Bagaining structures in French dairy sector and impact of policy reforms*

YU Jianyu

GREMAQ - Toulouse School of Economics
Contact: jianyu.yu@toulouse.inra.fr

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Abstract

The recent CAP reform to reduce gradually the intervention price of some industry products induces changes in both the raw milk price schemes and the bargaining structures in the French dairy sector. In this article, we develop a bargaining model to investigate the reason of current and potential changes. We find that the relative strongness of the downstream processors has great influence on the bargaining outcomes and the equilibrium bargaining structures. The policy reform changes the relative strongness of downstream processors and therefore, induces the change in the equilibrium price schemes and bargaining structures.

Key words: Bargaining structure, CAP reform, French dairy sector
JEL classification: Q18, Q13, L10

1 Introduction

A recent EU Common Agriculture Policy (CAP) reform reduces gradually the "intervention price", which assigns a price floor to some dairy processed products. This policy reform induces great changes in the French dairy sector. It affects not only the level of raw milk prices, which are decided through the negotiation among associations of the French dairy farmers and processors, but also the raw milk price schemes, upon which the dairy associations agree. Moreover, this policy reform may shack the adherence of the dairy processors to the downstream dairy association and therefore, affects the structure of bargaining over the raw milk prices.

Thus the major objective of the present paper is to investigate the link of the policy reform and the raw milk prices so as to better understand the reason of the current and potential changes in milk price schemes and bargaining structures. In doing so, we develop a bargaining model that captures the main characteristics of the French dairy sectors.

The French dairy sector exhibits a vertical structure where dairy farmers provide raw milk to processors for the production of final products. In general, final products are distinguished between two groups: industrial products (IP), which are homogeneous products including butter, skim milk powder, casein etc. and products for final consumption (PFC), which are differentiated products, including cheese, liquid milk, etc. The whole production chain receives various protections, coming from the CAP. Here are some major characteristics of the French dairy sector.

1. At the upstream level, there are large number of dairy farmers in atomic competition. They often attach to an association (namely, National Federation of Dairy Producers (FNPL)), which negotiates the raw milk prices with downstream processors. The raw milk production is confined by a milk quota.

2. At the downstream level, processors of IP competes intensively. They make poor profits and they are often supported by intervention prices, which assign a price floor to some IP such as butter and SMP.

3. A few number of processors dominate the market of PFC. Processing more than a half of total raw milk collected[1], they often make large profits and possess large market power at both downstream and upstream levels. They receive less protections.

[1] About 70% of the total raw milk collected is processed into PFC. (CNIEL report)

4. Most of the downstream processors (including processors of PFC and IP) attach also to an association (namely, French dairy processors' association (ATLA)). Raw milk prices are decided through the negotiation between the associations of the dairy farmers and processors.[2]

Before the policy reform on the intervention price, both processors of IP and PFC accept equal raw milk prices. The CAP reform (proposed in 2003 Luxembourg Agreement) reduces gradually the intervention price for some industrial products such as butter and skim milk powder.[3] This reform may lead to some radical changes. First, the equal milk price scheme may become inappropriate. Shortly after the reform, the dairy associations reached an interprofessional agreement to allow different raw milk prices for processors of PFC and IP. [4] Second, the consolidation of the downstream union might shacked. The dairy processors may find it more profitable to leave the downstream association. This tendency emerges as the recent merged firms, Sodiaal and Entremont Alliance refused to comply the milk prices recommended by the dairy associations.[5] Therefore, three kinds of situations may arise with the policy reform: the dairy processors may stay in the downstream association, accepting either the equal milk price or the different price scheme, or they break away from the association and negotiate separately the raw milk price with the association of dairy farmers.

In order to analyze the impact of the policy reform, we should model the bargaining among the dairy groups in a vertical structure. Large amounts of literatures are devoted to the analysis of bargaining on intermediate prices in vertical structures. Garnier (2000) studies the negotiation between the vegetable producers and processors in a bilateral monopoly bargaining model. This model is, however, too simple to be applied to the oligopoly industry of French dairy sector. Dobson and Waterson (1997) investigate the effect of downstream competition in monopoly-oligopoly bargaining model. But they do not analyze the incentive of oligopoly firms to form a union. Horn and Wolinsky (1988a), (1988b) and Davidson (1988) analyze and compares the outcomes of bargaining with or without a union. Their results are derived under the assumption that the members of union are symmetric. Jun (1989) studies the union formation of workers and wage schemes when workers are distinguished by productiveness. Their analysis shadows lights on how the bargaining structure is determined when there is asymmetry within a bargaining group.

