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Union–firm bargaining agenda: right-to-manage or efficient bargaining?

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Abstract

In this paper we revisit the issue of the scope of bargaining between firms and unions. It is shown that an agreement between parties on the bargaining agenda may endogenously emerge only on the Efficient Bargaining arrangement, provided that union's power is not too high.

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1. Introduction

The theme of the scope of bargaining between firms and unions – i.e. bargaining over wages alone (right-to-manage bargains, RTM) or negotiations also over employment directly (Efficient Bargaining, EB) – is relevant for the labour economics as well as for the industrial organization literature. However the literature dealing with this theme is rather scant. Three exceptions are Petrakis and Vlassis (2000) (henceforth, PV), Kraft (2006) and Vannini and Bughin (2000). However the latter authors abstract from the issue of the agreement between firms and unions on the scope of bargaining, although they show that under EB cost-raising strategies by firms may arise as subgame perfect equilibria and may be dominant strategies for sufficiently low union power and high product differentiation.

PV (2000) focus on the possibility of an agreement between firms and unions on the bargaining agenda, but under the assumption of specific rules.

They postulate that the union is unable to unilaterally impose bargaining over employment, and that "universal right-to-manage bargaining is an equilibrium institution only if no firm/union bargaining unit has an incentive to unilaterally deviate by including employment on its negotiation agenda. Of course, such an inclusion has to be profitable for both the firm and the union, otherwise the agent which is hurt will certainly veto it. " (PV, p. 269). A crucial feature of their model is that if one firm/union sticks to RTM, while the other firm/union 1 decides to conduct EB, the former becomes a Stackelberg leader in the product market and thus its pre-commitment to a larger output can increase its revenues in the product market.

The results of PV are that:[1] EB can never be sustained as a pure strategy equilibrium institution; on the other hand, either RTM is universally chosen only if the unions' bargaining power is sufficiently large ($b>0.5$), or a mixed result – at equilibrium one firm/union pair chooses EB while the

[1] Note that PV assume the following timing of the game: i) at stage 1 firm/union bargaining units decide simultaneously on both their negotiation agenda which may include either both wages and employment (EB, if there is a mutual agreement by the firm and its union on this) or only wages (RTM, if there is a veto by the firm on including employment); ii) at stage 2 the firm which has decided for EB implements its chosen employment while the firm which has decided for RTM chooses its employment taking into account its rival's choices. PV argue that having assumed the existence of one firm committing itself to EB (i.e. to a given production), the rival firm always prefers to become a Stackelbeg follower in the output market in order to avoid a Stackelberg warfare. As a consequence, they argue that both firms do never choose EB.

other pair chooses RTM - holds if the unions' bargaining power is sufficiently low (*b<0.5*).[2]

Finally Kraft (2006) assumes, along the lines of PV, that the wage-bargaining firm is Stackelberg leader in the product market but, in contrast with PV, concludes - as regard firms - that "a prisoner's dilemma concerning profits exists. The dominant strategy is efficient bargaining" (p. 595) and in particular that "for values of bargaining power β>0.27[3] a prisoner's dilemma situation exists."(Prop. 4, p. 599). However Kraft (2006) abstracts from the equilibrium results concerning the union's utilities and thus from the issue of the agreement on the scope of bargaining.[4]

In this paper we revisit the issue of the agreement on the choice of the agenda over which firms and unions negotiate, by studying whether and how an agreement may endogenously emerge as a subgame perfect Nash equilibrium of the game. The timing of the game – along the lines of PV - is the following: at the pre-play firms and unions choose their preferred arrangement, while either at the first stage both firms choose simultaneously wages and employment (in which case the game is ended) or only one firm chooses simultaneously wages and employment while the other one chooses only wages or, finally, none of them chooses simultaneously wages and employment and both choose only wages, in which case at the second stage the other firm (or both firms) choose employment for given wages.

It is shown that, although also either multiple equilibria or RTM at equilibrium may occur as regards firms' choices, only the Efficient Bargaining may endogenously emerge inside each firm/union bargaining unit as a sub-game perfect Nash equilibrium arrangement on which both parties agree. This agreement requires a not too high union's power, and in particular if the risk dominance criterion is used the EB arrangement seems to be the universal labour market institution for most plausible

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[2] The crucial assumption as regards the case of mixed modes of bargaining is that one firm become Stackelberg leaders in the market by committing to a particular output during the negotiations. The fact that the firm and its union both benefit from the additional Stackelberg rents, provided that the union's power is small enough, is the reason for the finding that in equilibrium, one firm–union pair will always choose to bargain over employment as well.

