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Fanti, Luciano and Buccella, Domenico

University of Pisa, Kozminski University, Warsaw

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# **Bargaining agenda in a unionised monopoly with network effects.**

**Luciano Fanti<sup>\*</sup> and Domenico Buccella**

## **Abstract**

This paper investigates the bargaining agenda selection in a unionised monopoly with network effects. In contrast with the established result that monopolist always prefers Right-To-Manage (RTM), it is shown that monopolist prefers Sequential Efficient Bargaining (SEB), provided that the network effect is sufficiently intense and union's power not too high. Since the union always prefers SEB, the presence of network effects may solve the traditional conflict of interests between parties and allow the achievement of the highest social welfare. Moreover, if the monopolist can choose the agenda, it may strategically commit either to RTM or SEB or EB to deter market entry, depending on the network intensity and thus all agendas are an effective device as a barrier to entry. Furthermore, with endogenous agenda's selection, the parties may agree on SEB, provided that the network effects are intense and the union's power not excessively low. The social welfare under duopoly with SEB is the Pareto-superior outcome. However, the SEB institution may deter entry in specific cases. Thus, the SEB institution itself may prevent the most desirable welfare outcome but in any case it remains socially preferred to RTM and EB.

**Keywords:** Efficient bargaining; Right-to-manage; Firm-union bargaining agenda; Network effects

**JEL Classification:** J51, L13, L21

## **Introduction**

The issue of bargaining agenda has been recently investigated by some works in an oligopoly context, such as Bughin (1999), Buccella (2011) and Fanti (2014,2015). Such papers have shown mixed results, but all of them supposed that goods have no consumption/network externalities. However, a recent growing literature has shown that the effects of network externalities may be relevant, and many established results of the industrial organization literature, obtained basically by assuming non-network goods, may be modified. For instance, Hoernig (2012), Battacharjee and Pal (2014),

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<sup>\*</sup> Luciano Fanti, Department of Economics and Management, University of Pisa, Via Cosimo Ridolfi, 10, I –56124 Pisa (PI), Italy. E-mail address: [lfanti@ec.unipi.it](mailto:lfanti@ec.unipi.it); tel.: +39 050 22 16 369; fax: +39 050 22 16 384.

Domenico Buccella, Department of Economics, Kozminski University, Jagellonska Street, 57/59 – 03301 – Warsaw, Poland. E-mail: [buccella@kozminski.edu.pl](mailto:buccella@kozminski.edu.pl); tel.: + 48 22 51 92 153

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.

In fact, it is known that for many products the utility derived by one consumer increases with the number of other consumers of that goods, that is, the total sales of the goods enhance the welfare of each consumer.<sup>1</sup>

Therefore, the consumers' expectations about the total sales of the goods may be in principle affected by different mechanisms of output decisions and different production costs, and thus by different labour market institutions.

Despite the possible relevance of positive consumption externalities, issues pertaining to network goods industries, to the best of our knowledge, have largely been ignored in the literature on unionised industries. A classical result in the unionised firm literature is that profits when firms bargain only over wage and choose employment (Right-To-Manage, RTM) are higher than when they bargain also over employment (simultaneous or sequential Efficient Bargaining). This is true particularly as regards a unionised monopoly in which strategic competitive effects are absent and thus wage costs (depending on the specific alternative bargaining arrangements) can never be used as a strategic device, as it may occur, under specific conditions, under oligopolistic competition (e.g. Vannini and Bughin, 2000). Then we consider here the monopoly case where the network effects on the choice of the agenda cannot be obfuscated, as regards the firm, by indirect strategic competitive effects. Moreover, another conventional result is that unions always prefer the EB agenda and thus a (possibly unpleasant) conflict of interest between parties always occurs.

Moreover it is natural to think that the choice of bargaining agenda may exert some influence on the behaviour of incumbents and entrants, although the investigation of this theme is rather scant. Exceptions are Bughin (1999) and Buccella (2011), but they abstract from the possibility of consumption externality.

Therefore, this paper attempts to answer the following questions: does the conventional result that under monopoly firms always prefer RTM to Efficient Bargaining (with a corresponding conflict of interests between firm and union) hold true in the presence of network effects? What happens if there is the threat of market entry in the industry? May the incumbent strategically select the agenda to deter entry? Which are the consequences in terms of social welfare?

The answers reveal that network effects may revert the established results of the previous literature.

The remainder of the paper is organised as follows. Section 2 presents the basic monopoly-union bargaining model. Section 3 analyses the issue of potential entry and

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<sup>1</sup> Typical examples of network goods are telephone and software: it is natural to observe that the utility of a particular consumer from using a telephone or a software increases with the number of other telephone or software users. More in general positive network externality may exist for those products which a consumer wishes to possess in part because others do (i.e. the so-called Bandwagon Effect), for instance products of fashion industry.

discusses the welfare implications. Finally, the last section summarises the main results and suggests directions for further research on the subject.

## 2. The model

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

We assume that, following, for instance, Hoernig (2012), Battacharjee and Pal (2014) and Chirco and Scrimatore (2013), the monopolist firm faces the following linear direct demand:

$$q = a - p + ny \quad (1)$$

where  $q$  denotes the quantity of the goods produced,  $y$  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 function is:

$$p = a - q + ny \quad (2)$$

where  $p$  is the price of goods. The monopolist's profit function is:

$$\pi = (p - w)q, \quad (3)$$

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

The efficient bargaining may be either simultaneous over wage and employment (EB) (Nickell and Andrews, 1983) or sequential, first over wage and then over employment (SEB) (Manning, 1987a,b).

In the RTM and SEB cases, monopolist's decisions are taken in two stages. In the first stage, both in the RTM and SEB cases, the monopolist-union unit bargains over wages  $w$  to maximise the Nash product. In the second stage 1) with RTM, the monopolist chooses the quantity  $q$  (alternatively, the price  $p$ ) to maximise profits, 2) with SEB, the monopolist-union unit negotiates over the quantity  $q$  (alternatively, the price  $p$ ) to maximise the Nash product. On the other hand, under EB, the monopolist-union unit bargains simultaneously over wages  $w$  and quantity  $q$  to maximise the Nash product.

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 the subgame-perfect Nash equilibrium, and we solve this game by the backward induction method.

The union utility function is  $V = (w - w^o)l$  (e.g. Pencavel, 1985), where  $l$  is employment and  $w^o$  the reservation wage. Given the standard assumption of constant returns to labour,  $q = l$ , it follows that  $V = (w - w^o)q$ .