In the present paper, we follow the framework of Davidson (1988) and Horn and Wolinsky (1988) to develop a monopoly-oligopoly bargaining model, which captures the features of French dairy industry. Two important features do not exist in the models in previous literatures. First, there is a milk quota for raw milk supply. This creates conflict of the two downstream firms in striving for more raw milk. Second, we allow that the downstream

[2]The dairy associations adhere to a joint organization, namely CNIEL (National Interprofessional Center of the Dairy Economy). Each trimester, CNIEL provides a recommended national milk price scheme (as an outcome of negotiation among the dairy associations). Farmers and processors comply this price scheme when making production decisions.

[3]The intervention price for butter is reduced by 25% (-7% in 2004, 2005, 2006 and -4% in 2007) and for SMP, by 15% (in 5% steps over three years from 2004 to 2006). See Analysis of the 2003 CAP reform (2004)

[4]The CNIEL report recommends a discount in raw milk price for the processors of IP. However, this discount has been abolished recently (since the third trimester of 2007) with the rapid increase in demand of raw milk.

[5]See "Dairy firms merge, blame CAP" in www.dariyreporter.com

firms to carry different weights for the downstream union. This makes the downstream firms different bargaining positions in negotiating with the union of farmers.

We find that the relative strongness of the two downstream processors has great influence in the bargaining outcomes when the two processors form a downstream union. Especially when the union chooses to negotiate two different raw milk prices, the interest of the weaker processor is subject to be sacrificed. This induces the separation of the weaker processor and forces the downstream union to choose a "second-best" price scheme. Hence, the policy reform of reducing the intervention price of the industry product changes the relative strongness of downstream processors in the downstream association and therefore, induces the change in the equilibrium price schemes and bargaining structures.

The rest of the paper is organized as follows. Section 2 presents the bargaining model. Section 3 analyzes respectively the outcome of three bargaining situations. Section 4 compares the equilibrium profits of the three bargaining situations. Section 5 derives the equilibrium bargaining structures and the impact of the policy reform. The last section concludes the paper.

2 The model

2.1 The basic setting

Considering the vertical structure of the dairy industry, we assume that there is a representative farmer (firm 0), who provides raw milk to two representative downstream processors (firm 1 and firm 2). Taking into account the characteristics of the dairy sector, we formulate the following specific assumptions:

Assumption 1 *Firm 0 produces at most K unit of raw milk. The cost of production is simplified to be zero.*[6]

Assumption 2 *Firm 1 is a monopoly processor in the market of the PFC, of which the inverse demand is denoted by $P(x)$. The marginal revenue of firm 1 $Rm(x) = P(x) + xP^{'}(x)$ decreases with x, i.e. $Rm^{'}(x) < 0$ and $Rm(K) < 0$.*

Assumption 3 *Firm 2 produces a homogeneous good for the market of IP and is supported by an intervention price denoted by p*[7] *and $p < Rm(0)$.*

Assumption 4 *Both downstream firms operate a constant return to scale technology, using one unit of raw milk to process one unit of final product. The marginal cost of processing is also set to be 0. The downstream firms thus incur only the cost of purchasing raw milk.*

Assumption 5 *The K units of raw milk are shared between the downstream firms as follows: firm 1 demands raw milk according to the raw milk price negotiated for him; firm 2 takes the rest of raw milk to process the IP so long as he makes non negative profit.*

[6] A more general statement is to assume that there is a capacity constraint in the production of raw milk and that the cost function is $C(x) = cx$ if $x \leq K$ and $C(x) = +\infty$ if $x > K$, where c is simplified to be 0.

[7] We assume, in a context without entry, that there is intensive competition in the market of IP. (For instance, a number of identical processors of IP compete in a Bertrand game.) Thus the representative firm 2 prices at the level of the intervention price p.

Assumption 6 *The two downstream firms attach to a union* ex ante. *The union is represented by a manager, who attaches different weights to the two downstream firms. There is no transfer among firms. Firms shut down if they gain negative profits.*

The first three assumptions captures three stylized facts of the French dairy sector: the quota that restricted the raw milk production, the likely existence of imperfect competition in the PFC market due to production of differentiated products and a floor price in the market of IP. The fourth assumption is for convenience of computation. Therefore, the quantity of the final product is the same as the quantity of raw milk used in the production. Notice that the specification on $Rm(x)$ and p implies that firm 1 will not demand more than the level of raw milk quota ($Rm(K) > 0$) and the market of the IP is less profitable than that of PFC ($p < Rm(0)$). This helps us to calibrate the set of interior solutions, which vary with different parameters.

