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# Manager-Union bargaining agenda under monopoly and with network effects

Luciano Fanti\* and Domenico Buccella

**Abstract:** The present paper investigates the determination of the bargaining agenda in a unionised monopoly with managerial delegation, without and with network effects in consumption. First, we show that, in contrast with the received literature, monopolist hires a manager even in the absence of risk-sharing and asymmetric information considerations. Without network effects, in contrast to standard oligopoly results, managerial delegation benefits the monopolist, while harms consumers, workers and society. Moreover, in contrast to the conventional wisdom, monopoly profits with managerial delegation are higher with sequential Efficient Bargaining (EB) than Right-to-Manage (RTM), while union's welfare can be higher with RTM than EB: then a conflict of interests between the parties may exist but, paradoxically, for reverted choices of the bargaining agenda. Consumption externalities change the picture: managerial delegation benefits consumers, workers and society, provided that the network effect is sufficiently strong and union's power relatively low. The monopolist still prefers sequential EB; however, the union's welfare becomes larger under EB even for relatively low value of their power, provided that the network effect is sufficiently strong. Thus, the monopolist and the union endogenously choose the EB agenda which is also Pareto-superior.

Keywords: Efficient Bargaining; Right-to-manage; Firm-union bargaining agenda; Managerial Delegation; Network effects.

JEL Classification: J51, L13, L21

## Introduction

The unionisation of oligopolistic and monopolistic firms is widely observed in the real life cases (e.g., Booth, 1995). On the other hand, the separation between ownership and management is a well established fact of the modern corporate governance (e.g. Berle and Means, 1932; Baumol, 1958). In particular, the strategic use of incentive contracts in oligopolistic markets where decisions are delegated to managers has been introduced in the literature by the pioneering works by Vickers (1985), Fershtman (1985), Fershtman and Judd (1987) and Sklivas (1987) (VFJS from here onwards). According to VFJS, owners try to motivate their managers through compensation contracts (i.e. with a bonus based on a weighted sum of profits

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and sales, denoted as “sales delegation”), with the aim to conduct a more aggressive behaviour to gain a competitive advantage in the market.

Clearly, such a strategic effect does not exist in the case of monopoly. However, managerial delegation as well as unionisation are widely observed in monopolistic firms. Therefore, it is natural to revisit the issue of the bargaining agenda selection between monopolist and union in a context of a managerial firm where the manager hired by monopolist is the bargainer with the union. A novelty of this paper is that a monopolist finds convenient to assume a manager to whom output and bargaining decisions are delegated, despite the absence of any risk-sharing and asymmetric information considerations, in sharp contrast with the received literature.<sup>1</sup>

The issue of the bargaining agenda has been recently investigated by some works in an oligopoly context, such as Bughin (1999), Buccella (2011) and Fanti (2015). Such papers have shown mixed results; however, all of them have abstracted from the managerial delegation as well as consumption/network externalities.<sup>2</sup>

In particular, in the first section of the paper, the following questions are tackled: 1) is it profitable for the monopolist to hire a manager to delegate him the task of bargaining with union?; 2) how does the introduction of managerial delegation affect the equilibrium welfare of consumers, union and society?; 3) does the conventional result that monopoly firm always prefers Right-to-Manage (RTM) to Efficient Bargaining (EB) (and the union always prefers EB to RTM) hold true when there is a manager to whom it is delegated the task to bargain with the union?

Moreover, an increasing recent literature argued that there are positive consumption externalities (or network effects) which may modify the results of the standard models of imperfect competition (e.g., Katz and Shapiro, 1985, Cabral et al., 1999). It is known that, for many products, the utility derived by one consumer of the good increases with the number of other consumers of that good, as in the cases, for example, of telephone and software goods.<sup>3</sup> Thus, a positive network externality exists if the quantity of a good demanded by a consumer increases in response to an increase in purchases by other consumers, that is, a consumer wishes to possess a good in part because others do.<sup>4</sup> In principle, the consumers' expectations about the total sales of the goods may be affected by different mechanisms of output decisions

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<sup>1</sup> A clear example of the common wisdom is in the words of the early authoritative contributors to the managerial delegation literature: “In the case of a monopoly firm [...] in the absence of risk-sharing and asymmetric information considerations, such an owner will motivate his manager to maximize profits.” (Fershtmann and Judd (1987), 928).

<sup>2</sup> However a recent growing literature has shown that the effects of network externalities may be relevant and many established results of industrial organization literature obtained basically by assuming non-network goods may be modified (e.g. Hoernig, 2012, Battacharjee and Pal, 2014, and Chirco and Scrimatore, 2013, have shown that the established results of the oligopoly managerial delegation literature may be changed in the presence of network externalities).

<sup>3</sup> In fact the utility of a particular consumer from using a telephone or a software increases with the number of other telephone or software users.

<sup>4</sup> The positive influence of the number of other users of the product may also be due to the fact that a such a number may be interpreted as an index of product quality and better availability of after-sale services for consumer durables.

and different production costs and, thus, by different labour market institutions. Therefore, subsequently in a second section, consumption externalities are taken into account and the effects of the interaction between the introduction of the managerial delegation and the network effects are analysed.

We show that the convenience to hire a manager, despite the absence of strategic product market interdependence, may depend on the strategic role that the managerial delegation plays on the bargaining between manager and union. Moreover, we show that the choice of the bargaining agenda is considerably affected by the fact whether output and bargaining choices are delegated to managers. In particular, the conventional result that profit under RTM is larger than EB (i.e. simultaneous and sequential EB have the same equilibrium outcomes) is reverted. The reason is that the managerial delegation may be used by monopolist as a device to weaken the wage claims through a larger penalization for output (employment) in the manager's bonus scheme. Therefore, such a device is more effective to dampen the wage claims in the case of EB than in the RTM one. This remains true also under network effects which, in turn, push the monopolist to incentive rather than to penalise for output (employment) its manager because the expansive effect on the consumers' expectations and thus on prices outweighs the effects on wage costs. However, such an incentive in the case of sequential EB remains always lower than in the case of RTM (note that, as below detailed, with network effects the equilibrium outcomes of simultaneous and sequential EB are different) and thus also with network effects the wages continue to be lower in the sequential EB case. Consequently, the monopolist still prefers the sequential EB agenda.

