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# Wage versus efficient bargaining in a Cournot duopoly: A preliminary note on welfare

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**Abstract**

**Wage versus efficient bargaining in a Cournot duopoly: A preliminary note on welfare**

In a unionized Cournot duopoly with decentralized, firm-level bargaining, this note re-examines the endogenous equilibrium agendas (wage vs. efficient bargaining) that can arise under three different specifications of the timing of negotiations and the impact of the outcome of the bargaining process on social welfare. Given that explicit conflict of interest among the bargaining parties can arise in every timing specification, this note proposes, analyzes, and discusses some guiding principles for governments and public authorities interested in pursuing social welfare improvements.

## 1. Introduction

The choice of the bargaining agenda between firms and unions is a central issue for labor market institutions. Given the interconnections between labor and product markets, the subject takes on significant importance both for labor economics and industrial organization.

In this note, the analysis discusses two of the models which are more frequent in the economic literature and are empirically observed in real-world bargaining agendas: the Wage Bargaining (WB), also known as Right-to-Manage, and the Efficient Bargaining (EB) models. In the WB (e.g., Nickell and Andrews, 1983), firms

and unions bargain over wages; once wages are set, the firms have the right to decide the employment level. On the other hand, in the EB model, firms and unions negotiate over wages and employment either simultaneously (e.g., McDonald and Solow, 1981) or sequentially (Manning, 1987a, b).

The economic literature has considered the scope of bargaining — negotiations over wages only or both employment and wage rates. The analysis regarding the selection of the bargaining agenda is limited to a few deserving contributions such as Petrakis and Vlassis (2000), Vannini and Bughin (2000), Kraft (2006), Fanti (2014, 2015), and Fanti and Buccella (2017). In a unionized Cournot duopoly with firms producing homogeneous goods, Fanti and Buccella (2017) have extensively analyzed which bargaining institution (and therefore negotiation agenda) is prevalent at market equilibrium and whether the bargaining parties (endogenously) agree with this institution. They show that the equilibria crucially depend on the specification of the timing of negotiations. In fact, in the presence of a mixed duopoly (in which one firm selects WB and the rival EB), three configurations are possible. First, in the presence of simultaneous EB, the EB firm can negotiate wages and employment when the WB firm chooses output; in other words, the EB firm is a Stackelberg wage follower (Fanti, 2015; Fanti and Buccella, 2017). In the second case, the EB firm negotiates wages and employment when the WB firm bargains the wage with its union; that is, the EB firm is the Stackelberg output leader (Bughin, 1999; Buccella, 2011; Fanti, 2014; Fanti and Buccella, 2017). Third, in the sequential EB, the EB firm and the WB firm negotiate wages, the EB firm negotiates employment with its union, and the WB firm autonomously selects its employment level (Fanti and Buccella, 2017).

The bargaining process between unions and firms is not only relevant to the negotiating parties. In fact, depending on the equilibria, the overall social welfare is affected. This note precisely offers a preliminary analysis of the impact of the parties' choice of the bargaining agenda on society, a missing aspect at the current stage in the literature. However, this issue is vital whenever policies have to be designed to regulate the proper functioning of labor markets, the organization of productive activities in different industries, as well as the evaluation of the impact on social welfare. As a consequence, governments, policy-makers, and antitrust bodies are directly implicated.

The remainder of the note is as follows. Section 2 briefly presents the model and studies of the impact on social welfare under the alternative frameworks. Section 3 closes the note with a brief discussion and some policy insights.

## 2. The model and the results

Two firms, labeled 1 and 2, operate in an imperfectly competitive sector of an economy. Each firm produces homogeneous goods. Labor, $l$, represents the unique

input factor. A constant returns-to-scale technology characterizes production, such that $q_i = l_i$, where $q_i$ is the firm $i$'s output. Following Kraft (2006, 597), the linear (inverse) product demand is

$$p = d - Q \tag{1}$$

where $p$ is the market price, the parameter $d$ (the intercept of the demand function) represents the highest willingness to pay of consumers for the goods (the slope, $b$, is normalized to the unity) and $Q = \sum_i q_i = \sum_i l_i,\ i = 1,2$, is total industry output (and employment). Thus, the expression for each firm's profits is