Assumption 5 specifies the rule of sharing raw milk between the two downstream firms. This assumption is drawn for two reasons: the first is that the processors of PFC, represented by firm 1, process twice as much raw milk as used by processors of IP and make great profits in the dairy production chain. Therefore it is reasonable to assume that the upstream firm prefers to supply raw milk to firm 1 first and thus firm 1 has a first-move advantage in demanding the raw milk compared to firm 2.[8] Given the raw milk price w_1, firm 1 maximize his profit, which leads to $Rm(x) = w_1$. This gives the raw milk demand function for firm 1: $x(w_1)$. Thus, the quantity of raw milk available for firm 2 is $K - x(w_1)$. The second reason is that the elasticity of demand in the market of IP is so high that all production of firm 2 can be absorbed by the market. Therefore, given the raw milk price w_2, so long as $p > w_2$, firm 2 will use all the rest of raw milk until the milk quota is saturated. Thus, the profits of all firms can be expressed as functions of w_1 and w_2 (where π_i denotes the profit of firm i, i=0,1,2):

$$\begin{aligned} \pi_0(w_1, w_2) &= \pi_{01}(w_1) + \pi_{02}(w_1, w_2) = w_1 x(w_1) + w_2[K - x(w_1)] && (1) \\ \pi_1(w_1) &= [P(x(w_1)) - w_1]x(w_1) && (2) \\ \pi_2(w_1, w_2) &= (p - w_2)[K - x(w_1)] && (3) \end{aligned}$$

Where $\pi_{01}(w_1) = w_1 x(w_1)$ and $\pi_{02}(w_1, w_2) = w_2(K - x(w_1))$ are the profits that firm 0 obtains by selling raw milk to firm 1 and firm 2, respectively.

Assumption 6 allows us to investigate asymmetric positions of the two downstream firms within a bargaining group. We use γ ($\gamma \in [0, \infty)$) to denote the relative political power of firm 1 with respect to firm 2 in the downstream union.[9] The total downstream profit can be represented by:

$$\pi_u = \gamma \pi_1 + \pi_2 \quad (4)$$

So the manager of the downstream union totally represents firm 1 when $\gamma = \infty$ and firm 2 when $\gamma = 0$. He treats equally the two downstream firms when $\gamma = 1$.

[8] This assumption becomes less relevant when firm 1 and firm 2 negotiate separately with the upstream firm. As we shall see in the next section, firm 1 always pays a higher raw milk price than firm 2 in the equilibrium. Therefore the upstream firm has incentive to supply first firm 1 the raw milk.

[9] A more general statement is to assume that the manager attaches some weight α to firm 1 and $1 - \alpha$ to firm 2 ($0 \leq \alpha \leq 0$). But this does not change the result as $\gamma = \frac{\alpha}{1-\alpha}$ is monotonically increasing with α.

2.2 The game

Taking into account the possible change in price schemes and bargaining structures, we model a game as follows: in the first stage, the preexisting manager decides whether to adopt a raw milk price equal to the two downstream firms (we denote by situation "E") or two different prices (situation "D"), then he bargains with firm 0 over the raw milk prices according to the price scheme he decides. In the second stage, the two downstream firms decide whether to accept the raw milk prices that the manager bargains for them or to deviate from the bargaining outcomes. If both firm 1 and firm 2 accept the raw milk prices, they stay in the downstream union and make production decisions according to the negotiated raw milk prices. Profits are realized afterwards. However, if one of the two downstream firms deviates from the bargaining outcomes, the downstream union is dismissed.[10] Then, in the third stage, firm 1 and firm 2 bargain separately and simultaneously with firm 0 over the raw milk prices (situation "S"). Production decisions are made according to the negotiated raw milk prices and profits are realized.

The game thus captures three possible bargaining situations that may occur in the French dairy industry.[11] We use e, d and s as superscripts to identify the bargaining outcomes (including the equilibrium raw milk prices and the equilibrium profits) in the three situations, respectively. Figure 1 illustrates how the game leads to the possible bargaining outcomes.