[3] Since in Kraft (2006) (1-β) denotes the union's bargaining power, this threshold value corresponds, in the present paper, to *b< 0.73.*

[4] For the sake of precision, we note that also Bughin (1999) investigated the optimal strategic choice of bargaining scope in a particular market structure, i.e. a duopoly versus a monopoly with threat of potential entry, arguing that Efficient Bargaining (EB) is always the industry equilibrium, but Buccella (2011) showed that this result is due to an erroneous computation of mixed oligopoly outcomes.

cases given that it simply requires that the union's power does not go over two third. Thus the results of the present revisiting paper markedly differ from those of the previous literature and thus contribute to the labour economics as well as industrial organization literature indicating another reason for the relevance of the Efficient Bargaining institution in an oligopolistic context.

The rest of the paper is organized as follows. Section 2 presents the basic duopoly model. Section 3 develops the case of the unionisation of the labour market under the two institutions (EB and RTM) and provides the sub-game perfect equilibrium outcomes as well as the key proposition as regards the choice of the preferred type of agreement by firms and unions. In Section 4, the results are briefly discussed.

2. The basic model

We consider a duopolistic Cournot market. There is a single homogenous product and its standard normalised linear inverse demand is given by

$$p = 1 - Q,^5 \qquad (1)$$

where p denotes price and Q is the sum of the output levels q_1 and q_2 of the two firms.

We assume the following production function – identical for both firms - with constant (marginal) returns to labour:

$$q_i = L_i \qquad (2)$$

where L_i represents the labour force employed by firm i. The i-th firm faces an average and marginal cost $w_i \geq 0$ for every unit of output produced, where w_i is the wage per unit of labour. Therefore, the firm i's cost function is linear and described by:

$$C_i(q_i) = w_i L_i = w_i q_i . \qquad (3)$$

For each firm, the cost of producing one unit equals $w_i < 1$. Π_i denotes the profits of the i-th firm, as follows:

$$\Pi_i = (1 - w_i - Q)q_i \qquad (4)$$

Following the standard unionised oligopoly literature above mentioned, first we build a firm-union two-stage game: in the first stage simultaneously firm-specific unions bargain with firms over wages (RTM), and in the second stage firms simultaneously choose their output (given wages chosen by unions). We solve for the equilibrium in the standard

[5] Note that the standard inverse demand model $p' = a - Q'$ can be transformed into this normalised model using $p = \frac{p'}{a}$ and $Q = \frac{1}{a}Q'$.

backward fashion. An equilibrium of the second stage of the game (the market game) satisfies the system of first-order conditions

$$\frac{\partial \Pi_i}{\partial q_i} = 0 \Leftrightarrow \left(1 - w_i - 2q_i - q_j\right) = 0, \quad i, j = 1,2; i \neq j \tag{5}$$

Therefore, the firms' reaction functions are given by:

$$q_i\left(q_j\right) = \frac{1}{2}\left[1 - w_i - q_j\right], \quad i, j = 1,2; i \neq j \tag{6}$$

From (6) we obtain output by firm *i*, for given w_i, w_j:

$$q_i(w_i, w_j) = \frac{\left[1 - 2w_i + w_j\right]}{3} \tag{7}$$

Then, the wages are endogeneised following the established literature on the unionised labour market, as shown in the next section.

3. The unionised labour market.

We consider the two typical models of the trade-union economics (Booth, 1995): 1) the efficient bargaining model (EB) (e.g. McDonald and Solow, 1981; Ashenfelter and Brown, 1986) which prescribes that the union and the firm are bargaining over both wages and employment (or, more realistically, hours of work); 2) the Right-to-Manage model (RTM) (e.g. Nickell and Andrews, 1983), in which wages are the outcome of negotiations between firms and unions (while firms have all the power to set the employment level).
Each firm-specific union has the following utility function: [6]

$$V_i = w_i L_i \tag{8}$$

We assume that unions are identical.
Therefore, by recalling that $q_i = L_i$, Eq. (8) becomes:

$$V_i = w_i q_i \tag{9}$$

This means that unions aim to maximise the total wage bill.
We begin by illustrating the cases of RTM and EB, respectively.