$$\pi_i = (d - Q - w_i) l_i,\ i = 1, 2. \tag{2}$$

According to Bughin (1999, 1030), Petrakis and Vlassis (2000, 265–266), Kraft (2006, 597), and Fanti and Buccella (2017, 61–62), the firms compete in quantities in the product market. The firms conduct firm-level negotiations with workers' representatives (union or other representative body). It is assumed that these representative bodies are large enough to meet each firm's labor demand. The workers' representatives maximize the wage rent,

$$Z_i = (w_i - a)\, l_i,\ i = 1, 2 \tag{3}$$

where parameter $a$ can be interpreted either as the alternative (competitive) wage or the workers' unemployment benefits. Given the firm-specific structure of the negotiations, the bargaining solution is modeled by the following generalized asymmetric Nash Product (Roth, 1979, 16); that is, the product of the parties' excess utilities (the difference between the utility functions of the players minus the utility obtained in case of no bargaining) weighted by the relative bargaining power:

$$V = (\pi_i)^{\beta}\, (Z_i)^{(1-\beta)}. \tag{4}$$

The parameter $\beta \in [0,1]$ in equation (4) measures the parties' relative bargaining power, assumed to be equal across units. Duopoly firms may bargain only over wages, retaining discretion over employment (WB), or wages and employment (EB). At the general level, the models of bargaining agenda selection present a potential controversy concerning who establishes the agenda: 1) the firm, 2) the union, 3) both parties, or 4) legal and institutional interventions which set rules to solve eventual conflicts. Fanti and Buccella (2017, 72–81) consider 1), 2), and 3) and focus on the agreed selection of the bargaining agenda. Therefore, the sequence of moves is as follows: first, the bargaining agenda is chosen (by the firm, by the union, or jointly), and then wages are negotiated simultaneously with employment in the case of EB or before output decisions in the case of WB. Finally, quantity competition á la Cournot takes place in the product market. The game is solved through backward induction, that is, the method of reasoning backwards in the progression of events, from the end of the game, to determine a sequence

of optimal actions. Thus, the equilibrium concept is the sub-game perfect Nash equilibrium.[1]

Without loss of generality, it is possible to normalize the parameters $d = 1$ in equation (2) and $a = 0$ in equation (3). With consideration for equations (2) and (3) and solving the Nash Product in (4), straightforward calculations lead to the results in Table 1. The possible bargaining combinations are as follows: all bargaining units conduct WB (universal WB), and all bargaining units conduct EB (universal EB) and asymmetric bargaining regimes. Regarding asymmetric bargaining, there are three alternatives for how the rules of the game can be specified (Fanti and Buccella, 2017, 67):

— Asymmetric bargaining 1 (AB1). Firm $i$ and union $i$ bargain over wage and employment taking as given the negotiated wage at $j$ and firm's $j$ output. Firm $j$ chooses employment for given wage and output of the bargaining unit $i$ and its own wage at $j$. Firm $j$ bargains over the wage with union $j$, taking as given the solutions of the production stage for wage and output in $i$ and output in $j$. In this case, firm $j$ is the Stackelberg wage leader, $i, j = 1, 2, i \neq j$;

— Asymmetric bargaining 2 (AB2). Firm $i$ and union $i$ bargain over wage and employment, taking as given the negotiated wage in $j$ and firm's $j$ reaction function to firm $i$ output decision in the successive production stage. Firm $j$ and union $j$ bargain over the wage, taking into consideration its reaction function to firm $i$ output choice in the subsequent production stage, taking the wage and employment level in $i$ as given. In this case, firm $j$ acts as the Stackelberg output follower, $i, j = 1,2, i \neq j$;

— Asymmetric bargaining 3 (AB3). In the second stage, firm $j$ selects its optimal quantity, taking its own wage level and the wage level in $i$ as given, while firm and union $i$ bargain efficiently over employment. In the first stage, the firm and the union in $j$ bargain the wage level, taking as given its own reaction function and the negotiated employment in the firm $i$ , and the firm and the union in $i$ negotiate efficiently the wage level, taking as given the reaction function of firm $j$ to the negotiated employment in the firm $i$ and its own efficiently negotiated employment, $i, j = 1,2, i \neq j$.