By contrast, the effects of the managerial delegation on the union's utility, and thus on its preferred agenda, work in an opposite direction with respect to the monopolist. In fact, the conventional result that the union prefers EB is reverted exactly for the same reason for which the preferred agenda of the monopolist has been reverted, as above discussed. As a consequence, the conflict of interests between monopolist and union remains true. However, the network effects imply an important qualitative change for the union's utility (differently to what occurs to the monopolist profit) and for its preferred agenda. In fact, the incentive for output (employment) used to increase the consumer's expectations about the network size reduces the relative negative wage differential between the sequential EB and RTM agendas, to the extent that the sequential EB agenda switches to be, as in the standard monopoly, the preferred one. Therefore, there is agreement on the sequential EB agenda between the monopolist and the union provided that the network effects are sufficiently strong (relatively to the union's power). Interestingly, when the network effect is sufficiently strong and union's power sufficiently low, also consumers, workers and society as a whole prefer sequential EB rather than RTM and are benefited by the presence of managerial delegation. Thus, not only the EB agenda is endogenously chosen by monopolist and union but it is also Pareto-superior.

We consider that the three stages of the game involved are as follows. In the first stage, the monopolist decides the (publicly observable) incentive parameter so that

profit is maximized. In the second stage, both in the RTM and sequential EB cases, the monopolist-union bargaining unit bargain over wages to maximise the Nash product while, under simultaneous EB, the monopolist-union bargaining unit bargain concurrently over wages and employment to maximise the Nash product. In the third stage 1) in the RTM case, the monopolist chooses quantity (alternatively, price) to maximize profit, 2) in the sequential EB case, the monopolist-union bargaining unit bargain quantities (alternatively, price) to maximise the Nash product.

Moreover, in the presence of consumption externalities, managerial delegation may serve as a commitment instrument which influences consumers' expectations about the size of the market, thus increasing their willingness to pay in its favour (e.g. Battacharjee and Pal, 2013). Therefore, in the case of consumption externalities, managerial delegation has a twofold strategic effect for a monopolist: on the one hand, to put a brake to the wage claims in the bargaining with unions through a penalization for output (employment) and, on the other hand, to affect in its favour consumers' expectations regarding product market size, through an incentive for output (employment). Clearly, these two effects are of opposite sign as regards whether manager has to be rewarded or punished for output (employment). As shown below, the sign of the manager's bonus will depend on the relative strength of the network effects and union's power effects.

The rest of the paper is as follows. Section 2 presents the model of a unionised monopoly firm with managerial delegation, while Section 3 extends it with network effects. Section 4 concludes.

## 2. The model

Let us consider that there is only one firm in the market producing a good.

The standard inverse demand function faced by the monopolist is given by

$$p = a - q \tag{1}$$

where  $p$  and  $q$  are the price and quantity of good, respectively. By assuming, as usual, a constant returns technology in the sole labour input, that is  $q = L$ , where  $L$  is the employment, the monopolist's profit function is given by:

$$\pi = (p - w)q, \tag{2}$$

where  $w$  is the per unit of output wage.

We assume that the monopolistic firm is unionised.<sup>5</sup> We consider the two typical negotiation models of the trade-union economics (Booth, 1995): 1) the Right-to-Manage model (RTM) (e.g. Nickell and Andrews, 1983), in which wages are the outcome of negotiations between firms and unionized labour; however, once wages are set, the firms have the right to set the employment levels; and 2) the efficient bargaining model (EB) which prescribes that the union and the firm are bargaining over both wages and employment (or, more realistically, hours of work). Wages and

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<sup>5</sup> We assume that the members of the union are large enough to meet the firm's labour demand.

employment negotiations may occur either simultaneously (e.g. McDonald and Solow, 1981; Ashenfelter and Brown, 1986), or sequentially (Manning, 1987a,b). The union has the following utility function:<sup>6</sup>

$$V = (w - w^\circ)L, \quad (3)$$

where  $w^\circ$  is the reservation or competitive wage. Therefore, by recalling  $q = L$ , eq. (3) becomes

$$V = (w - w^\circ)q, \quad (4)$$

that is, the unions' objective function is to maximise the total rent.

Moreover, we assume that the monopolist hires a manager and delegates the output decision and the bargaining with the union to this manager, paid through a bonus. Specifically, as regards the determination of the manager's bonus, we follow here the papers of Vickers (1985), Jansen et al. (2007, 2009), van Witteloostuijn et al. (2007), Fanti and Meccheri (2013) and Meccheri and Fanti (2015), which assume a bonus of the manager proportional to

$$U = \pi + zq \quad (5)$$

where  $\pi$  denotes the profits of the firm and the weight on output  $z$  is a positive (negative) number if the owner incentives (disincentives) the manager's choice of quantity.

Let us begin by illustrating the cases of RTM and EB, both in the simultaneous and sequential configurations.

## 2.1 RTM institution

At stage 3, solving the utility maximisation problem of the manager in eq. (5), we get the following output function,

$$q(w) = \frac{[a + z - w]}{2} \quad (6)$$

In the second stage of the game, under Right-to-Manage, manager- union bargaining unit selects  $w$ , to maximize the following generalized Nash product,

$$\max_{w.r.t. w} N = (U)^{1-b} (V)^b = [(a - w - q + z)q]^{1-b} ((w - w^\circ)q)^b \quad (7)$$

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<sup>6</sup> This is a specific case of the more general Stone-Geary utility function, i.e., Pencavel (1985), Dowrick and Spencer (1994):

$$V = (w - w^\circ)^\theta L.$$

A value of  $\theta = 1$  gives the rent-maximising case (i.e., the union seeks to maximise the total rent); values of  $\theta < (>) 1$  imply that the union is less (more) concerned about wages and more (less) concerned about jobs). Moreover, the unions aims to maximise the wage bill when  $w^\circ = 0$ .

where  $b$  represents the union's bargaining power.

Maximising eq. (7) with respect to  $w$ , after substitution of eq. (6) in (7), we obtain the wage as a function of the weight on quantities,  $z$ :

$$w = \frac{[(a+z)b + w^\circ(2-b)]}{2} \quad (8)$$

By using (8) we obtain output as a function of the weight on quantities:

$$q^{RTM}(z) = \frac{(2-b)[a+z-w^\circ]}{4} \quad (9)$$

By using (8) and (9) the profit as a function of the weight on quantities is obtained:

$$\pi^{RTM}(z) = \frac{(2-b)[a+z-w^\circ][w^\circ(b-2) - (z(b+2) + a(b-2))]}{16} \quad (10)$$

and at first stage of the game the monopolist maximises his profit selecting  $z$ :

$$z^{RTM} = -\frac{b[a-w^\circ]}{[b+2]} \quad (11)$$

The equilibrium outcomes are

$$w^{RTM} = \frac{ab + w^\circ}{b+2} \quad (12)$$

$$q^{RTM} = \frac{[(2-b)(a-w^\circ)]}{2(b+2)} \quad (13)$$

$$\pi^{RTM} = \frac{(2-b)[a-w^\circ]^2}{4[b+2]} \quad (14)$$

$$V^{RTM} = \frac{b(2-b)(a-w^\circ)^2}{2(b+2)^2} \quad (15)$$

$$CS^{RTM} = \frac{(2-b)^2[a-w^\circ]^2}{[8[b+2]]^2} \quad (16)$$

$$SW^{RTM} = \frac{[5b-6](2-b)[a-w^\circ]^2}{[8[b+2]]^2} \quad (17)$$

## 2.2. Efficient Bargaining institution.

Under efficient-bargaining the manager-union bargaining unit maximizes the following generalised Nash product,

$$N = (U)^{1-b}(V)^b = [(a-w-q+z)q]^{1-b}((w-w^\circ)q)^b \quad (18).$$

Hence, the manager-union bargaining unit selects at the first stage  $w$  and at the second stage  $q$  (or equivalently  $L$ ), in the case of SEB or, alternatively, simultaneously  $w$  and  $q$  in the case of EB.

