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Abstract

In a vertically related duopoly with input price bargaining, this paper re-examines the downstream firms' profitability under different market competition degrees. Downstream firms earn highest profits with semi-collusion whose level depends on product differentiation and relative parties' bargaining power. Holding fixed the upstream suppliers' bargaining power, the more the products are differentiated, the higher the downstream firms' collusive level that maximize profits, regardless of the negotiations' structure. On the other hand, holding fixed the product differentiation degree: 1) with uncoordinated bargaining, the higher the upstream suppliers' bargaining power is, the lower the downstream firms' collusive level is; 2) with upstream firms' bargaining coordination, a U-shaped relation exists between the upstream firms' power and the downstream firms' collusive level that maximizes their profits.

Keywords: Decentralized/semi-coordinated bargaining; Right-to-Manage; Conjectural Variation model.

JEL Classification: D43, J51, L13

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1. Introduction

Firms' profitability in vertically related markets is a core topic in industrial economics and organization, and its relevance relies on the fact that (often) input suppliers (and among them, unions as labor suppliers) have relations based on negotiated price (wage) contracts with the producers of the final goods for consumers.

Economic theory has stressed that several features must be taken into account when input price (wage) negotiations take place. One of the most relevant is the level of coordination between the parties during the bargaining process: either decentralized (uncoordinated) bargaining at each single upstream-downstream related unit or semi/full coordination among the parties during the negotiation process. The present paper precisely studies this aspect of negotiations. In particular, the work investigates the impact of upstream decentralization/coordination in input price bargaining and the competitive level of the downstream sector on downstream firms' profitability. The rationale for the focus on those bargaining structures is as follows. If input suppliers are considered labor unions, upstream coordination represents the case of an industry-wide union, widely observed in the real world, that conducts negotiations separately in different companies. Despite the decentralization trend in (wage) negotiations that has taken place in the OECD countries, this bargaining configuration is still extremely relevant in the European Union. In particular, it represents a central labor market institution in continental Europe (see e.g. Buccella, 2018).

In this respect, the current paper relates to a wide strand of the economic literature on bargaining. Considering unions as the input suppliers, authors such as Davidson (1988), Horn and Wolinsky (1988), and Bárcena-Ruiz and Garzón (2002) have analyzed the outcomes of different wage bargaining structures in oligopolies. Davidson (1988) studies simultaneous negotiations in a duopoly with homogeneous final products. In an influential paper, Horn and Wolinsky (1988) broaden Davidson's (1988) analysis to include the strategic effects emerging from product differentiation in a model in which input suppliers (unions) and downstream firms form bilateral monopolies. Those authors investigate the autonomous/coordinated negotiation structures endogenously arising in equilibrium and show that those structures crucially depend on the product substitutability/complementarity. Likewise, Bárcena-Ruiz and Garzón (2002) build a model in which multiunit firms and unions as labor input suppliers endogenously select their wage-bargaining structures.

The contributions of Symeonidis (2008) and Mukherjee (2010) are also similar to the present work. Symeonidis (2008) constructs a model whereby the firm-specific labor unions (upstream input suppliers) negotiate wages (input prices) and shows that, in the case of uniform wage (input price) negotiations, the product market cooperation among downstream firms increases the consumer surplus and social welfare when goods are close substitutes and the unions (upstream suppliers) have significant relative bargaining power. On the other hand, if unions (upstream suppliers) have low bargaining power, social welfare is higher under Cournot competition in the downstream market. Conversely, in the case of two-part wage (tariff) negotiations, the profits and union (upstream) utility decrease as the intensity of the competition decreases, and the opposite holds for the consumer surplus and total welfare.