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[6] This a specific case of the more general Stone-Geary utility function, i.e., Pencavel (1984, 1985), Dowrick and Spencer (1994):

$$V = \left(w - w^{\circ}\right)^{\theta} L,$$

where w° is the reservation or competitive wage. A value of $\theta = 1$ gives the rent-maximising case (i.e., the union seeks to maximise the total rent); values of θ smaller (higher) than 1 imply that the union is less (more) concerned about wages and more (less) concerned about jobs. Moreover, the union aims to maximise the wage bill when $\theta = 1$ and $w^{\circ} = 0$.

3.1. Right-to-manage institution

At the first stage of the game, under Right-to Manage, firm-union bargaining unit i selects w_i to maximize the following generalized Nash product,

$$\underbrace{\max}_{w.r.t.\ w_i} N_i = (\Pi_i)^{1-b}(V_i)^b = [(1-w_i-Q)q_i]^{1-b}(w_i q_i)^b \qquad (10),$$

where b represents the bargaining union's power.
Maximising eq. (10) with respect to w, after substitution of eq. (7) in (9), we get the sub-game perfect best-reply function in wages of union–firm pair i - i.e. $w_i(w_j)$ - under the assumption of a non-cooperative Cournot-Nash equilibrium in the product market. Solving the system composed by $w_i(w_j)$ and its counterpart for j, we obtain the sub-game perfect equilibrium wages:[7]

$$w_i = w_j = w^{RTM/RTM} = \frac{b}{(4-b)} \qquad (11)$$

By exploiting (11) and recalling (4), (7) and (9), after the usual algebra, the equilibrium values of output, profit and union's utility are derived:

$$q_i = q_j = q^{RTM/RTM} = \frac{2(2-b)}{3(4-b)} \qquad (12)$$

$$\Pi_i = \Pi_j = \Pi^{RTM/RTM} = \frac{4(2-b)^2}{9(4-b)^2} \qquad (13)$$

$$V_i = V_j = V^{RTM/RTM} = \frac{2b(2-b)}{3(4-b)^2} \qquad (14)$$

3.2. Efficient Bargaining institution.

Under Efficient-Bargaining and with the assumption that unions are identical and have the same bargaining power during the negotiations with their firms, we have that firm - union bargaining unit i selects w_i and L_i, or equivalently q_i, to maximize the following generalised Nash product,

$$\underbrace{\max}_{w.r.t.\ w_i, q_i} N_i = (\Pi_i)^{1-b}(V_i)^b = [(1-w_i-Q)q_i]^{1-b}(w_i q_i)^b \qquad (15)$$

[7] The apex – e.g. RTM/RTM – denotes the choice of the type of bargaining arrangement by firms i and j, respectively.

From the system of first-order conditions of the efficient bargaining game between firms and unions, the firms' reaction functions in output as well as unions' wages functions are the following:

$$q_i(q_j, w_i) = \frac{1}{2-b}\left[1 - w_i - q_j\right], \tag{16}$$

$$w_i(q_i, q_j) = \left[b(1 - q_i - q_j)\right] \tag{17}$$

From eq. (16), and its counterpart for j, we obtain output, respectively, by firm i, for given w_i, w_j $(i, j = 1,2; i \neq j)$:

$$q_i(w_i, w_j) = \frac{\left[(1-w_i)(2-b) - (1-w_j)\right]}{(3-b)(1-b)} \tag{18}$$