### 2.2.1. Sequential Efficient Bargaining

At the third stage, from the first-order condition of the efficient bargaining game between manager and union, the monopolist's output function for given  $w$  and  $z$  is the following:

$$q(w, z) = \frac{[a + z - w]}{2 - b} \quad (19)$$

At the second stage, after substitution of (19) in (18) and the usual maximisation procedure w.r.t.  $w$ , we obtain the wage:

$$w^{SEB} = \frac{(a + z)b - w^\circ(2 - b)}{2} \quad (20)$$

By using (20) in (19) we obtain output as a function of  $z$ :

$$q^{SEB}(z) = \frac{(a + z - w^\circ)(2 - b)}{2(2 - b)} \quad (21)$$

By using (20) and (21) the profit as a function of the weight on sales is obtained:

$$\pi^{SEB}(z) = \frac{(a + z - w^\circ)[(1 - b)(a - w^\circ) - (1 + b)z]}{4} \quad (22)$$

and at first stage of the game the monopolist maximises his profit selecting  $z$ :

$$z^{SEB} = -\frac{(a - w^\circ)b}{1 + b} < 0 \quad (23)$$

The equilibrium outcomes are

$$w^{SEB} = \frac{(a + w^\circ)b + 2w^\circ}{2(1 + b)} \quad (24)$$

$$q^{SEB} = \frac{(a - w^\circ)}{2(1 + b)} \quad (25)$$

$$\pi^{SEB} = \frac{(a - w^\circ)^2}{4(1 + b)} \quad (26)$$

$$V^{SEB} = \frac{b(a - w^\circ)^2}{4(1 + b)^2} \quad (27)$$

$$CS^{SEB} = \frac{(a - w^\circ)^2}{8(1 + b)^2} \quad (28)$$

$$SW^{SEB} = \frac{(a - w^\circ)[(a - w^\circ) - 4(1 + b)]}{8(1 + b)^2} \quad (29)$$

Finally we note that the equilibrium outcomes of the Simultaneous EB are the same of the Sequential EB (the straightforward demonstration is omitted here for economy of space).

### 2.3. Benchmark equilibrium outcomes for the profit-maximising monopoly.



Now we report here the equilibrium outcomes of the standard case of a profit-maximising monopoly (PM) for the purpose of comparison with those of the managerial monopoly above presented, for the cases of RTM and SEB, respectively.

$$w_{PM}^{RTM} = \frac{[ab + w^\circ(2-b)]}{2} \quad (12.bis)$$

$$q_{PM}^{RTM} = \frac{[(2-b)(a-w^\circ)]}{4} \quad (13.bis)$$

$$\pi_{PM}^{RTM} = \frac{(2-b)^2 [a-w^\circ]^2}{16} \quad (14.bis)$$

$$V_{PM}^{RTM} = \frac{b(2-b)[a-w^\circ]^2}{8} \quad (15.bis)$$

$$CS_{PM}^{RTM} = \frac{(2-b)^2 [a-w^\circ]^2}{32} \quad (16.bis)$$

$$SW_{PM}^{RTM} = \frac{[b+6](2-b)[a-w^\circ]^2}{32} \quad (17.bis)$$

$$w_{PM}^{SEB} = \frac{ab + w^\circ(2-b)}{2} \quad (24.bis)$$

$$q_{PM}^{SEB} = \frac{(a-w^\circ)}{2} \quad (25.bis)$$

$$\pi_{PM}^{SEB} = \frac{(1-b)(a-w^\circ)^2}{4} \quad (26.bis)$$

$$V_{PM}^{SEB} = \frac{b(a-w^\circ)^2}{4} \quad (27.bis)$$

$$CS_{PM}^{SEB} = \frac{(a-w^\circ)^2}{8} \quad (28.bis)$$

$$SW_{PM}^{SEB} = \frac{3(a-w^\circ)^2}{8} \quad (29.bis)$$

#### 2.4 Discussion of the findings in the standard case (without consumption externalities).

In this section, first, we comment the effects of the managerial delegation on the unionised wage. Second, we establish the effects of the introduction of the managerial delegation on the equilibrium outcomes. Third, we determine the preferred bargaining agenda by monopolist and union.

*Lemma 1.* The manager's bonus tends to increase wages in the same way under the different bargaining arrangements and to increase output (employment) more in the SEB case than in the RTM case.

*Proof:* by simply observing and comparing (8) and (20), and (9) and (21), respectively.

*Lemma 2.* The manager is penalised for output (employment) more under SEB than under RTM (i.e.  $z^{SEB} < z^{RTM} < 0$ ).

*Proof:* by simply observing and comparing (11) and (23).

*Lemma 3.* At equilibrium the wage under RTM is always higher than that under SEB (or EB).

*Proof:* by simply observing and comparing (12) and (24).

The economic intuition is that 1) since the manager's bonus increases wages the monopolist fixes a "negative" bonus to dampen union's wage claims, and 2) since the bonus' effect on wages is uniform while that on output is lower in the RTM case, then the "penalization" for output is allowed to be lower in the RTM case in order to sustain better firm's output. As a result of the working of the manager's incentive scheme, at equilibrium the wage under RTM is always higher than that under SEB (or EB).

**Result 1.** *The introduction of the managerial delegation in both bargaining arrangement cases at equilibrium increases profits and reduces the welfare of the union, consumer and society.*

*Proof:* the result follows straightforwardly by observing that  $\pi^{SEB} - \pi_{PM}^{SEB} > 0$ ,  $\pi^{RTM} - \pi_{PM}^{RTM} > 0$ ,  $V^{SEB} - V_{PM}^{SEB} < 0$ ,  $V^{RTM} - V_{PM}^{RTM} < 0$ ,  $CS^{SEB} - CS_{PM}^{SEB} < 0$ ,  $CS^{RTM} - CS_{PM}^{RTM} < 0$ ,  $SW^{SEB} - SW_{PM}^{SEB} < 0$ ,  $SW^{RTM} - SW_{PM}^{RTM} < 0$

This result is in contrast with that in the standard VFJS's approach in non-unionised oligopoly (where at equilibrium profits are reduced and the consumer and social welfare are enhanced); in the present case the monopolist may use the delegation as a device to weaken union's claims and thus profits are increased because the wage costs reduction is larger than the output (employment) reduction but consumers, workers and society as a whole are harmed.