Mukherjee (2010) extensively analyses the impact of product market cooperation in a Cournot duopoly with homogeneous goods, in which the labor market is characterized by the presence of an industry-wide union that negotiates wages separately but simultaneously with the firms. The author shows that the union's disagreement point in negotiations has a key impact on firms' profitability. In fact, if the union has a sufficiently strong bargaining power and the outside option is the anticipated duopoly equilibrium output, an increase in the degree of product market cooperation leads firms to expand output and to adopt a lower negotiated wage; therefore, cooperation among firms (measured by the coefficient of cooperation; see

e.g. Martin, 2002) yields an increase in profits due to its direct effect of output expansion and its indirect effect through wage. On the other hand, if the union's outside option is the monopoly output, the effect of market cooperation on output, negotiated wages, and profits is more complex. In fact, the monopoly output as a disagreement point allows the union to catch a larger share of the oligopoly rents and therefore to create a positive link between product market cooperation and wage. It follows that increasing product market cooperation tends to increase profits via its direct effect, but it tends to shrink profits because of the indirect effect through higher wages. As a consequence, the profits are maximized for intermediate levels of product market cooperation.

The paper also relates to the literature that studies the impact of different competition modes (Cournot vs. Bertrand) on profits in vertically related (mainly, unionized labor) markets (Correa-López and Naylor, 2004; Correa- López, 2007; Fanti and Meccheri, 2012; Alipranti et al., 2014; Basak and Wang, 2016; Basak, 2017; Wang and Li, 2018; Buccella and Fanti, 2018). In a decentralized wage (price) bargaining model with a monopolist upstream input supplier and two downstream final goods producers, Correa-López and Naylor (2004) show that, if the union (input supplier) is adequately wage (input price) oriented, Bertrand profits can be higher than Cournot ones, which is in contrast to the standard Singh and Vives' (1984) finding.[1] Using a different framework, Alipranti et al. (2014) substantiate the result of Correa-López and Naylor (2004); in fact, those authors build a two-part tariff vertical pricing contract model in which the input suppliers and the downstream firms negotiate at the decentralized level a wholesale price and a fixed fee. By contrast, Correa-López (2007) shows that, in the case of input price-centralized negotiations, profits are not only higher under Cournot competition, but also the quantity contract is the downstream firms' dominant strategy when the final products are substitutes. Indeed, if the input price is the outcome of centralized negotiations, the reversal of the Cournot-Bertrand profits ranking is usually precluded because the key element of the inter-union (upstream firms) competition in decentralized negotiations disappears.[2] Nonetheless, Fanti and Meccheri (2012) show that, while the literature has generally assumed linear costs, the assumption of convex costs may lead to the reversal of the Cournot-Bertrand profits ranking also in the presence of centralized negotiations.

Recently, Basak and Wang (2016), Basak (2017), Wang and Li (2018), and Buccella and Fanti (2018) reconsider the Cournot-Bertrand profit ranking in a vertically related upstream market for input (labor). Basak and Wang (2016) re-examine the endogenous selection of price (Bertrand) and quantity (Cournot) contracts in the vertically related upstream input market. Basak and Wang (2016) show that, in the case of full centralized bargaining with two-part tariff pricing, the price contract arises as the dominant strategy for downstream firms. Contrary to the findings obtained in similar vertical pricing models with decentralized negotiations, Basak (2017) shows that, in a centralized, industry-wide wage bargaining (input pricing contract), the downstream firms earn higher (lower) profits under Cournot competition than under Bertrand competition if the products are substitutes (complements), confirming the results of Correa-López (2007) and Fanti and Meccheri (2012). On the other hand, Wang and Li (2018) study the effect of downstream competition/cooperation in the presence of

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[1] Later, introducing labor decreasing returns, Fanti and Meccheri (2011) show that the "Cournot-Bertrand reversal result" may also apply in the presence of "total wage bill-maximizing" unions; that is, even if unions attach equal weight to wages and employment, thus when the crucial assumption of an adequately wage (input price) orientation is relaxed.

[2] This is clearly noted by Fanti and Meccheri (2012, 895): "it is easy to infer the crucial role for obtaining the reversal result played by wage competition between firm-specific unions". In particular, they attribute the absence of the reversal under centralized bargaining to the "wage rigidity result" proposed by Dhillon and Petrakis (2002) who state that, in the presence of a central union (input supplier), the wage rate (input price) is the same under both Cournot and Bertrand competition.

decentralized bargaining between two downstream firms and an upstream monopolist over a two-part tariff input price. Wang and Li (2018) find that the upstream monopolist's profits (resp. the downstream firms) and the competition intensity in the downstream product market have a U-shaped (resp. inverted U-shaped) relation, independent of the competition modes; moreover, if the intensity of competition is sufficiently high (low), the downstream firms earn higher profits under Bertrand (Cournot) competition. Making use of a conjectural variation model, Buccella and Fanti (2018) re-examine the subject of the firms' profits ranking under different degrees of market competition in a unionized duopoly with industry-wide efficient bargaining. The authors show that, in the presence of separated wage negotiations, profits in Cournot-like competition are always larger than Bertrand-like ones; however, a uniform wage bargaining can lead to the appearance of profit-ranking reversal.