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

### 2.1 RTM institution

At stage 2, solving the monopolist's profit maximisation problem, we obtain the following output function, for given consumers' expectations:

$$q(y, w) = \frac{a - w + ny}{2} \quad (4)$$

Solving (4) by imposing the "rational expectations" condition,  $y = q$ , the equilibrium quantities at stage 2 are:

$$q(w) = \frac{[a - w]}{2 - n} \quad (5)$$

At the first stage of the game, under RTM, the monopolist - union bargaining unit selects  $w$  to maximise the following generalised Nash product,

$$\underbrace{\max}_{w.r.t. w} N = (\pi)^{1-b} (V)^b = [(a - w - q + nq)q]^{1-b} ((w - w^\circ)q)^b \quad (6),$$

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

After substitution of (5) in (6), maximisation of (6) w.r.t.  $w$  leads to:

$$w^{RTM} = \frac{[ab + w^\circ(2 - b)]}{2} \quad (7)$$

Thus, the equilibrium outcomes are

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

$$\pi^{RTM} = \frac{(2 - b)^2 [a - w^\circ]^2}{[2(2 - n)]^2} \quad (9)$$

$$V^{RTM} = \frac{b(2 - b)[a - w^\circ]^2}{4(2 - n)} \quad (10)$$

$$CS^{RTM} = \frac{(1 - n)(2 - b)^2 [a - w^\circ]^2}{8(2 - n)^2} \quad (11)$$

$$SW^{RTM} = \frac{[2(3 - 2n) - b(1 - n)](2 - b)[a - w^\circ]^2}{8(2 - n)^2} \quad (12)$$

## 2.2. Efficient Bargaining institution.

Under efficient bargaining the monopolist-union bargaining unit maximises the following generalised Nash product,

$$N = (\pi)^{1-b} (V)^b = [(a - w - q + ny)q]^{1-b} ((w - w^o)q)^b \quad (13).$$

Hence, the monopolist - union unit selects 1) in the case of SEB, in the first stage  $w$  and in the second stage  $l$ , or equivalently  $q$ ; 2) in the case of EB, simultaneously  $w$  and  $q$ .

### 2.2.1. Sequential Efficient Bargaining

At second stage, from the first-order condition (FOC) of the efficient bargaining game between monopolist and union, one gets the monopolist's output function:

$$q(y, w) = \frac{1}{2-b} [a + ny - w]. \quad (14)$$

From (14), after imposing the "rational expectations" condition, we obtain the output level for given  $w$ :

$$q(w) = \frac{a - w}{2 - n - b} \quad (15)$$

In the first stage, after substitution of (15) in (13), the usual maximisation procedure w.r.t.  $w$  leads to

$$w^{SEB} = \frac{ab + w^o(2-b)}{2} \quad (16)$$

The equilibrium outcomes are

$$q^{SEB} = \frac{(a - w^o)(2-b)}{2(2-b-n)} \quad (17)$$

$$\pi^{SEB} = \frac{(1-b)(a - w^o)^2(2-b)^2}{4(2-b-n)^2} \quad (18)$$

$$V^{SEB} = \frac{b(2-b)(a - w^o)^2}{4(2-b-n)} \quad (19)$$

$$CS^{SEB} = \frac{(1-n)(a - w^o)^2(2-b)^2}{8(2-b-n)^2} \quad (20)$$

$$SW^{SEB} = \frac{(2-b)(a - w^o)^2[2(3-n) - b(3+n)]}{8(2-b-n)^2} \quad (21)$$

### 2.2.2. Simultaneous Efficient Bargaining

From the system of FOCs of the EB game between monopolist and union, we obtain:

$$q(y, w) = \frac{1}{2-b} [a + ny - w], \quad (22)$$

$$w(y, q) = w^\circ(1-b) + b(ny + a - q) \quad (23)$$

After imposing the “rational expectations” condition, and solving the system (22)-(23), we obtain the following wage and output, respectively:

$$q^{EB} = \frac{a - w^\circ}{2-n} \quad (24)$$

$$w^{EB} = \frac{ab + w^\circ(2-n-b)}{2-n} \quad (25)$$

The equilibrium outcomes are

$$\pi^{EB} = \frac{(1-b)(a - w^\circ)^2}{(2-n)^2} \quad (26)$$

$$V^{EB} = \frac{b(a - w^\circ)^2}{(2-n)^2} \quad (27)$$

$$CS^{EB} = \frac{(1-n)(a - w^\circ)^2}{2(2-n)^2} \quad (28)$$

$$SW^{EB} = \frac{(3-n)(a - w^\circ)^2}{2(2-n)^2} \quad (29)$$

Preliminarily, we remark the standard situation with demand without externalities.

**Remark.** *In the standard case without network externalities, a monopolist always gains larger profits with RTM rather than SEB and EB, and profits are the same irrespective of whether the timing of the efficient bargaining is sequential or simultaneous.*

Now, based on the equilibrium outcomes for the alternative bargaining agendas above presented, we analyse whether and how the conventional results are modified by the presence of network effects in consumption.

**Lemma 1.** *Under the presence of network effects, monopolist always prefers to bargain sequentially rather than simultaneously in the case of EB institution.*

Proof:  $\pi^{SEB} > \pi^{EB} \iff n > 0$ ;  $\pi^{SEB} = \pi^{EB} \iff n = 0$ .

**Lemma 2.** *Under the presence of network effects, both RTM and SEB wages are equal between them and lower than EB wages. Moreover RTM and SEB wages are independent on  $n$ , while EB wages are increasing with  $n$ .*

Proof: By simple inspection of (7), (16) and (25).

The economic intuition behind Lemmas above is that in the presence of network externality, the profits with SEB are higher than EB because the consumers' expectations on the market size are already realised when the wage is bargained at the first stage; thus, the SEB wage is independent of  $n$ . On the other hand, in the simultaneous EB game, where the wage and employment are concurrently determined, the consumers' expectations are not so far realised and the externality effect has a positive impact on the bargained wage. As a consequence, it follows that  $w^{EB} > w^{SEB}$ . A plausible explanation could be as follows. In the SEB case, the union may find optimal to agree a wage such that the firm can adapt employment to market conditions. On the other hand, in the case of EB, consumers' expectations are not immediately realised; therefore, the union would trade off part of this uncertainty on product demand with network externalities for higher wages.

**Result 1.** *In contrast with the conventional wisdom, a monopolist prefers SEB rather than RTM provided that the network effect is sufficiently high. Moreover, the lower the union's power, the more likely a monopolist prefers SEB.*

Proof: 1) 
$$\Delta\pi = (\pi^{RTM} - \pi^{SEB}) = \frac{b(b - n(2 - n))(2 - b)^2 (a - w^o)^2}{4(2 - n - b)^2 (2 - n)^2};$$

2) 
$$\Delta\pi \underset{>}{<} 0 \Leftrightarrow 1 > n > n_1 = 1 - \sqrt{1 - b}; \text{ or } \Delta\pi \underset{>}{<} 0 \Leftrightarrow 1 > b > b_1 = 1 - (1 - n)^2$$

3) 
$$\frac{\partial n_1}{\partial b} > 0, \frac{\partial b_1}{\partial n} > 0$$

Result 1 is graphically illustrated in Fig. 1 below.