3 Preliminary results

Since the downstream firms make the production decisions, taking into account the influences of the negotiated raw milk prices on their profits, we analyze firstly the influences of the raw milk prices then the equilibrium in the subgames corresponding to the three bargaining situations.

3.1 Impact of the raw milk prices

When making production decisions, the downstream firms face either two different raw milk prices (in situation "D" or "S") or a uniform milk price (in situation "E"). The profits for firms are defined in conditions (1)-(3). Under the different milk price regime, the influence of the raw milk prices are derived as follows:

$$\frac{\partial \pi_1}{\partial w_1} = -x < 0 \qquad \frac{\partial \pi_2}{\partial w_1} = -(p - w_2)x' > 0 \tag{5}$$

$$\frac{\partial \pi_1}{\partial w_2} = \frac{\partial \pi_{01}}{\partial w_2} = 0 \qquad \frac{\partial \pi_2}{\partial w_2} = -\frac{\partial \pi_{02}}{\partial w_2} = -(K - x) \tag{6}$$

[10] Here, the manager is just an invented representative for the downstream union. His role is only to choose the price scheme and then negotiate according to the price scheme. We do not model the strategies that he might take as a player in the bargaining game to rescue the downstream union when anticipating the deviation of the downstream firms. Therefore, the downstream union gains nothing if either of his member deviates.

[11] The third stage of the game ignores other possible situations that may occur after the deviation of a group of processors. In stead of negotiating simultaneously, the downstream processors may negotiate sequentially with the upstream suppliers (see Horn and Wolinsky (1988 a)) or compete intensively in demanding raw milk from the dairy farmers (This is analyzed in conventional literatures of vertical relationships such as Inderst and Shaffer (07), Lommerud *et al.* (2005), etc.). In the present paper, we avoid modeling explicit bargaining process and complicate strategies of players and assume a simultaneous bargaining structure that is tractable for the Nash axiom approach.

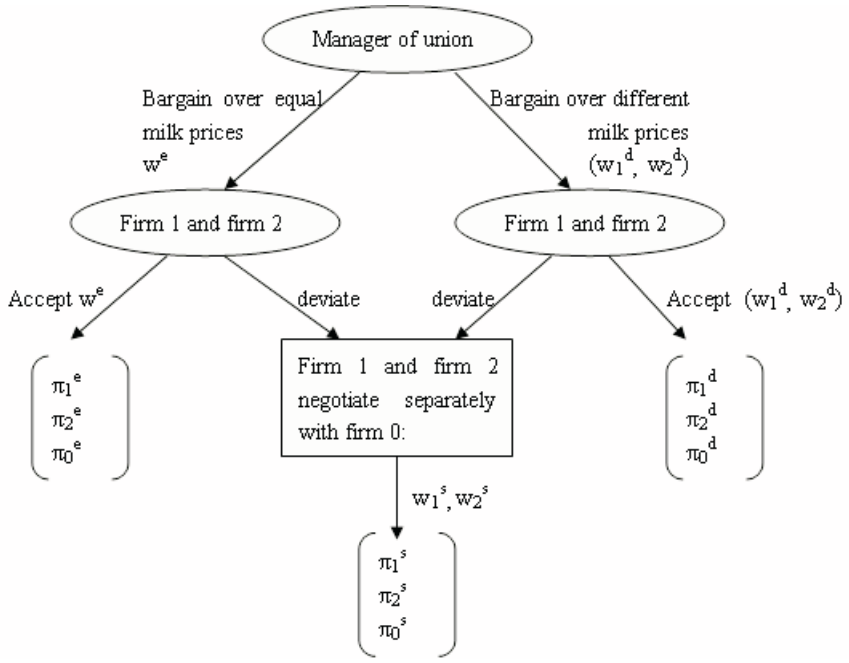

Figure 1: Possible bargaining situations

Obviously, the profits for the two downstream firms are decreasing with their respective raw milk prices. However, due to the asymmetry in the demand of raw milk of firm 1 and firm 2 (Assumption 5) and the difference of the two downstream markets (one with a monopoly and the other with intensive competition), the two raw milk prices influence asymmetrically the profits of the firms. w_1 is the only instrument to adjust the total size of the industry profit because it uniquely determines the partition of the raw milk quota between firm 1 and firm 2 (remember $x(w_1)$ quantity of raw milk is supplied to firm 1 and $K - x(w_1)$ to firm 2). An increase in w_1 discourages the use of raw milk of firm 1 and hence shifts some raw milk to firm 2. Therefore, it has unambiguously positive effect on the profit of firm 2. Thus w_1 influences inversely the profits of the two downstream firms. This implies that the downstream manager in situation "D" is confronted with strong conflict between the two downstream firms when negotiating w_1.