The present paper studies the effects of different upstream coordination levels in negotiations on downstream firms profitability, stressing the relevance of different levels of downstream market competition/cooperation, measured both by a conjectural variation model, particularly by the conjectural derivative (CD) parameter and the degree of differentiation among goods. The main reason for choosing the CD in this work, despite its theoretical shortcomings (lack of direct link to observable primitives like the share of cross participation, see e.g. Symeonidis, 2008, and Mukherjee, 2010; involvement of pseudo-dynamics on intrinsically static models, see e.g., Varian, 1992, p. 302, and Martin, 2002, p. 45), is the key virtue of this analytical tool, i.e. its adaptability in encompassing the study of different market structures. In essence, the CD covers the full range of market competition levels, from Bertrand competition to joint profit maximization, using a unique, simple parameter. The degree of product differentiation is also seen as another measure of the intensity of product market competition in industrial economics: the less the products are differentiated, the harsher the competition is among firms (Singh and Vives, 1984; Shy, 1995, pp. 138-140; Zanchettin, 2006; Fanti and Meccheri, 2014). Thus, the degree of product differentiation represents an additional element of analysis of the impact of market competition on the bargaining and, therefore, on firms' profitability.

The key results of the paper are as follows. It is shown that semi-collusion, but almost never full collusion, guarantees downstream firms the highest profitability. The precise level of semi-collusion changes as the degree of product differentiation and the relative parties' bargaining power vary. More precisely, the following relations hold. First, for a given level of the upstream suppliers' bargaining power, the more differentiated the products are, the higher the downstream firms' collusion level is to maximize their profits, regardless of the upstream suppliers' autonomous/coordinated bargaining structure. Second, while with decentralized input price (wage) bargaining, for a given degree of product differentiation, the higher the upstream suppliers' bargaining power is, the lower the collusion level is of the downstream firms' behavior to maximize profits, with bargaining coordination of the upstream input suppliers a U-shaped relation exists between the upstream firms' bargaining power and the downstream sector's competition level. In fact, downstream firms' profits are at their maximum with high collusive levels, either when the upstream firms' bargaining power is extremely low or extremely high, while profits are at their maximum for moderated levels of collusion when the upstream firms' bargaining power is intermediate. Therefore, the policy insight is that governments and antitrust authorities need a complete analysis of the related upstream sector(s) practices (or the labor market institution in place) before designing a policy intervention to regulate product market competition in an industry.

The rest of the paper is organized as follows. Section 2 presents the model and the results. Section 3 closes with an outline of the future research.

2. The model and the results

Let us consider a duopoly industry in which firms 1 and 2 operate. Each firm produces differentiated goods using only labor (or a single input), l, as a factor of production with a constant returns-to-scale technology. For simplicity, let us assume that each worker (unit of input) produces one unit of the goods, i.e. $l = q$ so that employment and production are equivalent. The linear (inverse) demand schedules for goods are

$$p_i = 1 - q_i - cq_j, \ i, j = 1,2 \quad i \neq j, \tag{1}$$

where q_i and q_j are the two firms' production levels, and $c \in [0,1]$ defines the degree of product differentiation. When $c = 0$, the goods are independent, and when $c \to 1$, the goods tend to be substitutes. To describe different degrees of market competition, the model assumes that firms decide their production levels according to a CD model (Dowrick 1989; De Fraja 1993, Buccella 2011, 2014, 2015). Defining $\lambda_i \in (-1,1)$ as $\lambda_i = dq_j(q_i)/dq_i$, it follows that, when $\lambda_i = 0$, the model collapses in the Cournot model; values of λ_i above zero indicate that firms adopt a more collusive behavior, whereas values of λ_i below zero denote that the industry is more competitive. As is common in the literature (see e.g. Martin, 2002, p. 46), it is assumed that all firms have identical, symmetric conjectures, so that $\lambda_i = \lambda_j = \lambda$. Consequently, the firm's profits are