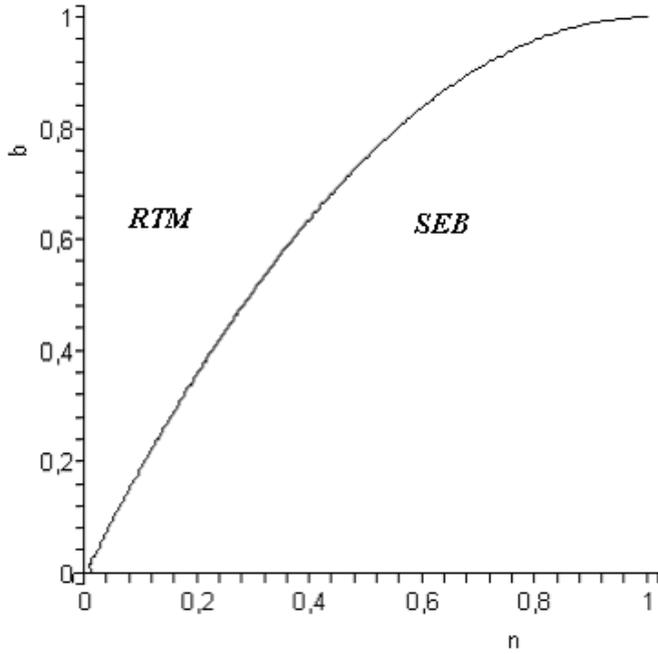


Fig. 1. Plot of the “threshold curve”  $\Delta\pi=0$  in  $[n,b]$ -space .

Legend: The curve is drawn for  $a=1$ ,  $w^o=0$ . For all  $\{n, b\}$  combinations along the curve  $b=1-(1-n)^2$ ,  $\Delta\pi^1 = 0$  holds true. For all  $\{n, b\}$  combinations above (below) the curve, profits are higher under RTM (SEB) arrangement (that is,  $\Delta\pi^1 > (<) 0$ ).

Result 1 reverts the conventional result as regards the preferred agenda by firms and is worth to be commented more in detail. At first glance, the finding that  $\Delta\pi \stackrel{<}{>} 0$  seems to be puzzling because  $w^{RTM} = w^{SEB}$  and  $q^{RTM} < q^{SEB}$ . Moreover, it is also valid that  $p^{RTM} > p^{SEB}$  in the  $[n,b]$ -space. A closer analytical inspection reveals that the monopolist, in equilibrium, produces on a point of the demand curve where the price elasticity of demand is larger under RTM than SEB, that is  $\varepsilon^{*RTM}(n,b) > \varepsilon^{*SEB}(n,b)$ . Depending on the values of  $[n,b]$ , the elasticity (and mark-up) differential may increase or decrease; as a consequence, the price effects may dominate or not the quantity effects on the monopolist revenues. Fig.1 tells us that when  $\Delta\pi^1 > (<) 0$ , the price effect dominates (is dominated by) the effect on quantity variation.<sup>2</sup>

<sup>2</sup> Analytically, we can describe this result as follows. Let us define the additional marginal revenues differential under the two bargaining agendas as  $\Delta R = [(MR^{RTM} dq^{RTM} - MR^{SEB} dq^{SEB})]$ . The latter expression can be developed and re-arranged in the following way:

$$\Delta R(n,b) = \left[ (p^{RTM}(n,b) - p^{SEB}(n,b)) + \left( \frac{dp^{RTM}(n,b)}{dq^{RTM}(n,b)} q^{RTM}(n,b) - \frac{dp^{SEB}(n,b)}{dq^{SEB}(n,b)} q^{SEB}(n,b) \right) \right] (dq^{RTM} - dq^{SEB}) .$$

Fig.1 shows that in the area of the  $(n,b)$ -space where  $\Delta\pi^1 > (<) 0$ , the combination of the parameters is such that the price differential effect between the two agendas dominates (is dominated by) the effect on the quantity variation.

**Lemma 3.** *Union always prefers, as expected, SEB rather than RTM. Otherwise, it may prefer SEB rather than EB provided that its union's power is high enough.*

$$\text{Proof: } V^{RTM} - V^{SEB} < 0; V^{EB} - V^{SEB} \begin{matrix} > 0 \\ < 0 \end{matrix} \Leftrightarrow b \begin{matrix} < \frac{2(2-n)}{4-n} \\ > \frac{2(2-n)}{4-n} \end{matrix}.$$

**Result 2.** *When network effects are sufficiently intense, the monopolist and the union agree on the SEB agenda.*

**Result 3.** *Consumers and society as a whole always prefers SEB rather than EB and RTM.*

$$\text{Proof: } CS^{SEB} \geq CS^{RTM} \Leftarrow n \geq 0; CS^{SEB} \geq CS^{EB} \Leftarrow n \geq 0; SW^{SEB} \geq SW^{EB} \Leftarrow n \geq 0; \\ SW^{SEB} \geq SW^{RTM} \Leftarrow n \geq 0.$$

**Result 4.** *Provided that the network effect is sufficiently high, the SEB arrangement is Pareto-superior (i.e. monopolist, workers and consumers prefers it). The proof follows from the previous Lemmas and Results.*

To sum up, network effects may be responsible for the elimination of the unpleasant conflict about the bargaining agenda between parties and the occurrence of a pleasant Pareto-superior choice.

The policy implication is that these novel findings may be useful for a better understanding of what happens in unionised network goods industries and for the achievement of an optimal labour market arrangement.

### 3 Monopoly with threat of entry

In the previous subsections, we have analysed the endogenous choice of the bargaining between the monopolist and its union, but we have considered the monopoly as the given market structure. In the following, we investigate the topic of the bargaining agenda selection in the context of market entry. As benchmark, we consider the case where the firm selects the agenda, and then we consider the endogenous choice.

In the traditional case of standard (i.e. not network) goods the strategic choice of the bargaining agenda for different market structures, namely duopoly vs. monopoly with threat of entry, has been studied by Bughin (1999) and Buccella (2011). Those authors consider that the institutional arrangements in the labour market are the simultaneous EB and the RTM agenda. They analyse different entry modes and constraints on the choice of bargaining scope: 1) committed bargaining, where the incumbent firm chooses the bargaining agenda; then, the entrant “joins the pack” and adopts the agenda of the incumbent; and 2) flexible bargaining, where the entrant freely chooses the agenda.

Their results are mixed: while Bughin (1999) argues that, under a unionised Cournot duopoly the EB agenda arises as the industry equilibrium for each firm, Buccella

(2011), by contrast, shows that a conflict of interest among the parties arises concerning the bargaining agenda (i.e. when the duopoly is the given market structure, RTM is the firms' dominant strategy while EB is the unions' dominant strategy). Nonetheless, in the case of threat of entry, the incumbent bargaining parties can agree on the EB agenda to deter the market entry of a potential competitor.