**Result 2.** *Under managerial delegation the SEB (or EB) bargaining agenda is more profitable for the monopolist, in sharp contrast to the standard case of profit-maximising behaviour. On the other hand, the welfare of the consumer and society is larger under SEB (or EB) than RTM, as in the standard case of profit-maximising behaviour.*

*Proof:* the result follows straightforwardly by observing that, on the one side,  $\pi^{SEB} - \pi^{RTM} > 0$ ,  $CS^{SEB} - CS^{RTM} < 0$ ,  $SW^{SEB} - SW^{RTM} < 0$ , and, on the other side,  $\pi_{PM}^{SEB} - \pi_{PM}^{RTM} < 0$ ,  $CS_{PM}^{SEB} - CS_{PM}^{RTM} > 0$ ,  $SW_{PM}^{SEB} - SW_{PM}^{RTM} > 0$ .

**Result 3.** *As regards the union, again in contrast with the standard case of profit-maximising behaviour, its utility is larger under RTM (except for a its very high bargaining power, i.e.  $b > 0.78$ ).*

*Proof:* the result follows straightforwardly by observing that, on the one side,

$$V^{SEB} - V^{RTM} \begin{matrix} \leq 0 \\ > \end{matrix} \Leftrightarrow b \begin{matrix} \leq \\ > \end{matrix} \frac{\sqrt{17}-1}{4} \approx 0.78 \text{ and, on the other side, } V_{PM}^{SEB} - V_{PM}^{RTM} > 0.$$

The intuition of this unconventional result as regards the monopolist is that the wage under SEB is always lower (Lemma 3) due to the mechanism of the managerial delegation above described. As regards the union the effect of a lower wage overweighs that of higher employment (and thus, unconventionally, the RTM arrangement is preferred) unless its power becomes extremely high. Therefore, in the most realistic cases (that is not too high union's strength) the introduction of managerial delegation leads to the choice of the SEB agenda by monopoly firm which has the novel effect to be jointly preferred by monopolist, consumers and society. However the SEB agenda cannot be considered Pareto-improving because the union's welfare would be harmed.

To sum up, with managerial delegation monopoly firm's profits are higher with Efficient Bargaining than Right-to-Manage (in particular, sequential bargaining is more profitable than the simultaneous one), while union's welfare can be higher with RTM than EB (for reasonable values of its power). Thus, a conflict of interests between the bargaining parties may exist but, paradoxically, for reverted choices of the agenda (with respect to the standard case of profit-maximising firm).

### 3. The model with network effects

To this point, we have treated with the standard demand function of the good. However in many markets network externalities in consumption are important.

The simple mechanism of network effects assumed here is that the surplus that a firm's client obtains increases directly with the number of other clients of this firm (i.e. Katz and Shapiro, 1985).

Following the recent literature (e.g. Hoernig, 2012; Battacharjee and Pal, 2014; and Chirco and Scrimatore, 2013), it is assumed the following linear direct demand faced by monopolist firm:

$$q = a - p + ny \tag{30}$$

where  $q$  denotes the quantity of the good produced by monopolist firm,  $y$  denotes the consumers' expectation about monopolist's equilibrium production, the parameter  $n$

$\in [0; 1)$  indicates the strength of network effects (i.e. the higher the value of the parameter the stronger the network effects).

The inverse demand functions are as follows, where  $p$  is the price of good:

$$p = a - q + ny \quad (31)$$

Following Katz and Shapiro (1985) and the above mentioned literature, we impose the additional “rational expectations” conditions, i.e.  $y = q$ , in Stage 2.

As usual, our equilibrium concept is subgame-perfect Nash equilibrium, and we solve this game by the backward induction method.

In the next section we analyse the cases of RTM, SEB and EB, respectively.

### 3.1 RTM institution

At stage 3, solving the maximisation problem of the monopoly firm’s manager, we get the following output function, for given consumers’ expectations:

$$q(y, w) = \frac{a + z - w + ny}{2} \quad (32)$$

and solving (32) by imposing the “rational expectations” condition above mentioned, the equilibrium quantity at stage 2 are given by:

$$q(w) = \frac{[a + z - w]}{2 - n} \quad (33)$$

At the second stage of the game, under Right-to-Manage, the manager-union bargaining unit selects  $w$ , to maximize the following generalized Nash product,

$$\underbrace{\max}_{w.r.t. w} N = (U)^{1-b} (V)^b = [(a - w - q(1 + n) + z)q]^{1-b} ((w - w^\circ)q)^b \quad (34),$$

where  $b$  represents the bargaining union’s power.

Maximising eq. (34) w.r.t.  $w$ , after substitution of eq. (33), we obtain the wage:

$$w = \frac{[(a + z)b + w^\circ(2 - b)]}{2} \quad (35)$$

By using (35) we obtain output as a function of the weight on sales:

$$q^{RTM}(z) = \frac{(2 - b)[a + z - w^\circ]}{[2(2 - n)]} \quad (36)$$

By using (35) and (36) the profit as a function of the weight on sales is obtained

$$\pi^{RTM}(z) = \frac{(2 - b)[a + z - w^\circ][w^\circ(b - 2) - (z(b - 2(n - 1)) + a(b - 2))]}{[2(2 - n)]^2}, \quad (37)$$

and at the first stage of the game the monopolist maximises his profit selecting  $z$ :

$$z^{RTM} = \frac{(n - b)[a - w^\circ]}{[b + 2(1 - n)]} \begin{matrix} > 0 \\ < \end{matrix} \iff n \begin{matrix} > \\ < \end{matrix} b \quad (38)$$

The equilibrium outcomes are

$$w^{RTM} = \frac{[ab(2 - n) + w^\circ(bn + 4(1 - n))]}{2(b + 2(1 - n))} \quad (39)$$

$$q^{RTM} = \frac{[(2-b)(a-w^o)]}{2(b+2(1-n))} \quad (40)$$

$$\pi^{RTM} = \frac{(2-b)[a-w^o]^2}{4[b+2(1-n)]} \quad (41)$$

$$V^{RTM} = \frac{b(2-n)(2-b)[a-w^o]^2}{4[b+2(1-n)]^2} \quad (42)$$

$$CS^{RTM} = \frac{(1-n)(2-b)^2 [a-w^o]^2}{8[b+2(1-n)]^2} \quad (43)$$

$$SW^{RTM} = \frac{[b(5-n) - 6(1-n)](2-b)(a-w^o)^2}{8[b+2(1-n)]^2} \quad (44)$$

### 3.2. Efficient Bargaining institution.

Under efficient-bargaining the manager-union bargaining unit maximizes the following generalised Nash product,

$$N = (U)^{1-b} (V)^b = [(a-w-q+ny+z)q]^{1-b} ((w-w^o)q)^b \quad (45)$$

As in the previous section 2.2, the manager-union bargaining unit selects at the first stage  $w$  and at the second stage  $q$  (or equivalently  $L$ ) in the case of SEB or, alternatively, simultaneously  $w$  and  $q$  in the case of EB.