$$\pi_i = [1 - q_i - cq_j(q_i) - w_i]q_i, \ i, j = 1,2 \quad i \neq j. \tag{2}$$

In the next section, the analysis considers the Right-to-Manage (RTM) framework. Under RTM, firms and unions (upstream suppliers) bargain over the wage level (input price) in the first stage. Then, once the wage has been negotiated, the firms choose the output levels in stage two (e.g. Nickell and Andrews, 1983). As usual, the model is solved by backward induction. Therefore, in the presence of RTM negotiations, in stage 2, from first-order conditions (FOCs) of (2), the equilibrium output in terms of input prices (wages) is

$$q_i = \frac{2(1 - w_i) - c[(1 - w_j - \lambda(1 - w_i)]}{4(1 + c\lambda) - (1 - \lambda^2)c^2} \quad i, j = 1,2 \quad i \neq j \tag{3}$$

Thus, downstream firms' profits can be expressed as

$$\pi_i = \frac{(1 + c\lambda)\{2(1 - w_i) - c[(1 - w_j - \lambda(1 - w_i)]\}}{4(1 + c\lambda) - (1 - \lambda^2)c^2} \quad i, j = 1,2 \quad i \neq j \tag{4}$$

2.1 RTM model, upstream decentralized bargaining

Let us first consider decentralized input price (wage) negotiations as in Correa-López and Naylor (2004) and Alipranti et al. (2014). Input price (wage) negotiations take place simultaneously and autonomously in the two bargaining units. Under decentralized negotiations, the upstream suppliers' profit function (union utility) takes the following form:

$$\Omega_i = (w_i - w_0)q_i , \ i, j = 1,2 . \tag{5}$$

As is common in the literature, it is assumed that the input suppliers have symmetric bargaining power across units. Moreover, it is assumed that the upstream suppliers (firm-specific union) are neutrally oriented in their preferences over input price (wages) and output (employment) (or, an alternative interpretation is that it is risk neutral). The positive utility of the upstream supplier (firm or union) derives from the fact that the input price (bargained wage) is above the marginal cost (or reservation wage), w_0, set, without loss of generality, equal to zero. The following generalized Nash Product models the bargaining solution

$$NP_i = (\Omega_i)^\alpha \left(\pi_i\right)^{(1-\alpha)} \quad i, j = 1, 2 \ , \tag{6}$$

where the parameter $\alpha \in (0,1)$ is the upstream suppliers' relative bargaining power. In the case of decentralized negotiations, it is reasonable to assume that, when negotiations break down, the disagreement point of both bargaining parties equals zero. Given the Nash product in (6), it can be derived that the negotiated input prices (wages) in equilibrium are

$$w_i^* = \frac{\alpha[2 - c(1-\lambda)]}{4 - c(\alpha - 2\lambda)}, \quad i, j = 1, 2 \tag{7}$$

with $\frac{\partial w_i^*}{\partial c} < 0$: with substitute goods, the duopoly rents tend to shrink, and the upstream supplier (union) captures a lower share of those rents. Substitution of (7) into (3) leads to the equilibrium output

$$q_i^* = \frac{(2-\alpha)(2+\lambda c)}{[4 - c(\alpha - 2\lambda)][2 + (1+\lambda)c]} \tag{8}$$

with $\frac{\partial q_i^*}{\partial \lambda} < 0$ and $\frac{\partial q_i^*}{\partial c} \gtrless 0$ if $\lambda \lessgtr \lambda^T(\alpha, c)$ in the relevant parameter space.[3] The rationale for the latter result is as follows. An increase in product differentiation shrinks output because firms can increase prices and, consequently, rents. However, if the market presents more the characteristic of Bertrand-like competition, firms can find beneficial output expansion in the presence of substitute goods to capture larger market shares in a wide range of upstream supplier bargaining strength (see Buccella, 2015). After substitutions of the equilibrium output and input prices in (7) and (8) into (6), the following expression for the downstream firms' profits is obtained

$$\pi_i = \frac{(1+c\lambda)(2-\alpha)^2(2+\lambda c)^2}{[4 - c(\alpha - 2\lambda)]^2[2 + (1+\lambda)c]^2} \quad i, j = 1, 2 \tag{9}$$

An analytical inspection reveals that, in the significant range of the parameters, the following comparative static applies $\frac{\partial \pi_i}{\partial c} < 0$: the market interactions tend to lower production levels if the goods are more differentiated, firms can charge higher prices, and therefore can earn larger profits.