After substitution of eq. (18) in (17), we obtain

$$w_i(w_j) = \frac{b\left[(2-b) - 1 + w_j\right]}{3-2b} \tag{19}$$

which defines the sub-game perfect best-reply function in wages of union–firm pair i. Solving the system composed by (19) and its counterpart for j, we obtain the sub-game perfect equilibrium wages:

$$w_i = w_j = w^{EB/EB} = \frac{b}{3} \tag{20}$$

By substituting (20) in (18) we obtain output and price:

$$q_i = q_j = q^{EB/EB} = \frac{1}{3} \tag{21}$$

$$p_1 = p_2 = p^{EB/EB} = \frac{1}{3} \tag{22}$$

Finally by substituting both eq. (20) and eq. (21) in $\Pi_i = (1 - w_i - Q)q_i$ we obtain profits:

$$\Pi_i = \Pi_j = \Pi^{EB/EB} = \frac{1-b}{9} \tag{23}$$

By using eqs. (20) and (21), the equilibrium union's utility is given by:

$$V_i = V_j = V^{EB/EB} = \frac{b}{9} \tag{24}$$

3.3 The mixed case: one bargaining unit chooses EB and the other one chooses RTM.

Let firm/union pair 1 (2) choose EB (RTM). Therefore, the timing of moves is as follows. At stage one, firm 1 chooses w_1 and q_1, while firm 2 chooses w_2. At stage two, firm 2 chooses q_2.

Firm/union pair 1 chooses w_1 and q_1 through the maximization of

$$\underbrace{\max}_{w.r.t.\ w_1,q_1} N_1 = (\Pi_1)^{1-b}(V_1)^b = [(1-w_1-q_1-R_2(q_1))q_1]^{1-b}(w_1q_1)^b \tag{25}$$

taking as given the negotiated wage w_2 and firm 2's optimal response to its employment decision in the subsequent production stage:

$$R_2(q_1) = \frac{1-w_2-q_1}{2} \tag{26}$$

Substituting $R_2(q_1)$ into Eq. 25, taking the f.o.c.s., and solving for w_1 and q_1 as functions of w_2 , we get:

$$w_1(w_2) = \frac{b(1+w_2)}{4} \tag{27}$$

$$q_1(w_2) = \frac{(1+w_2)}{2} \tag{28}$$

Note that an increase in the negotiated wage of firm/union bargaining unit 2 increases the negotiated wage as well as the employment of firm/union bargaining unit 1.

On the other hand, firm/union bargaining unit 2 chooses w_2 , taking also account of the own optimal output response in the subsequent production stage, $R_2(q_1)$, by maximising its Nash product:

$$\underbrace{\max}_{w.r.t.\ w_2} N_2 = (\Pi_2)^{1-b}(V_2)^b = [(1-w_2-q_1-R_2(q_1))R_2(q_1)]^{1-b}[w_1R_2(q_1)]^b \tag{29}$$

for given q_1, w_1 , yielding the wage reaction function to the rival's employment

$$w_2(q_1) = \frac{b(1-q_1)}{2} \tag{30}$$

As firm/union 2 pair conducts right-to-manage bargaining, while firm/union 1 pair conducts bargaining simultaneously over wage and employment, firm 2 becomes a Stackelberg follower in the product market.[8]

[8] Alternatively, it can be assumed, as in Fanti (2014), that when firm/union 2 conducts right-to-manage bargaining, while firm/union 1 conducts wage-employment bargaining, firm 2 becomes a Stackelberg leader in the wage determination game. This case investigated by Fanti (2014) shows that, given that the union's bargaining power is the same in both cases of EB and RTM, firms and unions always conflict over the bargaining agenda and only if the union's power is larger under RTM (i.e. the union tends to become a monopoly) then an agreement on the scope of bargaining between firms and unions may emerge.

This means that the gain due to the leadership in the output market allows firm/union pair 1 to have a larger joint gain than in the case in which it chooses RTM bargaining.
Note from Eq. (30) that the higher the level of employment chosen by firm/union pair 1 at first stage, the lower the wage chosen by firm/union pair 2 in order to preserve profitability and employment. Solving the system of linear equations - Eqs. (30) and (28) - we obtain a unique solution

$$q_1^{EB/RTM} = \frac{2+b}{(4+b)} \tag{31}$$

$$w_2^{RTM/EB} = \frac{b}{(4+b)} \tag{32}$$

and then

$$q_2^{RTM/EB} = \frac{2-b}{2(4+b)} \tag{33}$$

$$w_1^{EB/RTM} = \frac{b(2+b)}{2(4+b)} \tag{34}$$

Finally profits and union's utilities at equilibrium are given by, respectively:

$$\Pi_1 *^{EB/RTM} = \frac{(1-b)(2+b)^2}{2(4+b)^2} \tag{35}$$

$$\Pi_2 *^{RTM/EB} = \frac{(2-b)^2}{\left[2(4+b)\right]^2} \tag{36}$$

$$V_1 *^{EB/RTM} = \frac{b(b+2)^2}{2(4+b)^2} \tag{37}$$

$$V_2 *^{RTM/EB} = \frac{b(2-b)}{2(b+4)^2} \tag{38}$$

Now we are in position to investigate which institution will *endogenously* emerge in the subgame perfect Nash equilibrium (SPNE) for both firms and unions. The following tables 1 and 2 resume profits and union's utilities, respectively, in the four strategic situations.

Tab. 1. Profits matrix with two labour market institutions (RTM, EB).

Firm 2 / Firm 1	RTM	EB
RTM	$\frac{4(2-b)^2}{9(4-b)^2}, \frac{4(2-b)^2}{9(4-b)^2}$	$\frac{(2-b)^2}{[2(4+b)]^2}, \frac{(1-b)(2+b)^2}{2(4+b)^2}$
EB	$\frac{(1-b)(2+b)^2}{2(4+b)^2}, \frac{(2-b)^2}{[2(4+b)]^2}$	$\frac{1-b}{9}, \frac{1-b}{9}$

Tab. 2. Union's utility matrix with two labour market institutions (RTM, EB).

Union 2 / Union 1	RTM	EB
RTM	$\frac{2b(2-b)}{3(4-b)^2}, \frac{2b(2-b)}{3(4-b)^2}$	$\frac{b(2-b)}{2(b+4)^2}, \frac{b(b+2)^2}{2(4+b)^2}$
EB	$\frac{b(b+2)^2}{2(4+b)^2}, \frac{b(2-b)}{2(b+4)^2}$	$\frac{b}{9}, \frac{b}{9}$

Then the following results hold.

Result 1. *As regards firms, it holds that: when 1>b≥0.883 the unique SPNE is RTM/RTM; when 0.883>b≥0.42 there exist two SPN equilibria, RTM/RTM and EB/EB; when b<0.42 the unique SPNE is EB/EB.*
Proof: this result straightforwardly derives from the inspection of the following set of inequalities:

$$\pi^{RTM/RTM} - \pi^{EB/EB} > 0; \pi^{RTM/EB} - \pi^{EB/EB} \gtrless 0 \Leftrightarrow b \gtrless 0.883;$$

$$\pi^{EB/RTM} - \pi^{RTM/RTM} \gtrless 0 \Leftrightarrow b \lessgtr 0.42; \pi^{EB/RTM} - \pi^{RTM/EB} \gtrless 0 \Leftrightarrow b \lessgtr 0.935.$$

Result 2. *As regards unions, there exists a unique SPNE, given by EB/EB (irrespective of the values of b).*
Proof: this result straightforwardly derives from the inspection of the following set of inequalities:

$$V^{RTM/RTM} - V^{EB/EB} < 0;\ V^{RTM/EB} - V^{EB/EB} < 0;$$
$$V^{EB/RTM} - V^{RTM/RTM} > 0;\ V^{EB/RTM} - V^{RTM/EB} > 0.$$

Therefore, from the above Results we may state that:

Result 3. *The unambigous agreement between unions and firms as regards the scope of bargaining is on the EB institution provided that 0<b<0.42, while when 0.42≤b<0.883 there are multiple equilibria. In the latter case, the game between firms shows the structure of a coordination game, and thus, in principle, it could also be possible a coordination between firms towards the choice of the EB institution.*

Therefore we can investigate more in detail the case of multiple equilibria for firms.

Since in the situation in which *0.42<b<0.883*, the game between firms is a standard coordination game, then, in addition to the two pure-strategy equilibria, there is also one mixed-strategy equilibrium.