#### 3.2.1. Sequential Efficient Bargaining

At the third stage, from the first-order conditions of the efficient bargaining game between manager and union, the monopoly firm's output function is the following:

$$q(y, w, z) = \frac{1}{2-b} [a+z+ny-w], \quad (46)$$

From (46), after imposing the "rational expectations" conditions above mentioned, we obtain output for given  $w$  and  $z$ :

$$q(w, z) = \frac{[a+z-w]}{2-b-n} \quad (47)$$

At the second stage, after substitution of (47) in (45) and usual maximisation procedure w.r.t.  $w$ , we obtain the wage:

$$w^{SEB} = \frac{(a+z)b + w^o(2-b)}{2} \quad (48)$$

By using (48) in (47) we obtain output as a function of  $z$ :

$$q^{SEB}(z) = \frac{(a+z-w^o)(2-b)}{2(2-b-n)} \quad (49)$$

By using (48) and (49) the profit as a function of the weight on quantities is obtained:

$$\pi^{SEB}(z) = \frac{(2-b)(w^o - z - a)[w^o(2-b)(1-b) - z(b^2 - b + 2(n-1)) + a(b^2 - 3b + 2)]}{[2(2-b-n)]^2} \quad (50)$$

and at the first stage of the game the monopolist maximises his profit selecting  $z$ :

$$z^{SEB} = \frac{\left[ (a - w^\circ)(b^2 - 2b + n) \right]}{-b^2 + b + 2(1 - n)} \begin{matrix} > \\ < \end{matrix} 0 \Leftrightarrow n \begin{matrix} > \\ < \end{matrix} b(2 - b) \quad (51)$$

The equilibrium outcomes are

$$w^{SEB} = \frac{ab(b + n - 2) + w^\circ(b^2 - bn + 4(n - 1))}{-2(-b^2 + b + 2(1 - n))} \quad (52)$$

$$q^{SEB} = \frac{(a - w^\circ)(2 - b)}{2(-b^2 + b + 2(1 - n))} \quad (53)$$

$$\pi^{SEB} = \frac{(a - w^\circ)^2(2 - b)}{4(-b^2 + b + 2(1 - n))} \quad (54)$$

$$V^{SEB} = \frac{b(2 - b - n)(a - w^\circ)^2(2 - b)}{4(-b^2 + b + 2(1 - n))^2} \quad (55)$$

$$CS^{SEB} = \frac{(1 - n)(a - w^\circ)^2(2 - b)^2}{8(-b^2 + b + 2(1 - n))^2} \quad (56)$$

$$SW^{SEB} = \frac{(a - w^\circ)^2(2 - b) \left[ 6(1 - n) - 4b^2 - b(5 - n) \right]}{8(-b^2 + b + 2(1 - n))^2} \quad (57)$$

### 3.2.2. Simultaneous Efficient Bargaining

From the system of first-order conditions of the efficient bargaining game between manager and union, the following system is obtained:

$$q(y, w, z) = \frac{1}{2 - b} [a + z + ny - w], \quad (58)$$

$$w(y, q, z) = w^\circ(1 - b) + b(ny + z + a - q) \quad (59)$$

After imposing the ‘‘rational expectations’’ condition, and solving the system (58)-(59), we obtain wage and output, as a function of  $z$ , respectively:

$$q(z) = \frac{a + z - w^\circ}{2 - n} \quad (60)$$

$$w(z) = \frac{(a + z)b + w^\circ(2 - n - b)}{2 - n} \quad (61)$$

By using (60) and (61) the profit as a function of the weight on quantities is obtained:

$$\pi^{EB}(z) = \frac{(a + z - w^\circ) [w^\circ(b - 1) - (z(b + 1 - n) + a(1 - b))]}{[2 - n]^2} \quad (62)$$

and at first stage of the game the monopolist maximises his profit selecting  $z$ :

$$z^{EB} = \frac{\left[ (a - w^\circ)(n - 2b) \right]}{2(1 + b - n)} \begin{matrix} > \\ < \end{matrix} 0 \Leftrightarrow n \begin{matrix} > \\ < \end{matrix} 2b \quad (63)$$

The other equilibrium outcomes are

$$w^{EB} = \frac{ab + w^\circ(b + 2(1 - n))}{2(1 + b - n)} \quad (64)$$

$$q^{EB} = \frac{(a - w^\circ)}{2(1 + b - n)} \quad (65)$$

$$\pi^{EB} = \frac{(a - w^\circ)^2}{4(1 + b - n)} \quad (66)$$

$$V^{EB} = \frac{b(a - w^\circ)^2}{4(1 + b - n)^2} \quad (67)$$

$$CS^{EB} = \frac{(1 - n)(a - w^\circ)^2}{8(1 + b - n)^2} \quad (68)$$

$$SW^{EB} = \frac{[4b + 3(1 - n)](a - w^\circ)^2}{8(1 + b - n)^2} \quad (69)$$

3.3. *Benchmark equilibrium outcomes for the profit-maximising monopoly without managerial delegation and with network effects.*

Now we report here the equilibrium outcomes of the standard case of a profit-maximising monopoly (PM) for the purpose of comparison with those of the managerial monopoly with network effects above presented, for the cases of RTM and SEB, respectively.

$$w_{PM}^{RTM} = \frac{[ab + w^\circ(2 - b)]}{2} \quad (39.bis)$$

$$q_{PM}^{RTM} = \frac{(2 - b)[a - w^\circ]}{[2(2 - n)]} \quad (40.bis)$$

$$\pi_{PM}^{RTM} = \frac{(2 - b)^2 [a - w^\circ]^2}{[2(2 - n)]^2} \quad (41.bis)$$

$$V_{PM}^{RTM} = \frac{b(2 - b)[a - w^\circ]^2}{4(2 - n)} \quad (42.bis)$$

$$CS_{PM}^{RTM} = \frac{(1 - n)(2 - b)^2 [a - w^\circ]^2}{8(2 - n)^2} \quad (43.bis)$$

$$SW_{PM}^{RTM} = \frac{[2(3 - 2n) - b(1 - n)](2 - b)[a - w^\circ]^2}{8(2 - n)^2} \quad (44.bis)$$