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[3] The analytical expression of $\lambda^T(\alpha, c)$ is algebraically complex and not elegant. Therefore, for economy of space, it is not reported. The interested reader can obtain its expression upon request from the authors.

Table 1: values of λ^* such that profits are maximal under RTM with decentralized negotiations, for given degrees of product differentiation and union bargaining power

lambda max Profits		Alpha				
		0,05	0,25	0,5	0,75	0,95
C	0,25	0,969	0,845	0,69	0,534	0,409
	0,5	0,963	0,818	0,634	0,447	0,296
	0,9	0,956	0,78	0,551	0,31	0,1

Differentiation of (9) with respect to λ yields

$$\frac{\partial \pi_i}{\partial \lambda} = \frac{c^2(2+c\lambda)(2-\alpha)^2[(2\lambda^2+(\alpha-2)\lambda+3\alpha)\lambda c^2+(4\alpha(\lambda+1)+8\lambda(\lambda-1))c+4\alpha+8\lambda-8]}{[4-c(\alpha-2\lambda)]^3[2+(1+\lambda)c]^3} . \quad (10)$$

The expression in (10) has not an immediate interpretation; however, the numerical simulations in Table 1 show that, in the relevant range $\alpha \in (0,1)$ and $c \in [0,1]$, $\exists \lambda^*(\alpha,c) \left|\frac{\partial \pi_i}{\partial \lambda} \geq 0\right.$; that is, a degree of market competitiveness exists such that profits are maximized. An analytical inspection of Table 1 reveals the following result.[4]

Result 1. *In a duopoly with CV and decentralized input price (wage) bargaining under RTM: 1) for a given level of the upstream supplier (union) bargaining power, the higher the degree of substitutability, the less collusive the firms' behavior to maximize profits is; 2) for a given level of product differentiation, the higher the upstream firms bargaining power, the lower the downstream firms' collusive level is to maximize profits.*

The economic intuition behind Result 1 can be explained by exploiting the envelope theorem. Consider the first part 1) of Result 1. Holding constant the bargaining power of the upstream input supplier (union or manufacturer), $\alpha = \bar{\alpha}$, an analytical inspection and the results in Table 1 show that $\left.\frac{d\lambda(c)}{dc}\right|_{\alpha=\bar{\alpha}} < 0$. Based on the envelope theorem (see e.g. Varian, 1992, p.492) it is obtained that $\text{sign} \frac{d\lambda(c)}{dc} = \text{sign} \frac{\partial^2 \pi(\lambda(c),c)}{\partial \lambda \partial c}$; that is, the sign of the derivative with respect to the conjectural parameter depends on the second cross-partial derivatives of the profit function with respect to the two parameters measuring the degree of market competition, λ and c. Indeed, the analysis of the second cross-partial (mixed) derivatives of the profit function shows the substitutability/complementarity of the two parameters on firms' profitability. Given the negative sign of $\frac{d\lambda(c)}{dc}$, it follows that lower product differentiation has a substitute effect on (reduces) profitability with respect to the conjectural parameter. With a similar reasoning, consider now part 2) of Result 1. Keeping constant the degree of

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[4] Further analytical inspection of (10) reveals that, in the relevant parameter space, $\frac{\partial^2 \pi_i}{\partial \lambda^2} \leq 0$, and thus, the second-order conditions (SOCs) are satisfied.