The findings are reported in Table 1.[2]

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[1] In a non-cooperative game with two or more players, the Nash equilibrium is a solution concept in which each player is supposed to have knowledge of the equilibrium strategies of the other players, and no player gains by altering only their own strategy. If each player has selected a strategy and no player can improve its payoff by changing strategies while the other players keep theirs unaltered, then the current set of strategy choices (and the corresponding payoffs) is a Nash equilibrium. A strategy profile is a subgame perfect Nash equilibrium if it represents a Nash equilibrium of every subgame of the original game. In other words, this means that if the players play any shorter game that consists of only one part of the extended game, their behavior would represent a Nash equilibrium of that shorter game.

[2] The extensive analytical derivations can be found in Fanti and Buccella (2017), considering that $(1 - b)$ in that work is equivalent to $\beta$ here, $b$ equals $(1 - \beta)$, and $Z_i$ corresponds to $V_i$. However, additional details can be obtained from the author upon request.

**Table 1.** Firm-level unionized oligopoly outcomes. For the asymmetric bargaining cases, the first lower script denotes the agenda selected by the firm, while the second stands for the rival firm's agenda

| | $q$ | $w$ | $Z$ | $\pi$ |
|---|---|---|---|---|
| Duopoly | | | | |
| WB-WB | $\frac{2(1+\beta)}{3(3+\beta)}$ | $\frac{(1-\beta)}{(3+\beta)}$ | $\frac{2(1-\beta)(1+\beta)}{3(3+\beta)^2}$ | $\left[\frac{2(1+\beta)}{3(3+\beta)}\right]^2$ |
| Simultaneous EB-EB | $\frac{1}{3}$ | $\frac{(1-\beta)}{3}$ | $\frac{(1-\beta)}{9}$ | $\frac{\beta}{9}$ |
| Sequential EB-EB | $\frac{(1+\beta)^2}{(1+3\beta)(2+\beta)}$ | $\frac{\beta(1-\beta)}{1+3\beta}$ | $\frac{\beta(1-\beta)(1+\beta)^2}{(1+3\beta)^2(2+\beta)}$ | $\frac{\beta(1+\beta)^4}{[(1+3\beta)(2+\beta)]^2}$ |
| EB-WB Asymmetric Bargaining 1 | $q_{EB,WB}=\frac{(5-\beta)}{12}$; $q_{WB,EB}=\frac{(1+\beta)}{6}$ | $w_{EB,WB}=\frac{(1-\beta)(5-\beta)}{12}$; $w_{WB,EB}=\frac{(1-\beta)}{4}$ | $Z_{EB,WB}=(1-\beta)(q_{EB,WB})^2$; $Z_{WB,EB}=\frac{(1-\beta)}{4}(q_{WB,EB})$ | $\pi_{EB,WB}=\beta(q_{EB,WB})^2$; $\pi_{WB,EB}=(q_{WB,EB})^2$ |
| EB-WB Asymmetric Bargaining 2 | $q_{EB,WB}=\frac{(3-\beta)}{(5-\beta)}$; $q_{WB,EB}=\frac{(1+\beta)}{2(5-\beta)}$ | $w_{EB,WB}=\frac{(1-\beta)(3-\beta)}{2(5-\beta)}$; $w_{WB,EB}=\frac{(1-\beta)}{(5-\beta)}$ | $Z_{EB,WB}=\frac{(1-\beta)}{2}\left[q_{EB,WB}\right]^2$; $Z_{WB,EB}=\frac{(1-\beta)}{(5-\beta)}q_{WB,EB}$ | $\pi_{EB,WB}=\frac{\beta}{2}\left[q_{EB,WB}\right]^2$; $\pi_{WB,EB}=\left[q_{WB,EB}\right]^2$ |
| EB-WB Asymmetric Bargaining 3 | $q_{EB,WB}=\frac{2(1+\beta)[(1+\beta)(3-\beta)-(1-\beta)]}{[(3+\beta)(5-\beta)]-8(1-\beta)}$; $q_{WB,EB}=\frac{(1+\beta)^2(1+3\beta)}{[(3+\beta)(5-\beta)]-8(1-\beta)}$ | $w_{EB,WB}=\frac{(1-\beta)[(2+\beta)(3-\beta)-(1-\beta)]}{[(3+\beta)(5-\beta)]-8(1-\beta)}$; $w_{WB,EB}=\frac{(1-\beta)(1+3\beta)}{[(3+\beta)(5-\beta)]-8(1-\beta)}$ | $Z_{EB,WB}=\frac{(1-\beta)}{(1+2\beta)}(q_{EB,WB})^2$; $Z_{WB,EB}=\frac{(1-\beta)(1+2\beta)}{(1+\beta)^2}(q_{WB,EB})^2$ | $\pi_{EB,WB}=\beta(q_{EB,WB})^2$; $\pi_{WB,EB}=(q_{WB,EB})^2$ |

Source: own work based on Fanti and Buccella (2017).