In the present paper, differently from the previous works, we consider goods with the characteristic of having positive externalities in consumption (the network effects). Moreover, we consider three institutional arrangements, that is, the RTM agenda, and the EB agenda, both in the simultaneous and sequential form. However, for simplicity, we restrict the analysis to the case of monopoly with threat of entry with committed bargaining.

The game, as usual, is solved by backward induction to derive sub-game perfect Nash equilibria. The timing of the game is the following. In the first stage, the incumbent firm/union pair chooses which bargaining agenda to introduce into negotiations, that is, either EB or RTM. In the second stage, given the committed bargaining, the entrant firm/union pair adopts the agenda of the incumbent pair. In the third stage, the potential entrant unit decides whether to enter in the industry and conduct the negotiations according to the agenda of the incumbent pair. In the last stages, depending on the agenda, the sequence is as follows. In the case of RTM, first, each firm-union bargaining unit simultaneously negotiates over wages (given the output chosen by firms); and then, firms simultaneously choose their output level (given the wages bargained with the unions). On the other hand, under the sequential efficient-bargaining the union and the management of the firm negotiate the wages and employment at different stages. First, each firm-union pair negotiates over wages; in the second stage, each union-firm pair bargains the employment level (given the previously bargained wages). Finally, under the simultaneous efficient bargaining, the union and the management of the firm negotiate the wages and employment at the same time.

We define firm 1 as the incumbent and firm 2 the potential entrant. In duopoly, the demand function becomes

$$p = a - q_1 - q_2 + n(y_1 + y_2) \quad (30)$$

The firms' profit function are

$$\pi_1 = (p - w_1)q_1 \quad (31)$$

$$\pi_2 = (p - w_2)q_2 - E \quad (32)$$

for the incumbent and the entrant, respectively. The term  $E$  represents an exogenous fixed cost the entrant faces. On the other hand, the union utility function is

$$V_i = (w_i - w^\circ)q_i \quad i = 1, 2. \quad (33)$$

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

### 3.1 Duopoly with RTM

Given eq. (30) and imposing the additional “rational expectations” conditions, i.e.  $y_i = q_i, i = 1, 2$ , the firm maximization problem under RTM leads to

$$q_i = \frac{a - w_i - (1-n)q_j}{2-n} \quad i \neq j, \quad i, j = 1, 2 \quad (34)$$

Solving the system of equations in (34), the firms’ output decision as function of the wages are

$$q_i = \frac{a - (2-n)w_i + (1-n)w_j}{3-2n} \quad i \neq j, \quad i, j = 1, 2 \quad (35)$$

At the previous stage of the game, under RTM, the each firm - union bargaining unit chooses  $w$  to maximise the following generalised Nash product,

$$\underbrace{\max}_{w.r.t. w_i} N = (\pi_i)^{1-b} (V_i)^b = \left[ (a - w_i - q_i - q_j + n(q_i + q_j))q_i \right]^{1-b} \left( (w_i - w^\circ)q_i \right)^b \quad (36)$$

where  $b$  represents the union’s bargaining power. After substitution of (35) in (36), maximisation of w.r.t.  $w$  leads to:

$$w_i = \frac{[a - (1-n)w_i - (2-n)w^\circ]b - 2(2-n)w^\circ}{4-2n} \quad i \neq j, \quad i, j = 1, 2 \quad (37)$$

Solving the system of equations in (37), the equilibrium wages are

$$w_i^{RTM/RTM} = \frac{ab - 2w^\circ(n+b) + w^\circ(4+bn)}{4-2n-b(1-n)} \quad i, j = 1, 2 \quad (38)$$

where the apex, e.g.  $RTM/RTM$  indicates the case of duopoly. Further substitutions lead to the following equilibrium outcomes

$$q_i^{RTM/RTM} = \frac{(2-b)(2-n)[a - w^\circ]}{(3-2n)[4-2n-b(1-n)]} \quad (39)$$

$$\pi_i^{RTM/RTM} = \frac{(2-b)^2(2-n)^2[a-w^\circ]^2}{(3-2n)^2[4-2n-b(1-n)]^2} \quad (40)$$

$$V_i^{RTM/RTM} = \frac{b(2-b)(2-n)[a-w^\circ]^2}{(3-2n)[4-2n-b(1-n)]^2} \quad (41)$$

for  $i, j = 1, 2$ , and

$$CS^{RTM/RTM} = \frac{2(1-n)(2-b)^2(2-n)^2[a-w^\circ]^2}{(3-2n)^2[4-2n-b(1-n)]^2} \quad (42)$$

$$SW^{RTM/RTM} = \frac{2(2-n)(2-b)[a-w^\circ]^2[(b-2)n^2 + (8-2b)n + b-8]}{(3-2n)^2[4-2n-b(1-n)]^2} \quad (43)$$

### 3.2. Duopoly with Efficient Bargaining institution.

In the presence of the efficient bargaining institution, each firm-union pair maximises the following generalised Nash product,

$$N = (\pi_i)^{1-b} (V_i)^b = \left[ (a - w_i - q_i - q_j + n(y_i + y_j))q_i \right]^{1-b} \left( (w_i - w^\circ)q_i \right)^b \quad i, j = 1, 2 \quad (44)$$

Thus, each firm – union pair negotiates 1) in the case of SEB, first  $w_i$  and then  $q_i$ ; 2) in the case of EB, simultaneously  $w_i$  and  $q_i$ .

#### 3.2.1. Sequential Efficient Bargaining

In the last stage, the FOC of the efficient bargaining game between each firm and its union leads to the output level

$$q_i(y_i, y_j, q_j) = \frac{1}{2-b} \left[ a - q_j + n(y_i + y_j) - w_i \right] \quad i, j = 1, 2. \quad (45)$$

From (45), after imposing the “rational expectations” condition, we obtain the output level for given  $w_i$ :

$$q(w_i, w_j) = \frac{\left[ a(1-b) - (2-n-b)w_i + (1-n)w_j \right]}{(1-b)(3-2n-b)} \quad i, j = 1, 2 \quad (46)$$

In the first stage, after substitution of (46) in (44), the usual maximisation procedure w.r.t.  $w_i$  leads to

$$w_i^{SEB/SEB} = \frac{ab(1-b) + b^2w^\circ + b[(n-4)w^\circ + w_j(1-n)] + 2w^\circ(2-n)}{2(2-b-n)} \quad i \neq j, i, j = 1, 2 \quad (47)$$