product differentiation, $c = \bar{c}$, an analytical inspection and the results in Table 1 reveals that $\dfrac{d\lambda(\alpha)}{d\alpha}\bigg|_{c=\bar{c}} < 0$. Again, from the envelope theorem, one gets that $\text{sign } \dfrac{d\lambda(\alpha)}{d\alpha} = \text{sign } \dfrac{\partial^2 \pi(\lambda(\alpha),\alpha)}{\partial\lambda\partial\alpha}$, that is, the sign of the derivative with respect to the conjectural parameter depends on the second cross-partial derivatives of the profit function with respect to the conjectural parameters and the bargaining power, λ and α. Given that $\dfrac{d\lambda(\alpha)}{d\alpha} < 0$, the analysis of the second cross-partial derivatives of the profit function reveals that, when the upstream suppliers' bargaining power increases, it has a substitute effect on (reduces) downstream firms' profitability. In fact, the upstream suppliers charge high input prices (wages, in case of unions), thus increasing the downstream firms' total costs and reducing output. However, the downstream firms' collusion on output decreases when the upstream suppliers' bargaining power rises: a further output reduction does not sufficiently push upward the downstream firms' final prices and, therefore, the impact of the increase in total costs due to higher input prices overcomes the overall effect of output reduction on revenues. As a consequence, to increase their profitability, downstream firms behave in a (relatively) more competitive fashion.

2.2 RTM model, upstream coordinated bargaining

Let us now consider the case of the upstream suppliers' coordinated bargaining (i.e. a form of semi-centralized bargaining) as Mukherjee (2010) and Basak (2017) in a similar fashion do. This can be alternatively interpreted as a monopoly upstream firm (an industry-wide union) negotiating with downstream firms. The cases of separate input prices (wages) are analyzed. The coordinated upstream suppliers (industry-wide union) negotiate(s) simultaneously though disjointedly with each downstream firm the input price (wage) to catch the idea that the coordinated upstream suppliers (industry-wide union) can have an incentive to behave opportunistically during the bargaining process (see McAfee and Schwartz, 1994; Milliou and Petrakis, 2007). In other words, the coordinated upstream suppliers (industry-wide union) cannot commit to each downstream firm that it will not negotiate more favorable conditions to enhance the competitive position of the rival. Under separate negotiations, the (coordinated) upstream suppliers profit function (union utility) takes the following form:

$$\Omega = (w_i - w_0)q_i + (w_j - w_0)q_j, \ i, j = 1,2 \quad i \neq j. \tag{11}$$

and, as in the previous subsection, it is assumed that the coordinated upstream suppliers (union) are (is) neutrally oriented in the preferences over input prices (wages) and output (employment) (or, assumption of risk neutrality). The marginal cost (or reservation wage), w_0, is equal to zero as before.

The following generalized Nash Product now models the bargaining solution

$$NP_i = (\Omega - D_j)^\alpha (\pi_i)^{(1-\alpha)} \quad i, j = 1,2 \quad i \neq j, \tag{12}$$

where D_j is the coordinated upstream input suppliers' (industry-wide union's) outside option. On the other hand, each downstream firm's outside option is zero. As is known (e.g. Horn and Wolinsky 1988), the bargaining parties' outside option can be diversely specified. In contrast

to Basak (2017) and as in Mukherjee (2010), the paper considers that, in the case of a breakdown in the negotiations at the bargaining unit i, firm j can produce the anticipated duopoly equilibrium output, q_j^{*D}, at the equilibrium wage, w_j^{*D}, where $q_j^{*D} = \dfrac{2(1-w_j^{*D})-c[(1-w_i^{*D}-\lambda(1-w_j^{*D})]}{4(1+c\lambda)-(1-\lambda^2)c^2}$. That is, the disagreement utility is $D_j = w_j^* q_j^* = w_j q_j$. In the presence of separate input price (wage) negotiations, given (11), maximization w.r.t. w_i of the Nash Product in (12) with the above definition of D_j leads in equilibrium to

$$w_i^* = w_j^* = \frac{\alpha[2-c(1-\lambda)]}{2[2-c(\alpha-\lambda)]}, \qquad i,j = 1,2 \tag{13}$$

with $\dfrac{\partial w_i^*}{\partial c} < 0$: as the goods become more differentiated ($c \to 0$), the degree of competition among firms decreases; consequently, the duopoly rents increase and the union can catch a larger share of those rents. Substitution of (13) into (3) gives the equilibrium output,