$$w_{PM}^{SEB} = \frac{ab + w^\circ(2 - b)}{2} \quad (52.bis)$$

$$q_{PM}^{SEB} = \frac{(a - w^\circ)(2 - b)}{2(2 - b - n)} \quad (53.bis)$$

$$\pi_{PM}^{SEB} = \frac{(1 - b)(a - w^\circ)^2(2 - b)^2}{4(2 - b - n)^2} \quad (54.bis)$$

$$V_{PM}^{SEB} = \frac{b(2-b)(a-w^o)^2}{4(2-b-n)} \quad (55.bis)$$

$$CS_{PM}^{SEB} = \frac{(1-n)(a-w^o)^2(2-b)^2}{8(2-b-n)^2} \quad (56.bis)$$

$$SW_{PM}^{SEB} = \frac{(2-b)(a-w^o)^2[2(3-n)-b(3+n)]}{8(2-b-n)^2} \quad (57.bis)$$

$$w_{PM}^{EB} = \frac{ab + w^o(2-n-b)}{2-n} \quad (64.bis)$$

$$q_{PM}^{EB} = \frac{a-w^o}{2-n} \quad (65.bis)$$

$$\pi_{PM}^{EB} = \frac{(1-b)(a-w^o)^2}{(2-n)^2} \quad (66.bis)$$

$$V_{PM}^{EB} = \frac{b(a-w^o)^2}{(2-n)^2} \quad (67.bis)$$

$$CS_{PM}^{EB} = \frac{(1-n)(a-w^o)^2}{2(2-n)^2} \quad (68.bis)$$

$$SW_{PM}^{EB} = \frac{(3-n)(a-w^o)^2}{2(2-n)^2} \quad (69.bis)$$

Under network effect, Lemmas 1 and 3 hold true. However, Lemma 2 and Results 1, 2 and 3 are modified and novel results emerge under network effects as regards the effects of the introduction of managerial delegation as well as the choice of the bargaining agenda.

**Lemma 4.** Provided that  $n$  is sufficiently high, both managers are incentivized for output (employment) and in particular more incentivized under RTM than SEB (i.e.  $z^{RTM} > z^{SEB} > 0$ ).

*Proof:* by comparing (38) and (51) we obtain that

$$z^{RTM} \begin{matrix} > \\ < \end{matrix} 0 \Leftarrow b \begin{matrix} < \\ > \end{matrix} n \quad z^{SEB} \begin{matrix} > \\ < \end{matrix} 0 \Leftarrow b \begin{matrix} < \\ > \end{matrix} 1 - \sqrt{1-n}$$

**Result 4.** Also with network effects the introduction of the managerial delegation in both bargaining arrangement cases at equilibrium increases the monopoly firm's profit. By contrast, while without network effects such an introduction reduces the welfare of the union, consumer and society (see Res. 1), in the presence of sufficiently strong network effects it may enhance them. In particular the latter result occurs less likely under SEB.



*Proof:*  $x_i^{RTM} - x_{i,PM}^{RTM} \begin{matrix} > \\ < \end{matrix} 0 \Leftrightarrow b \begin{matrix} < \\ > \end{matrix} n$ ,  $x_i^{SEB} - x_{i,PM}^{SEB} \begin{matrix} > \\ < \end{matrix} 0 \Leftrightarrow b \begin{matrix} < \\ > \end{matrix} 1 - \sqrt{1-n}$ , where  $x$  denotes a generic variable and  $i$  denotes unions' utility, consumer welfare and social welfare, respectively (see also Figs. 1 and 2, where the content of this result is illustrated).

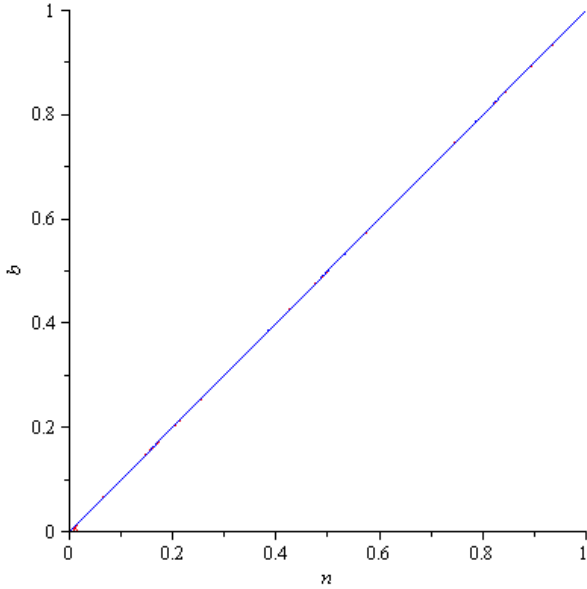


Fig. 1. Plot of the “threshold curves”  $x_i^{RTM} - x_{i,PM}^{RTM} = 0$  in  $[n,b]$ -space .

*Legend:* The curves are drawn for a given value of  $a=1$ ,  $w^o=0$ . Since the curves are perfectly overlapping between them, then *i)* for all  $\{n, b\}$  combinations along the curve,  $x_i^{RTM} - x_{i,PM}^{RTM} = 0$  holds true; *ii)* for all  $\{n, b\}$  combinations below (above) the curve, unions' utility, consumer welfare and social welfare are higher in the presence of managerial delegation (that is  $x_i^{RTM} - x_{i,PM}^{RTM} >(<) 0$ ).

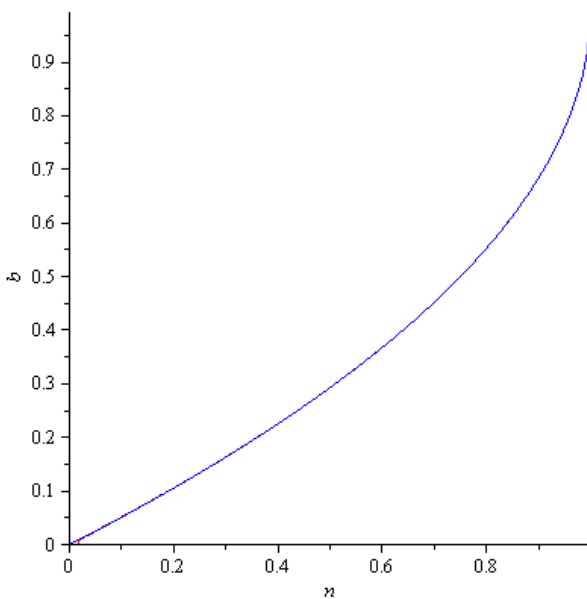


Fig. 2. Plot of the “threshold curves”  $x_i^{SEB} - x_{i,PM}^{SEB} = 0$  in  $[n,b]$ -space .