Solving for  $w_i$  the system of eq. in (47), the equilibrium wages are

$$w_i^{SEB/SEB} = \frac{ab(1-b) + bw^\circ[b(4-n)] + 2w^\circ(2-n)}{[(4-2n) - b(3-n)]} \quad i, j = 1, 2 \quad (48)$$

and, consequently, the equilibrium outcomes are

$$q_i^{SEB/SEB} = \frac{(2-b)(2-b-n)[a-w^\circ]}{(3-b-2n)[(4-2n) - b(3-n)]} \quad (49)$$

$$\pi_i^{SEB/SEB} = \frac{(1-b)(2-b)^2(2-b-n)^2[a-w^\circ]^2}{(3-b-2n)^2[(4-2n) - b(3-n)]^2} \quad (50)$$

$$V_i^{SEB/SEB} = \frac{b(1-b)(2-b)(2-b-n)[a-w^\circ]^2}{(3-b-2n)[(4-2n) - b(3-n)]^2} \quad (51)$$

for  $i, j = 1, 2$ , and

$$CS^{SEB/SEB} = \frac{2(1-n)(2-b)^2(2-b-n)^2[a-w^\circ]^2}{(3-b-2n)^2[(4-2n) - b(3-n)]^2} \quad (52)$$

$$SW^{SEB/SEB} = \frac{2(2-b)(2-b-n)[a-w^\circ]^2[2b^2 - b(n-3)^2 + 2(n-2)^2]}{(3-b-2n)^2[(4-2n) - b(3-n)]^2} \quad (53)$$

### 3.2.2. Simultaneous Efficient Bargaining

From the system of FOCs of the EB game in each firm/union pair, we obtain:

$$q_i(y_i, y_j, w_i) = \frac{1}{2-b} [a - q_j + n(y_i + y_j) - w_i], \quad i \neq j, i, j = 1, 2 \quad (54)$$

$$w_i(y_i, y_j, q_i, q_j) = w^\circ(1-b) + b[a - q_i - q_j + n(y_i + y_j)], \quad i \neq j, i, j = 1, 2 \quad (55)$$

After imposing the “rational expectations” condition  $y_i = q_i$ ,  $i = 1, 2$ , and solving the system (54)-(55), we obtain the following wage and output, respectively:

$$q_i^{EB/EB} = \frac{a - w^\circ}{3 - 2n}, \quad i, j = 1, 2 \quad (56)$$

$$w_i^{EB/EB} = \frac{ab + w^\circ(3 - 2n - b)}{3 - 2n}, \quad i, j = 1, 2 \quad (57)$$

Therefore, the equilibrium outcomes are

$$\pi_i^{EB/EB} = \frac{(1-b)(a - w^\circ)^2}{(3 - 2n)^2} \quad (58)$$

$$V_i^{EB/EB} = \frac{b(a - w^\circ)^2}{(3 - 2n)^2} \quad (59)$$

for  $i, j = 1, 2$ , and

$$CS^{EB/EB} = \frac{2(1-n)(a - w^\circ)^2}{(3 - 2n)^2} \quad (60)$$

$$SW^{EB/EB} = \frac{2(2-n)(a - w^\circ)^2}{(3 - 2n)^2} \quad (61)$$

### 3.3 The selection of the agenda as barrier to entry and welfare considerations

Following the reasoning of Bughin (1999) and Buccella (2011), in the case of threat of entry with “*committed bargaining*”, the incumbent firm ( $M$ ) can strategically use the bargaining agenda as an entry deterrence tool. In fact, if the fixed costs the entrant has to face are such that

$$\begin{aligned} \Pi_1^{RTM/M} < E < \Pi_1^{SEB/SEB,EB/EB} \quad (\text{Case A}), \quad \Pi_1^{SEB/M} < E < \Pi_1^{RTM/RTM,EB/EB} \quad (\text{Case B}), \\ \Pi_1^{EB/M} < E < \Pi_1^{RTM/RTM,SEB/SEB} \quad (\text{Case C}). \end{aligned} \quad (62)$$

where  $\Pi_1^M$  are the monopoly profits, the incumbent firm may commit to a particular agenda to deter market entry.

Let us first consider that the firm has the right to choose the negotiation agenda. With the payoffs’ in eqs. (9), (18), (26), (40), (50) and (58), it is possible to construct

Figure 2 below, where the monopoly profits are compared with the duopoly profits under the three agendas in relation to Cases A, B and C in eq. (62). It can be immediately observed that, in all the three cases, the monopolist can use the bargaining agenda to prevent entry in a certain areas of the parameter space: in Case A, the red area; in Case B, the blue area; and in Case C, the green area. A straight forward closer inspection reveals that those areas cover the overall relevant parameter space. The latter observation has the following striking consequence.