$$q_i^* = \frac{2(2-\alpha)-c[\alpha-\lambda(2-\alpha)]}{2[2-c(\alpha-\lambda)][2+(1+\lambda)c]}. \tag{14}$$

with $\dfrac{\partial q_i^*}{\partial \lambda} < 0$. Further analytical inspection reveals that $\dfrac{\partial q_i^*}{\partial c} < 0$ for $\lambda \in (\approx -.265,1)$, while $\dfrac{\partial q_i^*}{\partial c} \overset{>}{\underset{<}{=}} 0$ for $\lambda \in (-1,-.265]$ if $c \overset{>}{\underset{<}{=}} c^{\mathrm{T}}(\alpha)$ in the relevant parameter space. The rationale for this finding is that, if the market is not characterized by a high degree of competitiveness, an increase in product differentiation shrinks output because firms can further raise prices and, consequently, rents. Nonetheless, if the market is characterized by more Bertrand-like competition, downstream firms can find beneficial output expansion in the presence of substitute goods to capture larger market shares in a wide range of the coordinated upstream suppliers (industry-wide union) bargaining strength (see Buccella, 2015). Further substitution of (13) and (14) into (4) gives the expression of the downstream firms' profits

$$\pi_i = \frac{(1+c\lambda)\{2(2-\alpha)-c[\alpha-\lambda(2-\alpha)]\}^2}{4[2-c(\alpha-\lambda)]^2[2+(1+\lambda)c]^2} \tag{15}$$

with $\dfrac{\partial \pi_i}{\partial c} < 0$, whose economic rationale is as in the previous subsection. Differentiation of (15) with respect to λ leads to

$$\frac{\partial \pi_i}{\partial \lambda} = \frac{\begin{aligned}\{&[(\lambda+1)^2\alpha^2 + (\lambda^3-5\lambda)\alpha - 2\lambda^3 + 2\lambda^2]c^2 + \\ &[4\alpha^2(1+\lambda)+(4\lambda^2-4\lambda-8)\alpha-8\lambda(\lambda-1)c] + \\ &4\alpha^2+(4\lambda-8)\alpha-8(\lambda-1)\}c^2\{[(\lambda+1)\alpha-2\lambda]c+2\alpha-4\}\end{aligned}}{4[2+(1+\lambda)c]^3[(\alpha-\lambda)c-2]^3}. \tag{16}$$

Table 2: values of λ^* under separated RTM such that profits are maximal, for given degrees of product differentiation and union bargaining power

lambda max profits		alpha				
		0,05	0,25	0,5	0,75	0,95
c	0,25	0,969	0,863	0,777	0,786	0,93
	0,5	0,964	0,835	0,719	0,714	0,9
	0,9	0,957	0,793	0,622	0,572	0,842

The expression in (16) is not of straightforward interpretation; however, the numerical simulations in Table 2 show that, in the relevant range of $\lambda \in (-1,1)$, for $\alpha \in (0,1)$ and $c \in (-1,1)$, $\exists \lambda^*(\alpha,c) \left| \dfrac{\partial \pi_i}{\partial \lambda} \geq 0 \right.$; in other words, there exists a degree of market competitiveness such that maximizes profits. From the analytical inspection of Table 2, the next result follows.[5]

Result 2. *In a duopoly with CV and coordinated upstream suppliers (industry-wide union) and separated wage bargaining under RTM: 1) for a given level of the upstream firms' bargaining power, the higher the degree of substitutability, the less collusive the firms' behavior is to maximize profits; 2) for a given level of product differentiation, a U-shaped relation exists between the upstream suppliers' bargaining power and the degree of competitiveness. The firms' profits are maximized by high collusive behaviors either when the upstream firms' bargaining power is low or high higher, while they are maximized for more moderated collusive behaviors if the upstream input supplier bargaining power is at intermediate levels.*