In contrast, w_2 has no effect on the profit of firm 1. Condition (6) shows that w_2 has the same scale but opposite effects on π_2 and π_{02}. Hence it serves only for sharing the rent that firm 2 and firm 0 generate from selling each unit of industrial product (IP).[12] In so far, the two different milk prices partially separates the goal of allocating the milk quota to maximize the size of the industry pie from the goal of sharing the pie (only for the part of pie created by firm 0 and firm 2).

Under the uniform price regime ($w_1 = w_2 = w$), the raw milk price serves at same time for adjusting the size of total industry pie and for sharing the pie among firm 0 and the two downstream firms. Again, w has negative effect on the profit of firm 1. However, its effect on the profit of firm 2 is indeterminate, since an increase in w shifts some raw milk

[12]It is also due to the fact that firm 2 and the farmer produce with constant marginal cost. Thus the total profit of the vertical chain is $p(K - x(w_1))$, which is independent of m_2.

to firm 2 (just like w_1 in the different price regime) but raises the unit cost of firm 2. It can be verified that the profit of firm 2 is a concave function of w. When w is small, an increase in w raises the profit of firm 2 but dampens that of firm 1. In so far, there is conflict between the two downstream firms when the manager negotiates w with firm 0. The conflict is nevertheless weaker than in the different price regime because w is the unit cost for both downstream firms. It disappears when w is large.

3.2 Equilibrium raw milk prices in three bargaining situations

Having known the impact of the raw milk prices on the profits, the upstream and downstream firms bargain over the raw milk prices. We follow the standard Nash bargaining framework (the axiomatic approach)[13] to derive the equilibrium raw milk prices and the equilibrium profits in each subgame that corresponds to each of the three bargaining situations.

3.2.1 Bargaining Separately

When bargaining separately over the raw milk price, a downstream firm gains nothing if he fails to settle an agreement with firm 0. However, firm 0 gains a monopoly profit by only dealing with one downstream firm, if he fails to settle with another. Here, we follow the framework of Davidson (1988) to assume that the disagreement payoff of firm 0, when dealing with firm i, is the profit that he obtains by selling the monopoly quantity of raw milk to firm j at the price that he settles with firm j (where $i, j = 1, 2$ and $i \neq j$).[14] Thus, the disagreement payoff of firm 0 is $d_1(w_2) = w_2$ when dealing with firm 1 and $d_2(w_1) = w_1 x(w_1)$ with firm 2. Assume that the upstream and downstream firms have equal bargaining power.[15] They maximize the respective joint profit, taking into account the effects of different raw milk prices (Conditions (5) and (6)). The bargaining problem is described as follows:

$$\max_{w_1} \pi_1(w_1)\big(\pi_0(w_1, w_2) - d_1(w_2)\big) \tag{7}$$

$$\max_{w_2} \pi_2(w_1, w_2)\big(\pi_0(w_1, w_2) - d_2(w_1)\big) \tag{8}$$

We denote by w_1^s and w_2^s the Nash bargaining solution to the problem. The first-order conditions give:

$$w_1^s = -\frac{P'x}{1 + P'x'} + w_2^s(p) \tag{9}$$

$$w_2^s = \frac{p}{2} \tag{10}$$

[13] The axiomatic approach has been widely used to analyze the bargaining solutions (see Horn and Wolinsky (1988b), Dowrick (89), Garnier(2000), etc.). Binmore *et al.* (1986) show that the Nash bargaining solution derived from the axiomatic approach coincides with the equilibrium solution of the alternative-offer game (see Rubinstein (1982)) when the players make immediate offer. Davidson (1988) shows also that the Nash bargaining solution can predict the outcomes of a non-cooperative game. The axiomatic approach allows us to derive the equilibrium outcomes without specifying the bargaining process and strategies of players that is complicate in the present context.

[14] As noted by Davidson, the disagreement payoff represents the monopoly payoff realized in a three-player non-cooperative game, when a particular subgame is reached. In this subgame, the strategies of the farmer and firm j are fixed since it is assumed that the farmer and firm j have settled the raw milk price to be w_j.