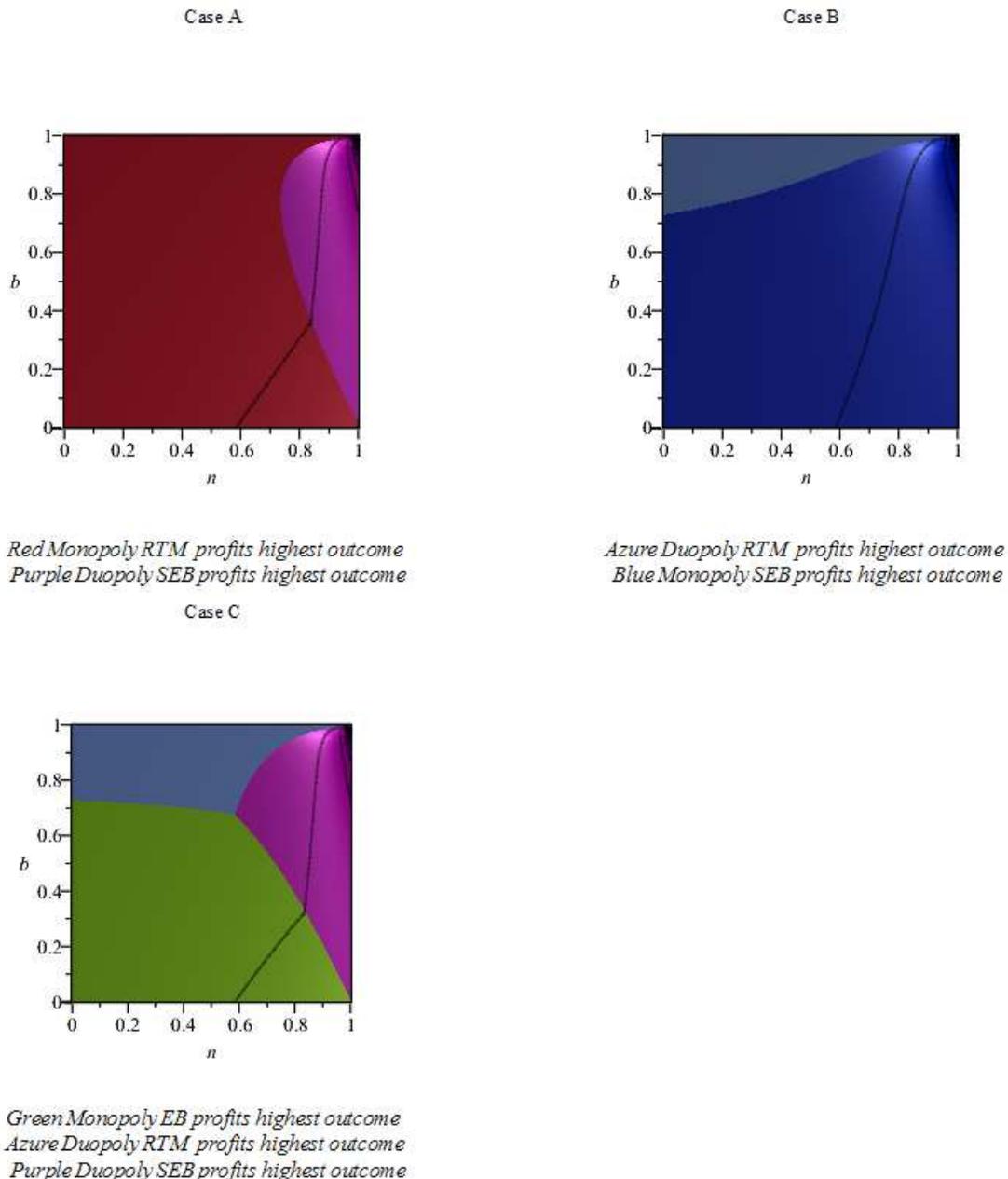


Fig. 2. Plot of the monopoly and duopoly firm profits in Eq.(62) under the RTM, EB and SEB institution outcome in  $[n,b]$ -space .

Legend: The graphs are drawn for  $a=1, w^o=0$ . Note: duopoly profits under EB are always the lowest in Cases A and B.

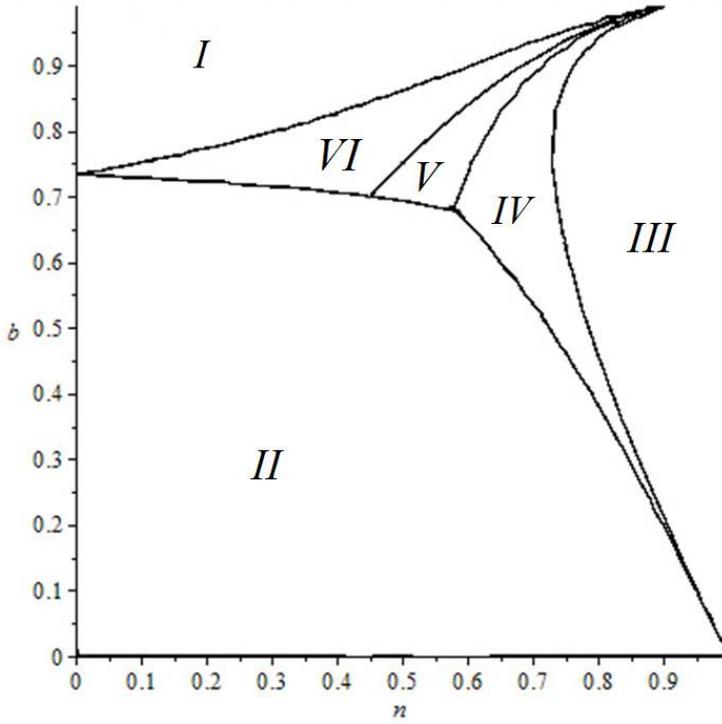


Fig. 3. Bargaining agendas as potential entry deterrence tools in  $[n, b]$ -space .  
 Legend: The graphs are drawn for  $a=1, w^o=0$ .

**Result 5** Whenever the fixed costs of the initial investment for the potential entrant are sufficiently large, the monopolist can always use the bargaining agenda as a strategic tool to prevent market entry.

Therefore, in a monopoly with network effect, the incumbent firm can switch among the bargaining agendas to deter entry; in other words, entry is not allowed.

From the results in Fig.2 and the threshold  $b = 1 - (1 - n)^2$  in Result 1, it is possible to build Fig. 3, which is characterized by six regions.

In region I,  $\Pi_1^{RTM/M} > \Pi_1^{SEB/SEB,EB/EB}$  : when the union bargaining power is high, RTM may block the entry of a competitor under the alternative EB and SEB at all level of the network effect.

In region II, we have that  $\Pi_1^{RTM/M} > \Pi_1^{SEB/SEB,EB/EB}$  ,  $\Pi_1^{SEB/M} > \Pi_1^{RTM/RTM,EB/EB}$  and  $\Pi_1^{EB/M} > \Pi_1^{SEB/SEB,RTM/RTM}$  . In other words, every agenda may be used by the incumbent to deter the entry under the alternative options for medium/low unions' bargaining power. The choice of the monopolist about the precise agenda to be used depends on the size of the fixed costs. However, given that for  $b \geq 0$  ,  $\Pi_1^{SEB/M}, \Pi_1^{RTM/M} \geq \Pi_1^{EB/M}$  , when the fixed cost are low, the selection of the EB agenda can be more effective than SEB and RTM to prevent entry because it reduces the industry's profitability. In region III,  $\Pi_1^{SEB/M} > \Pi_1^{RTM/RTM,EB/EB}$  : SEB is the agenda that, in the presence of strong network effects, may block the entry of a competitor under the alternative EB and RTM.

Region IV has the following characteristics:  $\Pi_1^{SEB/M} > \Pi_1^{RTM/RTM,EB/EB}$  and  $\Pi_1^{RTM/M} > \Pi_1^{SEB/SEB,EB/EB}$ . Therefore, SEB and RTM can be used to deter entry under EB. However, it occurs that the SEB agenda can deter entry under RTM and vice versa. In fact, a closer inspection reveals that  $\Pi_1^{SEB/M} > \Pi_1^{RTM/M} > \Pi_1^{SEB/SEB} > \Pi_1^{RTM/RTM} > \Pi_1^{EB/EB}$ . Again, the choice of the agenda to deter entry depends on the magnitude of the fixed costs. The reasoning applied to region II also works here: when the fixed cost are small enough, the selection of the RTM agenda can be more effectual than SEB to deter market entry because it lowers the entrant's profitability.

Region V is similar to region IV, except for the fact that  $\Pi_1^{SEB/M} > \Pi_1^{RTM/M} > \Pi_1^{RTM/RTM} > \Pi_1^{SEB/SEB} > \Pi_1^{EB/EB}$ . The discussion presented in region IV and the core results apply also in this region.