The economic intuition behind part 1) of Result 2 is precisely as in part 1) of Result 1. On the other hand, consider now part 2) of Result 2. Keeping constant the degree of product differentiation, $c = \bar{c}$, an analytical inspection and the results in Table 2 now shows that $\left. \dfrac{d\lambda(\alpha)}{d\alpha} \right|_{c=\bar{c}} \lessgtr 0$. Again, according to the envelope theorem, one finds that $\mathrm{sign}\, \dfrac{d\lambda(\alpha)}{d\alpha} = \mathrm{sign}\, \dfrac{\partial^2 \pi(\lambda(\alpha),\alpha)}{\partial\lambda\partial\alpha}$; that is, the sign of the derivative with respect to the conjectural parameter depends on the second cross-partial derivatives of the profit function with respect to the conjectural parameters and the bargaining power, λ and α. Given that $\dfrac{d\lambda(\alpha)}{d\alpha} \lessgtr 0$, the analysis of the second cross-partial derivatives of the profit function reveals that, when the upstream supplier's bargaining power is low, an increasing α has a substitute effect on (reduces) downstream firms' profitability. The upstream supplier charges high input prices (wages, in the case of a union), thus increasing the downstream firms' total costs and reducing output. On the other hand, when the upstream supplier's bargaining power is adequately high, the additional increase of the input prices further reduces output, which in turn pushes the downstream firms' final prices upward to a such a level that, combined with

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[5] Moreover, it can be verified that, in the parameter space of analysis, $\dfrac{\partial^2 \pi_i}{\partial \lambda^2} \leq 0$, and therefore, the SOCs are satisfied.

the firm's collusive behavior, has complementarity on downstream firms' profitability. The combined positive effects due to output restriction on downstream firms' revenues overcome the negative effects of higher wages on their total costs.

In summary, the above results show that the bargaining structure/coordination activities in the upstream industry (unionized labor market) have a deep impact on the competitive degree of the downstream industry, showing that downstream firms do not always have an interest in excessive collusive behaviors. Thus, when the government and the antitrust authorities want to design a policy intervention to shape the product market competitiveness, a close look at the related upstream sectors practices or the labor market institution in place is needed.[6]

3. Conclusion

Making use of a CD model in a vertically related duopoly market (alternatively interpreted as a unionized duopoly), this paper has investigated how coordination among the upstream input suppliers (unions) in the bargaining process affect the downstream market competition level and profitability. The paper has shown that collusive-like behaviors, but not full collusion, ensures downstream firms' highest profits, depending on the degree of product differentiation and the relative parties' bargaining power. In detail, for a given level of the upstream suppliers' bargaining power, the more differentiated the products are, the higher the level of collusion among downstream firms that maximizes profits, irrespective of the negotiations' structure. On the other hand, with decentralized, uncoordinated input price (wage) negotiations, for a given level of the product differentiation, the higher the upstream suppliers' bargaining power, the less collusive the firms' behavior is to maximize profits, and with upstream firms' bargaining coordination, there is a U-shaped relation between the upstream firms' bargaining power and the downstream sector's competition level. In fact, downstream firms' profits are maximized by a high level of collusion either when the upstream firms' bargaining power is low or high, while profits are maximized for moderated collusive behaviors if the upstream firms' bargaining power is at intermediate levels. As a consequence, when designing a policy intervention to regulate product market competition in an industry, government and antitrust authorities need a comprehensive analysis of the related upstream sectors practices (or the labor market institution in place).

The results of the model are based on several restrictions. In fact, the analysis is limited to precise analytical forms for the demand and cost functions. A further step would be to check the robustness of the current findings in an extended game framework in which network industries, different production technologies, managerial delegation, and capacity choices are considered.

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[6] The qualitative results of the model under upstream bargaining coordination have been tested under different specifications. First, the case in which the upstream suppliers coordinate negotiations and commit to a uniform input price rate has been investigated, confirming the assumption that the upstream input suppliers' outside option is the anticipated monopoly output. Under this specification, the standard result that downstream profits are maximal under full collusion is re-established. Second, the outcome of the upstream bargaining coordination with separated negotiations but with different outside options has been investigated. If the outside option is set as equal to zero, then the qualitative results of the model are confirmed. However, if the outside option for the upstream input suppliers is represented by the equilibrium monopoly output, then the standard result that full collusion guarantees the highest profitability for downstream firms is re-established. Analytical details are available upon request from the authors. To sum up, those extensions confirm that the outcome of input price negotiations is sensitive to the precise characteristics and elements of the bargaining process.

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