Mixed Nash equilibrium strategies (by defining, as usual, $p,(1-p)$ (resp. $q,(1-q)$) the probabilities that firm 1 (resp. firm 2) chooses either RTM or EB)) are given by:[9]

$$p = q = \frac{(4-b)^2(28+4b-4b^3-37b^2)}{14b^5-79b^4+156b^3+4b^2-96b+320} \qquad (39)$$

Thus only considering – for the sake of simplicity and for the stability reason discussed in the footnote 9 - the pure-strategy equilibrium selection problem, the well-known criteria are mainly two: Pareto-dominance [10] and Risk-dominance.[11]

According to the Pareto-dominance equilibrium selection criterion, firms would coordinate on RTM equilibrium (it is easy to see from tab. 1 that RTM pay-off dominates EB for both firms). However, since in a

[9] By passing we note that, as known, in 2 player coordination games, the mixed strategy Nash equilibrium - although perfect in the sense of Selten (1975) and proper in the sense of Myerson (1978) - is not persistent (i.e. is lacking of strong neighbourhood stability in the sense of Kalai and Samet (1984)).

[10] In essence, a Nash equilibrium is *Payoff-dominant* if it is Pareto superior to all other Nash equilibria in the game.

[11] An established result is that when faced a choice among equilibria, a Nash equilibrium is considered *Risk-dominant* if it is less risky. Two analogous definitions of the Risk-dominance in a 2x2 symmetric coordination game may be the following: *i)* a strategy is Risk-dominant if it is a best response to a 50-50 randomization by the other player; *ii)* the strategy is Risk-dominant if it has the smallest probability in the mixed strategy Nash equilibrium.

coordination game, players always face strategic uncertainty about rivals' moves, then it could be argued that if players are interested in minimizing the risk of coordination failure, they will tend to coordinate on the risk-dominant equilibrium, even when it is Pareto-dominated by another pure equilibrium. [12]

As known (Harsanyi and Selten, 1988, Lemma 5.4.4), strategy pair (*EB, EB*) *risk dominates* (*RTM, RTM*) if the product of the deviation losses is highest for (*EB, EB*). In this case of symmetric game, if we assume that each player assigns probabilities ½ to *RTM* and *EB* each, [13] then (*EB, EB*) risk dominates (*RTM, RTM*) if the expected payoff from playing *EB* exceeds the expected payoff from playing *RTM*, that is if $\Pi_2^{EB/RTM} + \Pi_2^{EB/EB} \geq \Pi_2^{RTM/RTM} + \Pi_2^{RTM/EB}$

It follows that:

Result 4. *The strategic situation (EB, EB) risk dominates (RTM, RTM) if* $b<0.666$. [14]

Thus with the presumption that firms are interested in minimizing the risk of coordination failure in their choice of the labour market institution, it is yielded EB as the unique equilibrium when $b< 2/3$.

In conclusion we have shown that only EB may be the arrangement on which each firm/union bargaining unit may agree, provided that the union's power is either sufficiently low (i.e. $b<0.42$ under pure strategies) or not too high (i.e. $b<0.666$ under the critierion of the risk dominance). Since, as known, the EB arrangement (in contrast with the RTM) is "efficient" from a societal point of view, the result that it may be the endogenously determined scope of barganing for a fairly noticeable range of union's bargaining power is interesting also for policy.

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[12] This explains the predictive success of Risk-dominance in experimental studies, as well as in evolutionary games characterized by experimentation and myopic learning (see e.g. Kandori et al, 1993). For instance, some experimental evidence in favour of Risk-dominance in coordination games is in Cooper et al. (1992).

[13] The assignment of these probabilities may be seen as an example of the Principle of *Insufficient Reason:* if which of n possible outcomes will occur is completely unknown, then probability $1/n$ that each outcome will occur is assigned. Applying this principle to this two stage game, we assign probability ½ to the one firm choosing RTM and probability ½ to its rival firm choosing EB.

[14] Note that this result obtained applying the definition of Risk-dominance exposed in the part *i*) in footnote 11 , may be also obtained by applying the definition in the part *ii*) of the same footnote: indeed it is easy to see from Eq. (43) that the probability to play EB (i.e. $(1-p)$) is the smallest one until $b<0.666$.

4. Concluding remarks.

In this paper we revisit the issue of the scope of bargaining between firms and unions. It is shown that an agreement between parties on the bargaining agenda may endogenously emerge only on the Efficient Bargaining arrangement, provided that union's power is not too high. This finding provides another motive in favour of the importance of the EB institution. As future directions of research, the robustness of the present findings can be checked under a more extended game in which also managerial delegation, R&D investments, capacity choices and price competition are considered.

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