*Legend:* The curves are drawn for a given value of  $a=1$ ,  $w^o=0$ . Since the curves are perfectly overlapping between them, then *i)* for all  $\{n, b\}$  combinations along the curve,  $x_i^{SEB} - x_{i,PM}^{SEB} = 0$  holds true; *ii)* for all  $\{n, b\}$  combinations below (above) the curve, unions' utility, consumer welfare and social welfare are higher in the presence of managerial delegation (that is  $x_i^{SEB} - x_{i,PM}^{SEB} > (<) 0$ ).

Now we preliminarily note that under network effects the equilibrium outcomes are different between sequential and simultaneous EB. The main reason why these differ is that under network effects the bargaining of wages occurs with EB (SEB) before (after) the fulfilment of the consumer's expectations on output.

**Result 5.** *Also under network effects, the SEB agenda is the most profitable for the monopolist, and with highest welfare for consumer and society as a whole.*

*Proof:* the result straightforwardly follows by observing that  $\pi^{SEB} - \pi^{RTM} > 0$ ,  $\pi^{SEB} - \pi^{EB} > 0$ ,  $CS^{SEB} - CS^{RTM} > 0$ ,  $CS^{SEB} - CS^{EB} > 0$ ,  $SW^{SEB} - SW^{RTM} > 0$ ,  $SW^{SEB} - SW^{EB} > 0$

**Result 6.** *While the SEB arrangement ensures the highest welfare for both the monopolist and consumer and society, the welfare's comparison between EB and RTM is ambiguous and strictly depends on the relative strength of the network effect and the bargaining power. In particular the monopolist, the consumer and the society as a whole, prefer RTM to EB when  $n > b$  (and vice-versa).*

*Proof:* the result follows straightforwardly by observing that

$$\pi^{RTM} - \pi^{EB} \begin{matrix} > 0 \\ < 0 \end{matrix} \Leftrightarrow n \begin{matrix} > \\ < \end{matrix} b, CS^{RTM} - CS^{EB} \begin{matrix} > 0 \\ < 0 \end{matrix} \Leftrightarrow n \begin{matrix} > \\ < \end{matrix} b, SW^{RTM} - SW^{EB} \begin{matrix} > 0 \\ < 0 \end{matrix} \Leftrightarrow n \begin{matrix} > \\ < \end{matrix} b.$$

**Result 7.** *As regards the union, its utility may be the largest under SEB, provided that both  $n$  and  $b$  are sufficiently high (otherwise the relationship between the union's utilities under the three bargaining arrangements is rather complex and shown in detail in Fig. 4, below). *Proof:* the result follows straightforwardly by the following inequalities:*

$$V^{SEB} - V^{RTM} \begin{matrix} < 0 \\ > 0 \end{matrix} \Leftrightarrow n \begin{matrix} > \\ < \end{matrix} \frac{\sqrt{(b^4 - 4b^3 + 20b^2 - 32b + 16)b - (b^3 - 2b^2 - 8b + 8)}}{8(b-1)}$$

$$V^{RTM} - V^{EB} > 0 \Leftrightarrow \frac{\sqrt{(b^2 - 4b + 8)b + b^2 + 2b - 4}}{2(b-2)} < n < b$$

$$V^{SEB} - V^{EB} \begin{matrix} < 0 \\ > 0 \end{matrix} \Leftrightarrow n \begin{matrix} < \\ > \end{matrix} \frac{\sqrt{(5b^2 - 12b + 8)b + b^2 + 2b - 4}}{2(b-2)}$$

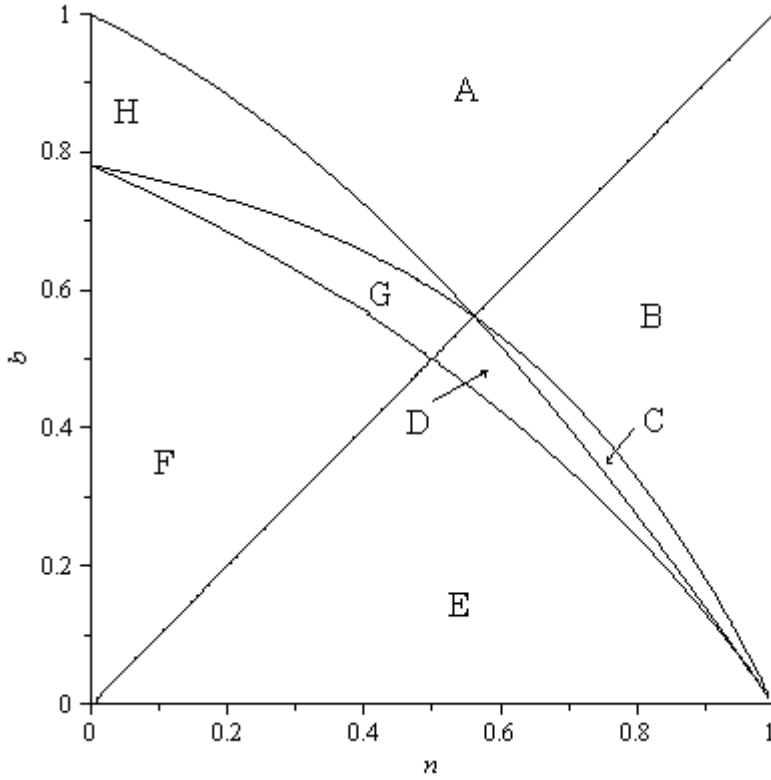


Fig. 4. Plot of the “threshold curves”  $V^{EB} - V^{SEB} = 0, V^{RTM} - V^{SEB} = 0, V^{RTM} - V^{EB} = 0$  in  $[n, b]$ -space .

*Legend:* The curves are drawn for a given value of  $a=1, w^0=0$ . In the space’s regions A-H the following inequalities between union’s utilities hold:

**A**=  $V^{SEB} > V^{EB} > V^{RTM}$  ; **B**=  $V^{SEB} > V^{RTM} > V^{EB}$  ; **C**=  $V^{SEB} > V^{RTM} > V^{EB}$  ; **D**=  $V^{RTM} > V^{EB} > V^{SEB}$  ;  
**E**=  $V^{EB} > V^{RTM} > V^{SEB}$  ; **F**=  $V^{RTM} > V^{EB} > V^{SEB}$  ; **G**=  $V^{EB} > V^{RTM} > V^{SEB}$  ; **H**=  $V^{EB} > V^{SEB} > V^{RTM}$  .

Therefore unions’ utility is highest under SEB in regions A, B and C. This means that for sufficiently intense network effects the union may prefer SEB also when its power is realistically low. As a consequence, the following Remark holds.

**Remark:** Provided that the network effect is sufficiently strong, also the union’s welfare may become larger under SEB even for union’s power relatively low. Thus in most realistic case as regards the bargaining power, the EB agenda is endogenously chosen by monopolist and union and such an agenda is also Pareto-superior.

#### 4. Conclusions.

In this paper we have examined the issue of the bargaining agenda in a unionised monopoly in the presence of managerial delegation, showing that the latter is convenient for the monopoly firm also in the absence of strategic competition between firms.