## 2.1. Asymmetric Bargaining 1

Let us consider first in detail the game in which the AB1 applies. Concerning firms, given the payoffs in the first, second, and fourth row of the last column in Table 1, it is easy to verify that profits under universal EB are lower than in the universal WB. Moreover, despite the fact that the firm selecting EB produces a larger output than the WB competitor, the profits of the latter are higher than those of the former. The rationale for this result is as follows (Buccella, 2011, 691; Fanti and Buccella, 2017, 72–73). The profit margins of the WB firm are higher than those of the EB firm, because the market price is identical but the bargained wages are lower. The WB is the dominant strategy[3] for firms, and thus, universal WB arises as an equilibrium bargaining agenda in the industry. On the other hand, direct comparison of the payoffs in the first, second, and fourth row of the third column in Table 1 shows that EB is the dominant strategy from the workers' representatives viewpoint. These results can be summarized in the following proposition.

Proposition 1 (Buccella, 2011, 691; Fanti, 2014, 21; Fanti and Buccella, 2017, 72): In a unionized duopoly with AB1, WB is the firms' dominant strategy, while EB is the workers' representatives' dominant strategy. Universal WB is the equilibrium bargaining agenda, triggering, however, a conflict of interest between the bargaining parties.

Proposition 1 and $\pi_{WB,WB} \geq \pi_{EB,EB}\ \forall \beta \in [0,1]$ show that, with this timing specification of the game, firms are not cast into a prisoner's dilemma.[4] Closer analytical inspection also reveals that universal EB leads to the highest rents for workers' representatives $\forall \beta \in [0,1]$. A direct consequence of Proposition 1 is that, in the case that unions have a voice in the selection of the agenda, no endogenous agreement arises between the bargaining parties.

## 2.2. Asymmetric Bargaining 2

Let us consider the game in which AB2 applies. When the rules of the game have this specification, it follows that $Q^{AB2} > Q^{AB1}$ (the upper scripts denote the game specification). To be more precise, the firm that negotiates with EB in AB2 has production levels larger than in AB1, namely $q^{AB2}_{EB,WB} > q^{AB1}_{EB,WB}$, while the WB competitor has lower output than in AB1, that is, $q^{AB1}_{WB,EB} > q^{AB2}_{WB,EB}$. The reason is straightforward. The bargaining unit $i$ incorporates the firm $j$ best-response function in

[3] A dominant strategy is defined as a strategy whose payoffs are always higher than the payoffs the player may obtain choosing any other strategy available to her/him, irrespective of the strategic choice made by the rival player.

[4] The prisoner's dilemma is a game analyzed in game theory which explains why two completely rational individuals, pursuing only their individual reward, may not cooperate even if it occurs that it is in their best interests to do so.

the negotiations over wage and employment in stage 1. Hence, the bargaining unit *i* takes into account that firm *j* will decrease its output level in response to bargaining unit *i* production expansion. In other words, the bargaining unit *i* acts as a Stackelberg quantity leader (Shy, 1995, 104–105; Petrakis and Vlassis, 2000, 272–275; Fanti, 2015, 6–8).

Regarding firm profits, the payoffs in the first, second, and fifth rows in the last column in Table 1 reveal that, for $\beta \in [0,.118]$ the firms' payoff structure is such that $\pi_{WB,WB} \geq \pi_{EB,WB}$ and $\pi_{WB,EB} \geq \pi_{EB,EB}$: WB is the firms' dominant strategy. On the other hand, it can be shown that, for $\beta \in [.118,.573]$, the firm which adopts EB in the asymmetric bargaining experiences an increase in its wage to a level such that $\pi_{WB,WB} \geq \pi_{EB,WB}$, while $\pi_{EB,EB} \geq \pi_{WB,EB}$. Therefore, the game shows multiple symmetric equilibria: both universal EB and WB may emerge in equilibrium. Finally, for $\beta \in [.573,1]$, $\pi_{EB,WB} \geq \pi_{WB,WB}$, universal EB is the dominant strategy for firms. Given that $\pi_{WB,WB} \geq \pi_{EB,EB}$ $\forall \beta \in [0,1]$, it follows that, within the range $\beta \in [.573,1]$ , firms face a classical prisoner's dilemma. The intuition behind this result is as follows. The firm which selects EB in AB2 produces more output than in the identical situation in AB1 by paying a lower wage level. As a consequence, the firm improves its margins and, hence, profits.