In region VI we have again that  $\Pi_1^{SEB/M} > \Pi_1^{RTM/RTM,EB/EB}$  and  $\Pi_1^{RTM/M} > \Pi_1^{SEB/SEB,EB/EB}$ ; however,  $\Pi_1^{RTM/M} > \Pi_1^{SEB/M} > \Pi_1^{RTM/RTM} > \Pi_1^{SEB/SEB} > \Pi_1^{EB/EB}$ : when the fixed cost for the potential competitor are sufficiently small, now the selection of the SEB agenda can be more effective than RTM to prevent entry.

Let us discuss, for matter of comparison, the cases without network effects ( $n=0$ ). From Case A in Fig. 2, it is immediately observed that  $\Pi_1^{RTM/M} > \Pi_1^{SEB/SEB,EB/EB}$ : RTM always ensures the highest profits against the duopoly outcomes under SEB and EB. It follows that the monopolist does not use the bargaining agenda to deter entry. On the other hand, in Case B and C in Fig. 2, simple calculations shows that, for  $b \leq .73$ ,  $\Pi_1^{SEB/M} = \Pi_1^{EB/M} > \Pi_1^{RTM/RTM}$ , and therefore the monopolist can commit to SEB and EB to deter a potential entry with RTM (Fanti and Buccella, 2015)

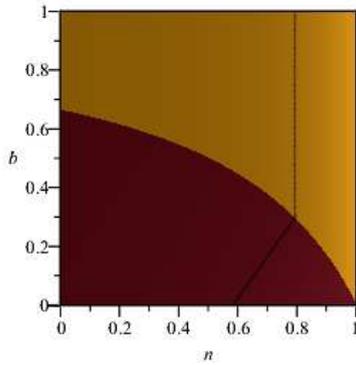
At this point of the discussion, it can be of interest to check if the unionised monopolist with network effects could be potentially able to use the negotiation agendas to prevent entry. In this respect, we compare the former situations with the case where the incumbent firm becomes non-unionised and faces the presence of a potential non-unionised competitor.

To do so, we compare the monopoly profits in the presence of unions under RTM, SEB and EB with the duopoly profits where both firms pay the competitive wage. The latter profits can be immediately derived by inserting eq. (30) and (35) after replacing  $w_i$  and  $w_j$  with  $w^\circ$ , into eq. (31), and are equal to

$$\pi_i^{\text{No Union}} = \frac{[a - w^\circ]^2}{(3 - 2n)^2}, i = 1, 2.$$

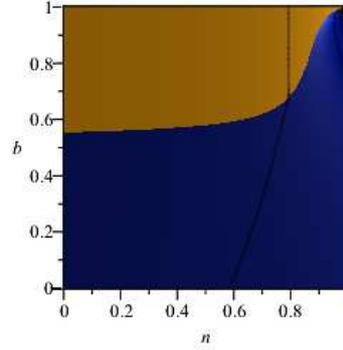
Figure 4 shows graphically the results. If the union bargaining power is not too high (simple algebra leads to the result of  $b \leq .55$ ), it is evident that the monopolist can use each agenda to prevent entry for every degree of intensity of the network effects. Once again, the choice of the agenda to be used crucially depends on the exact size of the fixed costs of the initial investment the entrant has to face. However, with RTM and EB, as the network intensity increases and the union power decreases, the entry deterrence effect weakens.

Unionised Monopoly, RTM agenda vs non-unionised duopoly

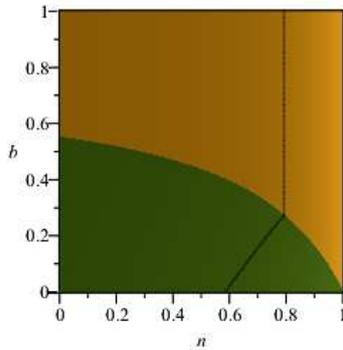


Red monopoly profits RTM, Orange duopoly profits non-unionised firms  
Unionised Monopoly, EB agenda vs non-unionised duopoly

Unionised Monopoly, SEB agenda vs non-unionised duopoly



Blue monopoly profits RTM, Orange duopoly profits non-unionised firms



Green monopoly profits RTM, Orange duopoly profits non-unionised firms

Fig. 4 Plots of the Unionised Monopoly profits and Non-unionized Duopoly profits in  $[n,b]$ -space . Legend: The graphs are drawn for  $a=1, w^o=0$ .

On the other hand, under the SEB agenda, a different result holds: as the network intensity increases and the union power increases, the entry deterrence effect strengthens. As a consequence of these findings about the role played by the presence of unions on the entry outcomes, the following Remarks hold.

**Remark 1.** If the labour unions are sufficiently weak, a monopolist, rather paradoxically, may find strategically advantageous to unionise its labour force to deter the entry of a potential non-unionised competitor in the industry.

**Remark 2.** In an industry with the presence of positive network externalities, if the labour market is not unionised, the incumbent firm has no instrument available to deter market.

Consider now the endogenous agreement as regards the negotiation agenda. Lemma 3 and Result 2 also hold true in the present context. Thus, in the presence of sufficiently intense network effects, the monopolist and its union endogenously selects the SEB agenda.

### 3.4. Welfare effects of the entry game

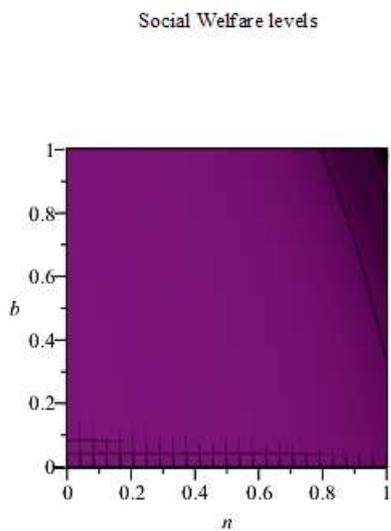
Let us finally consider the welfare effects of the entry game with committed bargaining.<sup>3</sup> Given the relevant payoffs in eq. (12), (21), (29), (43), (53) and (61), it is possible to build the Figure 5 below.

A straight forward analytical and graphical inspection of Fig. 5 leads to the following result.

**Result 6** *Duopoly under SEB is always the socially Pareto-superior outcome.*

The SEB agenda is the institution that ensures the highest social welfare level under duopoly; however, from the discussion of Fig. 3, the SEB agenda can be endogenously selected to deter market entry only in a restricted area.

The following result immediately holds.



*Red RIM monopoly, Blue SEB monopoly, Green EB monopoly  
 Azure RIM duopoly, Purple SEB duopoly, Green Blue EB duopoly*

Fig. 5. Plot of the Social Welfare level functions in  $[n, b]$ -space .

*Legend:* The graph is drawn for  $a=1$ ,  $w^o=0$ . Note: the graph is monochrome because the Social Welfare under duopoly with the SEB agenda is always the highest in the relevant  $[n, b]$ -space .