[15] In fact, the bargaining power between bargaining groups affects the equilibrium raw milk prices. The present model, however, focus on the asymmetric power of members within a bargaining group. We fix the parameter of bargaining power to be $\frac{1}{2}$ for convenience.

The first term in the RHS of condition (9) is positive, implying that firm 1 pays a higher raw milk price than firm 2. Otherwise, the upstream firm 0 would like to offer all raw milk to firm 2, who faces a perfect elastic market. w_2^s, defined in condition (10) is just a half of the unit rent that firm 0 created jointly with firm 2 since the two firms share equally the unit rent p. Note that both of the two downstream firms secure positive profits in the bargaining. This gives the two firms to separate from the downstream union when they gain poor profit in the union.

3.2.2 Bargaining on different prices in form of downstream union

In presence of a downstream union, the raw milk prices are negotiated between the manager and firm 0. If the negotiation fails, the manager of the downstream union gains nothing. The upstream firm gains an income stream, which we assume to be zero for convenience.[16] The manager and firm 0 have equal bargaining power. They jointly decide two different raw milk prices, taking into account the effect of these prices. The bargaining problem is as follows:

$$\max_{w_1,w_2} \pi_u(w_1,w_2)\pi_0(w_1,w_2) \qquad (11)$$
$$s.t. \quad \pi_i \geq 0 \quad i = 0,1,2$$

Where $\pi_u(w_1,w_2)$ and $\pi_0(w_1,w_2)$ are defined by condition (1) and (4), respectively. We look at the interior solutions where $1-x \neq 0$ and $\pi_0 \neq 0$. The first-order conditions lead to the following conditions:

$$(\gamma\frac{\partial\pi_1}{\partial w_1} + \frac{\partial\pi_2}{\partial w_1}) + \frac{\partial\pi_0}{\partial w_1} = 0 \qquad (12)$$
$$(\gamma\pi_1 - \pi_{01}) + (\pi_2 - \pi_{02}) = 0 \qquad (13)$$

Where γ is the relative political power of firm 1 with respect to firm 2 in the downstream union. As we have analyzed in section 3.1, w_1 serves for adjusting the size of the industry pie and w_2 serves for sharing the pie between firm 2 and firm 0. Condition (12) shows that the industry pie is adjusted in such a way that the weighted gain (or loss) in the profits of the downstream firms, induced by a marginal change of w_1 totally offsets the loss (or gain) in the profit of firm 0. Condition (13) implies that the industry pie is shared "evenly" between the bargaining groups, that is, if the manager wants firm 1 to gain more from the part of pie that firm 1 creates with firm 0 ($\gamma\pi_1 > \pi_{01}$), he has to increase w_2 to sacrifice the share of firm 2 in the part of pie that firm 2 creates with firm 0 ($\pi_2 < \pi_{02}$). In so far, which part of pie that the downstream union wants to share more (or sacrifice), depends on the relative strongness of firm 1 and firm 2 in the downstream union. This point is clear when we investigate the equilibrium raw milk prices.

Combining the two conditions with condition (5) and (6), we derive a unique set of equilibrium raw milk prices (w_1^d, w_2^d). The two equilibrium prices are functions of many parameters such as the intervention price p, the relative political power γ, the parameters

[16] In Binmore *et.at*(1986), the disagreement payoff is interpreted as a payment that a party receives from a "*status quo* agreement: no loss-no gain, as compared with the parties' positions in the course of the negotiations". Dowrick (1989) treats the disagreement payoff as exogenous parameters, which might be influenced by such factors as the party's financial resource, access to "solidarity funds" etc. In this model, we ignore the financial problems for the farmers and assume that the dairy farmers have no access to processors outside the downstream union. Thus, the *status quo* payoff for the union of dairy farmers is zero.