With regard to workers' representatives, direct payoff comparison of the first, second, and fifth rows in the third column in Table 1 shows that, once again, EB is their dominant strategy. These findings can be summarized in the following proposition.

Proposition 2 (Fanti, 2015, 9–10; Fanti and Buccella, 2017, 74–75): In a unionized duopoly, under AB2, EB is the workers' representatives' dominant strategy $\forall \beta \in [0,1]$. For $\beta \in [0,.118]$, WB is the dominant strategy for firms; universal WB is the industry equilibrium bargaining agenda, in conflict of interests with the workers' representatives. For $\beta \in [0,.118,.573]$, both universal EB and WB are game equilibria; therefore, conflict of interests may potentially arise. For $\beta \in [.573,1]$, universal EB is the dominant strategy for firms; thus, in this range, universal EB is the equilibrium agenda in the industry, and it can be implemented without conflict of interest between the bargaining parties.

A straightforward consequence of Proposition 2 is that, when unions have a say in the selection of the agenda, EB endogenously emerges as the equilibrium agreement between the parties, provided that firms have a sufficiently high bargaining power.

## 2.3. Asymmetric Bargaining 3

Let us consider the game characterized by the sequential EB. Given the payoffs in the first, third, and sixth rows in the fourth column in Table 1 regarding firms, it is possible to obtain results qualitatively similar to those in Proposition 2, though valid for different ranges of the bargaining power parameter. In fact, the EB firm in the

mixed duopoly with sequential bargaining produces more output than the WB rival by paying a higher wage. However, when the union is not too strong, the total output is not so large to drive down the product price, and the bargained wages are sufficiently low to guarantee that $\pi_{EB,EB} > \pi_{WB,WB}$. On the other hand, for $\beta \in [.12,.39]$, the negotiations in the EB bargaining unit lead to an increase in the bargained wage to a level such that $\pi_{WB,WB} > \pi_{EB,\,WB}$, while $\pi_{EB,EB} > \pi_{WB,EB}$; multiple equilibria arise. Finally, for a low value of the firm bargaining power $\beta \in [0,.12)$, the total output in the mixed duopoly is adequately large to reduce the price level so that WB is more profitable because the common price for the goods lowers while the wage level paid by the EB firm is relatively high with respect to that of the WB unit. The situation for the unions is not only quantitatively (as for firms) but also qualitatively slightly different. In fact, EB is almost always the most preferred agenda. However, if unions have strong bargaining power, every union has an incentive to deviate toward the WB, provided that the rival bargaining unit negotiates with EB, and vice versa. Therefore, two asymmetric equilibria arise. The results are summarized in the next proposition.

Proposition 3 (Fanti and Buccella, 2017, 76–77): In a unionized Cournot duopoly with sequential EB: a) regarding firms, it holds that, when $\beta \in [0,.12)$, the unique SPNE is universal WB; when $\beta \in [.12,.39)$, there exist two SPN equilibria, universal WB and universal EB. When $\beta \in [.39,1]$ the unique SPNE is universal EB; b) regarding unions, there exists a unique SPNE, given by universal EB, for $\beta \in (.07,1)$ while for $\beta \in [0,.07]$, there exist two asymmetric SPN equilibria, namely WB,EB and EB,WB.

## 2.4. Welfare considerations

Let us now discuss some effects on welfare of the endogenous equilibrium agendas under the three timings of the negotiations. First, consider the total returns (*TR*) of the bargaining parties, namely

$$TR = \sum_i \pi_i + \sum_i Z_i,\ i = 1,2\,. \tag{5}$$

In the game specified by AB1, it has been shown that there is an insolvable conflict of interest among the bargaining parties: firms prefer WB, unions EB. Therefore, the parties do not find an agreement over the agenda to conduct negotiations. In this case, an external solution could be designed by the authorities. If the government uses as a guiding principle the total returns to the negotiating parties, the results in Table 1 allow evaluation that $\forall \beta \in [0.1]$, total returns are higher under universal WB. This is equivalent to the introduction of a measure that gives firms the right to choose the bargaining agenda; in fact, the industry equilibrium in that case would be universal WB.

