all firms, regardless of ability to pay. On the other hand, Petrakis and Vlassis ([11]) show that firms may use their unions to become Stackelberg leaders in the market, via the inclusion of employment into their bargaining agendas.

While unions play the major co-ordinating role in this paper, one could imagine in general that any intermediate input could fulfill this function. In this sense, our approach parallels the literature on vertical restraints. Empirical evidence in the telecoms industry e.g. suggests that various schemes are used to encourage suppliers of intermediate goods to carry out practices that result in increased concentration in downstream firms (access pricing literature). Most of this literature is however concerned with issues of entry rather than collusion of existing firms.

We also demonstrated some conditions under which profit-sharing leads to lower employment, in contrast to the results of Martin Weitzman.

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