of demand and supply conditions, etc. In order to have a clear understanding on how the bargaining groups adjust the raw milk price, we isolate the effect of other parameters and focus only on the impact of reducing p on the bargaining outcome. Comparative statics shows that $\frac{dw_1^d}{dp} > 0$, whereas $w_2^d(p)$ is a convex function of p (see Figure 2). Thus, when p is large, the production of firm 2 is profitable. In so far, firm 2 in strong for the downstream union (for a given γ). Therefore, a large w_1^d is negotiated to shift raw milk to firm 2. To this extent, the interest of firm 1 is damaged for he has to bear a large cost and process little amount of raw milk. When p is small, a further reduction in p decreases w_1^d but increases w_2^d rapidly. This can be explained by the cooperative behavior of the manager and firm 0: as firm 2 is now much weaker than firm 1, the manager for the downstream union negotiates a small w_1^d so as to ensure a large quantity of raw milk for firm 1. To compensate the upstream firm 0, a high level of w_2^d is proposed. In this case, the interest of firm 2 is sacrificed so as to benefit firm 1. In a word, the interest of the weaker downstream firm could be badly dampened by the cooperative behavior of the manager and firm 0 under the bargaining situation "D".

Since the manager cares only about the joint profit of the two downstream firms, it is quite possible that the raw milk price for firm 2 w_2^d exceeds the level of intervention price p, when p is small. Figure 2 shows that when $p < \underline{p}^d$, $w_2^d > p$, where $\underline{p}^d$ is defined by $\{p|w_2^d = p\}$—a price that leads to zero profit of firm 2. in this case, the non-negative profit condition of firm 2 is violated and thus firm 2 has incentive to break away from the union.[17]

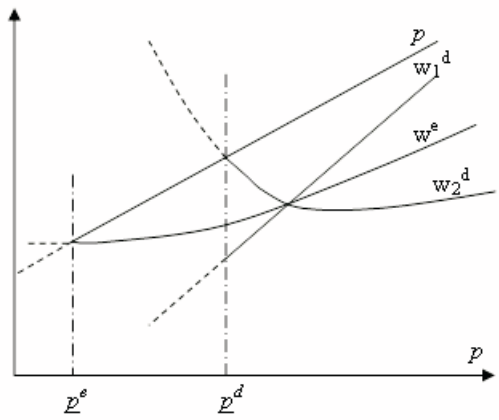

Figure 2: Impact of p on the equilibrium raw milk prices

3.2.3 Bargaining on equal milk price with the downstream union

If the manager of the downstream union chooses equal raw milk prices for the two downstream firms, he bargains with firm 0, taking into account the impact of the raw milk prices under the uniform price regime. The bargaining problem is similar to the case of bargaining on different prices. We only have to impose a condition $w_1 = w_2 = w$. Thus

[17]Note that we do not mention the possibility that firm 1 gains negative profit. This is because we assume that firm 1 is more profitable than firm 2 before any production takes place, i.e. $p < Rm(0)$. Therefore the bargaining outcome should give firm 1 positive profit so that he has incentive to produce.

we have:

$$\begin{aligned} \max_{w} \pi_u(w_1, w_2)\pi_0(w_1, w_2) \\ s.t. \quad w_1 = w_2 = w \\ \pi_i \geq 0 \quad i = 0, 1, 2 \end{aligned} \tag{14}$$

This problem has a unique Nash bargaining solution: w^e. Comparative statics leads to $\frac{dw^e}{dp} > 0$. Therefore, the policy reform of reducing p decreases the level of the uniform raw milk price. A priori, since the conflict between the two downstream firms is less intensive under the equal price scheme, the behavior that the manager sacrifices the weaker firm is less obvious in the bargaining situation "E" than the situation "D". As illustrated in Figure 2, w^e lies between w_1^d and w_2^d. When p is large, $w^e < w_1^d$, which implies a higher profit for firm 1 under the bargaining situation "E" than under the situation "D". When p is small, $w_1^d < w^e < w_2^d$. Firm 2 is also better off under situation "E". Therefore, the manager may choose the equal raw milk price scheme to prevent the weaker firm from being sacrificed under the different price regime. However, as w^e gets smaller, the conflict between the downstream firms appears. Again, the manager may sacrifice the interest of the weaker firm to favor the stronger one. This also leads to the nonsupport of firm 2 for the bargaining structure "E". As can be seen from, figure 2, when $p < \underline{p}^e$, $w^e > p$. Thus the non-negative profit condition of firm 2 violates. The stability of the downstream union will be analyzed in Section 4.

4 Union formation and the decision of the manager

4.1 Incentive of unionization

If the downstream firms form a union in equilibrium, they both gain at least the same profits as they can obtain in separate negotiation. Otherwise, either of them can deviate and negotiate separately with the upstream firm. Therefore, the profits of the two downstream firms in situation "S" (π_1^s and π_2^s) serve as outside options of the two downstream firms, which constrain the set of equilibrium raw milk prices in the situation "E" or "D".[18] Thus the two downstream firms have incentive to form a union if $\pi_1^j \geq \pi_1^s$ and $\pi_2^j \geq \pi_2^s$ where $j = e$ or d.