<sup>3</sup> The analysis of entry in an industry without unions and the relative effects on social welfare have been analysed in the literature, inter alias, by Mankiw and Whinston (1986) and Cellini et al. (2004).

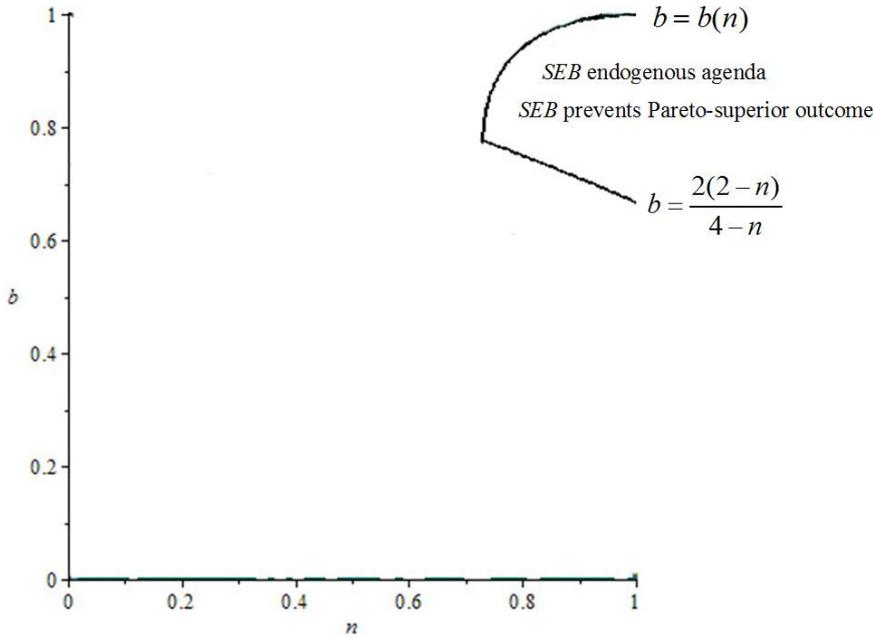


Fig. 6. Plot of the area where monopoly with SEB institution prevents the socially Pareto-superior outcome in  $[n, b]$ -space .

Legend: The curves are drawn for  $a=1, w^o=0$ . For all  $\{n, b\}$  combinations such that  $b > \frac{2(2-n)}{4-n} \cap b < b(n)$ , where  $b = b(n)$  is an expression analytically not manageable, SEB prevents the socially Pareto-superior outcome.

**Result 7.** *Provided that the both the network effect and union bargaining power are sufficiently low, a monopoly under the SEB arrangement is the endogenous market structure, and prevents the achievement of the Pareto-superior outcome.*

The proof follows from Lemmas 1 and 3 and Results 1, 2, 5 and 6 and discussion of Fig.3. Fig. 6 depicts the area in the  $\{n, b\}$ -space where Result 7 applies.

The consequences in terms of social welfare are as follows. In an industry characterised by positive network externalities, if the monopolist have the right of choosing the negotiation agenda, a government interested in guaranteeing the highest overall social welfare level has no clear-cut solution. In fact, as discussed above, the monopolist can shift from one bargaining agenda to another to prevent market entry, and the strategic choice of the precise agenda critically depends on the size of the fixed cost for the potential competitor. This may entail that policy maker should know many information not easily available and it may turn into an extremely complex task. However, in the case of endogenous bargaining agenda selection, the policy recommendation is less complicated. In fact, the government should promote the choice of a SEB agenda in negotiations which ensures the overall highest welfare level. However, one may argue that, as Fig. 6 shows, there is an area of the parameter

space where SEB is the endogenous bargaining agenda in monopoly and, at the same time, it prevents the achievement of the socially desirable welfare level. Nonetheless, it can be checked that in that area, the social welfare under monopoly with SEB is the “second-best”<sup>4</sup> outcome, with a welfare level higher than the duopoly under RTM and EB. In the overall, the choice of a SEB agenda would always remain the socially preferred one.

## 4 Conclusions

In this paper we have examined the issue of the bargaining agenda in the presence of network goods in a unionised monopoly. We have shown that the monopolist’s preferred agenda, i.e. RTM or SEB or EB, depends crucially on the strength of the network externality. While the conventional result (without network goods) is that profits are always higher under RTM than EB arrangement (and both sequential and simultaneous EB yield the same outcome), we show that, with network externalities, the monopolist prefers SEB, especially if the union’s power is low. We argue that this result is due to the sequential negotiation for which the consumers’ expectations on the market size are already realised in the long-run, that is, in the first stage of wage determination.<sup>5</sup> Moreover, since the union always prefers SEB (with or without network effects), it follows that the traditional conflict of interests between parties may be resolved in the presence of network externalities. Moreover, such an agenda also implies a Pareto superior equilibrium (i.e., the welfare of monopolist, workers, consumers and the entire society is the highest).

We have also investigated the threat of market entry in the industry under the “committed bargaining”, focusing separately on the cases in which the firm choose unilaterally the agenda or the agenda is endogenously selected by both firm and union. We have shown that, if the firm can choose the negotiation agenda, depending on the strength of the network externality and the union bargaining power, the incumbent may commit either to every agenda to deter market entry. However, the precise agenda the monopolist would like to adopt to prevent entry crucially depends on the size of the fixed costs the competitor has to face. Therefore, the monopolist may always strategically use the bargaining agenda as a deterrence tool. This means that every labour market arrangement is a sufficient device to raise effective barriers to entry. This finding contributes to the literature on the entry barriers, arguing that the labour market institutions add to the other known devices used as a barrier (i.e. capacity investment, patents, limit prices and so on) in network goods industries.

On the other hand, in the case of endogenous selection, the monopolist and its union agree on the SEB to prevent entry, provided that the network effects are intense and

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<sup>4</sup> Of course the highest social welfare would be achieved with duopoly under SEB, as shown in Result 6.

<sup>5</sup> In fact, in the case of EB, where the wage and employment are simultaneously determined, the consumers’ expectations are not so far realised. Consequently, the conventional result that a monopolist prefers RTM still holds.

the union power adequately high. As regards the welfare effects of the entry game, we have shown that the social welfare in duopoly under SEB is the Pareto-superior outcome. However, since the SEB institution itself can be used as entry deterrent tool for intense network effects and strong unions, then a monopoly under SEB emerges as the endogenous market structure and prevents the most desirable welfare level, but also in such a case welfare is higher than under RTM and EB. An interesting extension of this analysis could be to relax the assumption of monopoly firm. A reasonable further step would be to analyse whether a monopoly firm should hire a manager to bargain with the union and, if it is the case, how the findings of this paper may change. Finally the entry game should be extended allowing for the “flexible” commitment.

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