Since the unionisation is a widespread real-life phenomenon, then our results shed new light on the issue of the managerial delegation. In fact, since so far the sole motivation justifying the presence of managers’ contracts in monopolistic firms is

grounded on the existence of agency problems (e.g., Bolton and Dewatripont, 2004), our findings identify in the role played by manager's incentive schemes in reducing the effects of the unionisation on monopoly profits a new channel through which managerial delegation can be effective even in the absence of strategic competition between firms.<sup>7</sup> In other words, the strategic value of the delegation is in the bargaining with unions rather than in the competition with rival firms.

It is shown that *i*) in contrast to standard oligopoly results, managerial delegation benefits the monopolist, while harms consumers, workers and society; *ii*) in contrast to the conventional wisdom, monopoly profits with managerial delegation are higher with sequential Efficient Bargaining (SEB) than Right-to-Manage (RTM), while union's welfare can be higher with RTM than EB: then a conflict of interests between the parties may exist but, paradoxically, for reverted choices of the bargaining agenda.

Moreover, by also considering the presence of network effects, the welfare of monopolist, consumer, union, and society are enhanced by the introduction of managerial delegation with both bargaining arrangements, differently from the standard results of the VFJS's approach where there are always conflicting effects between firms and society. In addition, the unique equilibrium bargaining arrangement (i.e. SEB) for the monopoly firm also ensures the highest welfare for the union and furthermore for all agents, provided that network effects are sufficiently intense. Therefore, policy makers may be inspired by this Pareto-superior effects of managerial delegation, network effects and SEB in their regulation of monopoly.

A testable implication of these findings is that SEB arrangements should be more often stipulated in markets with strong positive consumption externalities.

Finally a further direction of research should take into account explicitly the dynamics, which is crucial in a context with consumers' expectations.<sup>8</sup> By extending the present static model to a multi-period one, we conjecture that also the paper's results may be enriched.

## References

- Ashenfelter, O., and Brown, J.N., 1986. Testing the efficiency of employment contracts. *Journal of Political Economy* 94, 41–87.
- Baumol W. 1958. On the theory of oligopoly. *Economica* 25: 187–198.
- Berle A.A., and Means G. C. 1932. *The Modern Corporation and Private Property*. Harcourt, Brace and World: New York.
- Bhattacharjee, T. and Pal, R., 2013. Managerial Delegation in Monopoly under Network Effects, WP-2013-009, Indira Gandhi Institute of Development

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<sup>7</sup> One exception is the recent result of Batthacharjee and Pal (2013) which shows that managerial delegation can work in case of monopoly without the presence of unions, through the channel of positive consumption externalities.

<sup>8</sup> As noted by Katz and Shapiro (1985, 439) "Explicitly dynamic, multiperiod models are needed to shed additional light on the behaviour of markets in which network externalities are important".

- Research, Mumbai, May 2013. <http://www.igidr.ac.in/pdf/publication/WP-2013-009.pdf>
- Bhattacharjee, T. and Pal, R., 2014. Network externalities and strategic managerial delegation in cournot duopoly: Is there a prisoners dilemma? *Review of Network Economics*, 12(4):343–353
- Bolton, P. and Dewatripont, M., 2004. *Contract Theory*. MIT Press, Cambridge, MA.
- Booth, A.L., 1995. *The Economics of the Trade Union*. Cambridge Univ. Press.
- Buccella D., 2011. Corrigendum to “The strategic choice of union oligopoly bargaining agenda” [Int. J. Ind. Organ. 17 (1999) 1029–1040], *International Journal of Industrial Organization* 29, 690–693.
- Bughin, J., 1999. The strategic choice of union–oligopoly bargaining agenda. *International Journal of Industrial Organization* 17, 1029–1040.
- Cabral, L., Salant, D.J., and Woroch, G.A., 1999. Monopoly pricing with network externalities. *International Journal of Industrial Organization* 17 (2), 199–214.
- Chirco A., and Scrimatore M., 2013. Choosing price or quantity? The role of delegation and network externalities. *Economics Letters* 121 (2013) 482–486.
- Dowrick, S., and Spencer, B.J., 1994. Union attitudes to labor-saving innovation: when are unions luddites? *Journal of Labor Economics* 12, 316–344.
- Fanti, L., 2015. Union-Firm Bargaining Agenda: Right-to-Manage or Efficient Bargaining? *Economics Bulletin*, 35(2), 936-948.
- Fanti, L., and Meccheri, N., 2013. Managerial Delegation under Alternative Unionization Structures, *Labour*, CEIS, 27 (1), 38-57.
- Fershtman, C and Judd, K., 1987. Equilibrium incentives in oligopoly, *American Economic Review* 77: 927-940.
- Jansen, T., van Lier, A. and van Witteloostuijn, A., 2007. A note on strategic delegation: the market share case, *International Journal of Industrial Organization* 25: 531-539.
- Jansen, T., van Lier, A. and van Witteloostuijn, A., 2009. On the impact of managerial bonus systems on firm profit and market competition: the cases of pure profit, sales, market share and relative profits compared, *Managerial and Decision Economics* 30: 141-153.
- Hoernig, S., 2012. Strategic delegation under price competition and network effects. *Economics Letters*, 117(2):487-489.
- Katz, M. and Shapiro, C., 1985. Network externalities, competition, and compatibility. *American Economic Review*, 75(3):424-440.
- Manning, A., 1987a. An Integration of Trade Union Models in a Sequential Bargaining Framework. *The Economic Journal*, 97, 121–139.
- Manning, A., 1987b. Collective Bargaining Institutions and Efficiency. *European Economic Review*, 31, 168–176.
- McDonald, I.M., and Solow, R.M., 1981. Wage bargaining and employment. *American Economic Review* 71 (5), 896–908.
- Meccheri N., and Fanti L., 2014. Managerial Delegation Contracts under Centralized Unionization, *Managerial and Decision Economics*, 35, 51–66.

- Nickell, S.J., and Andrews, M., 1983. Unions real wages and employment in Britain 1951–1979. *Oxford Economic Papers* 35, 183–206, Supplement.
- Pencavel, J.H., 1985. Wages and employment under trade unionism: microeconomic models and macroeconomic applications. *Scandinavian Journal of Economics* 87, 197–225.
- Sklivas, S., 1987. The strategic choice of managerial incentives, *RAND Journal of Economics* 18: 452-458.
- van Witteloostuijn, A., Jansen, T. and van Lier, A. (2007), Bargaining over managerial contracts in delegation games: managerial power, contract disclosure and cartel behavior, *Managerial and Decision Economics* 28: 897-904.
- Vickers, J., 1985. Delegation and the theory of the firm, *Economic Journal* 95: 138-147.