On the other hand, when the game is specified by AB2, the findings show that, if the firms have a sufficiently strong bargaining power, universal EB arises as the commonly agreed bargaining agenda when $\beta \in [0,.573,1]$; that is, for a high bargaining power of the firms which, in most cases, seems to be the situation observed in the real world. Moreover, as Fanti (2015, 11) shows and Fanti and Buccella (2017, 75) report, in the case of multiple equilibria, the WB equilibrium payoff-dominates the EB equilibrium (i.e., the firms would coordinate on the WB equilibrium); however, universal EB risk-dominates universal WB.[5] As a consequence, under the risk-dominance criterion, the EB can be extended as the commonly agreed bargaining agenda, for instance in the range $\beta \in [.33,1]$. Otherwise, considering that total returns are higher under WB than EB, the government may align its decision to the preferences of the firms, however, generating a conflict of interest among the parties.

Under AB3, the results reveal that, when firms have a sufficiently strong bargaining power, universal EB arises as the commonly agreed-upon bargaining agenda when $\beta \in [.39,1]$; that is, for a range higher than AB2. Let us consider the case of multiple equilibria. Concerning the Pareto-dominance criterion, firms are better off under WB. On the other hand, under the risk-dominance criterion, universal EB risk-dominates universal WB in $\beta \in [.31,1]$, and therefore an EB agreement can be extended in common interest by the involved parties (Fanti and Buccella, 2017, 79). However, insertion of the relevant expressions of Table 1 into equation (5) shows that, when the timing of the game is specified by AB3, the total returns of the bargaining parties are higher under universal WB $\forall \beta \in [0,1]$ . Again, if the government follows that total returns as a guiding principle, it may align its preference to those of the firms generating an undesirable conflict of interest among the bargaining parties.

However, the government would take into account not only the returns of the bargaining parties but also the overall effects on social welfare. In this respect, two different measures of social welfare ($W$) are calculated: A) the sum of consumers surplus and profits

$$W = CS + \sum_i \pi_i = (1/2)(\sum_i q_i)^2 + \sum_i \pi_i,\ i = 1,2; \tag{6}$$

[5] A payoff-dominant Nash equilibrium is a Pareto-superior equilibrium to all other Nash equilibria in the game. Pareto superiority means that, given two possible outcomes, say A and B, outcome A is preferred to B by at least one member of the group (its utility is higher with A than with B), and no member of the group prefers B to A (i.e., for no member of the group is the utility of B less than the utility of A). On the other hand, a risk-dominant Nash equilibrium is an equilibrium which is less risky (e.g., Harsanyi and Selten, 1988, 82). A similar definition of the risk-dominant criterion in a 2x2 symmetric coordination game is as follows: a strategy is risk-dominant if it is a best response to a 50–50 randomization by the rival player.

and B) the sum of consumers surplus, profits, and workers' representative rents

$$W = CS + \sum_i \pi_i + \sum_i Z_i = (1/2)(\sum_i q_i)^2 + \sum_i \pi_i + \sum_i Z_i = \left(\sum_i q_i\right)\left[1 - \left(\sum_i q_i \Big/ 2\right)\right],\ i = 1,2\,. \quad (7)$$

Outcomes in Table 1 lead to the following expressions (the upper script *SEQ* denotes the case of sequential EB):

for A) $W_{\text{WB}} = \dfrac{16(1+\beta)^2}{9(3+\beta)^2}, W_{\text{EB}} = \dfrac{2(1+\beta)}{9}, W_{\text{EB}}^{SEQ} = \dfrac{10(1+\beta)^4}{(1+3\beta)^2(2+\beta)^2};$

for B) $W_{\text{WB}} = \dfrac{4(1+\beta)(7+\beta)}{9(3+\beta)^2}, W_{\text{EB}} = \dfrac{4}{9}, W_{\text{EB}}^{SEQ} = \dfrac{3+9\beta+4\beta^2}{2+7\beta+3\beta^2}.$

Direct comparison shows that universal EB ensures the highest social welfare, irrespective of its measure, and in particular, sequential EB leads to the highest welfare outcomes. The reason for this result is straightforward. Universal EB is associated with the highest workers' representatives' rents, the largest output, and thus the lowest market price. This in turn implies an increase in the consumers' surplus that more than compensates the lower profit levels of the duopoly firms. This effect is magnified in the case of sequential EB.

Therefore, if the guiding principle of the government (when its intervention could be required) is that of welfare rather than total returns to the bargaining parties, this implies that: 1) in AB1, the government's alignment should be toward the unions' (and consumers) interest; 2) in AB2 and in AB3, the government's alignment should be toward the endogenously, commonly agreed among the parties' EB agenda which, under the risk-dominance criterion, ensures a stable negotiation environment in a wide and rather realistically observed range of the firms' bargaining power.

## 3. Conclusion

This note has briefly analyzed the impact on social welfare outcomes of the selection of the bargaining agenda in a unionized duopoly. It has been discussed regarding the cases in which 1) firms, 2) unions, and 3) both parties choose their bargaining agenda independently and simultaneously in the first stage of the game. Then, irrespective of the first player in stage one, in stage two wages and employment are simultaneously negotiated in the firm(s) choosing EB; or wages are negotiated before production level decisions in the firm(s) selecting WB. This note considers three different specifications of the rules of the game in the case of asymmetric bargaining. In Asymmetric bargaining 1, one bargaining unit negotiates over wage and employment while the rival firm bargains over the wage with

its union, taking as given the solutions of the production stage for the wage and output of the rival and its own output. In Asymmetric bargaining 2, one bargaining unit negotiates over wage and employment, taking as given the rival's negotiated wage, while the other firm bargains over the wage with its union, considering its optimal response to the rival output choice in the production stage, taking as given the rival's wage and output level. In Asymmetric bargaining 3, one unit negotiates at different stages the wages (first) and employment (after) with the firm, while the WB rival unit, when negotiating the wage, must take into account the negotiated employment level of the rival.

The key point of the note is the following. The equilibrium bargaining agenda is sensitive to the specification of the rules of the game. If the game is specified by Asymmetric bargaining 1, the analysis shows that WB is the dominant strategy for firms, in explicit conflict of interest with the workers' representatives. When the game is specified by Asymmetric bargaining 2, different equilibria arise depending on the relative strength of the parties. Specifically, EB is the dominant strategy for firms for low values of the bargaining power parameter and, consequently, the industry equilibrium. Thus, firms face a classical prisoner's dilemma. For intermediate values of the bargaining power parameter, multiple symmetric equilibria emerge. Finally, WB is the dominant strategy for the firms for high values of the bargaining power parameter and hence the equilibrium bargaining agenda. On the other hand, EB is always the dominant strategy for unions. Therefore, a range of the bargaining power parameter exists so that an agreement on the EB agenda emerges in the parties' common interest. Qualitatively similar results appear in the case of Asymmetric bargaining 3, with the curiosum of having an anti-coordination game for unions when their bargaining power is (unrealistically) extremely high.

Regarding welfare, this note has considered three different measures the government might take under consideration when its intervention is (potentially) required to bring an end to situations of conflict of interest. If the government's guiding principle is the total returns to the bargaining parties, then the WB should be always recommended; however, this principle, while aligning the interest of the government with that of firms, tends to generate conflict of interest among the bargaining parties. On the other hand, if the guiding principle is that of social welfare (either measured as the sum of profits and consumers' surplus, or as the sum of the welfare of all agents including workers), then EB should be preferred. In this case, under AB1, the government aligns with the unions' preferences without eliminating the conflict among the bargaining parties, while under AB2 and AB3, the government supports the endogenous bargaining agenda commonly agreed upon by the parties. However, those considerations lead to the observation that the timing of the negotiations is crucial. The insight is that the aspect of the negotiation timing should be clearly and priorly regulated by labor market institutions.

This note is limited to the study of symmetric bargaining power and labor productivity across bargaining units. The use of linear functional forms represents another drawback. Moreover, an in-depth analysis of other criteria to assess the effects of the government's intervention in solving potential problems of conflict of interest is definitively called for, and the explicit introduction of the cost of having (potential) situations of conflict of interests in the evaluation of social welfare could be extremely useful. These extensions are left for future research.

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