In order to derive a precise comparison of the equilibrium profits, we assume that the raw milk demand function of firm 1 is of linear form: $x(w_1) = a - bw_1$.[19] With this function, the existence of solution requires that $a \leq K$, $0 < p < \frac{a}{b}$ and $\gamma < 2$.[20] The equilibrium raw milk prices and profits in the three bargaining situations are derived in Appendix **??**.

[18] To abstract from the strategic behavior of the upstream firm, we assume that the outside option of firm 0 is zero. Binmore *et al.* (1986) distinguish the outside option from the disagreement payoff and interprets the outside option as "The best alternative that a payer can command if he withdraw unilaterally from the bargaining process". Muthee(1999) adds that the outside option is the payoff pair that a player obtains when he strategically opts out. It serves only as a constraint on the set of possible utility pairs. In our model, we assume that the upstream firm is unaware of what happens if he withdraw from negotiation with the downstream union (otherwise, he would always prefer to the separate bargaining structure, which gives him more bargaining power) and anticipates zero profit if he opts out.

[19] This function is derived by assuming that the inverse demand of firm 1 follows the form $P(x) = \frac{a}{b} - \frac{x}{2b}$. The profit-maximizing condition gives $P(x) + xP^{'} = Rm(x) = w_1$, which leads to the raw milk demand function.

[20] $a \leq K$ comes from the assumption $Rm(K) < 0$; $0 < p < \frac{a}{b}$ comes from $0 < p < Rm(0)$. Under the two assumptions, the solution in bargaining situation "D" exists only if $\gamma < 2$.

The equilibrium variables are functions of p, γ and other parameters of demand and supply conditions, such as K and a. Thus the comparison of the equilibrium profits varies with the range of these parameters.

4.1.1 Stability of structure "D"

We analyze first the incentive of the downstream firms to stay in the union when the manager chooses the different raw milk price scheme. If firm 1 is indifferent of accepting or rejecting the raw milk price proposed by the manager, we have $\pi_1^d = \pi_1^s$. This condition defines a relation among parameters. For convenience, we represents γ as functions of other parameters. Thus the equal profit condition be expressed by $\gamma = g_1^{ds}(\cdot)$. Analogously, we can also derive the relation $\gamma = g_2^{ds}(\cdot)$ that makes firm 2 indifferent of accepting and rejecting the different raw milk price scheme. Lemma 1 shows how the range of parameters influences the incentive of the downstream firms to stay in the union.

Lemma 1 *If the manager bargains over two different raw milk prices with firm 0, then for the range of parameters that makes the bargaining solution exists, the bargaining is accepted by firm 1 only if $\gamma > g_1^{ds}(\cdot)$ and by firm 2 only if $\gamma < g_2^{ds}(\cdot)$. $g_1^{ds}(\cdot) < g_2^{ds}(\cdot)$. Other things equal, both $g_1^{ds}(\cdot)$ and $g_2^{ds}(\cdot)$ increase with p.*

Therefore, under the different raw milk price regime, the downstream union is sustained only if $g_1^{ds}(\cdot) < \gamma < g_2^{ds}(\cdot)$. If $\gamma < g_1^{ds}(\cdot)$, the union breaks down due to the deviation of firm 1. If $\gamma > g_2^{ds}(\cdot)$, it is firm 2 who deviates. The intuition comes from the joint behavior of the manager and firm 0 to sacrifice the interest of the weaker downstream firm. For a given level of p, firm 1 is subject to be sacrificed when his relative weight in the downstream union is small. This leads to his retreat from the union. The same thing occurs for firm 2 when γ is large.

4.1.2 Stability of structure "E"

We now investigate the incentive of the downstream firms to stay in the union when the manager chooses the equal raw milk price scheme. Proceeding as before, we derive the set of parameters from the equal profit conditions that make the two downstream firms indifferent of accepting and rejecting the uniform price. Lemma 2 summarizes the result of comparison:

Lemma 2 *If the downstream union negotiates a raw milk price equal for the two downstream firms, then for the ranges of parameters that make the bargaining solution exists, we have:*

1. *firm 1 always accepts the equal raw milk price scheme;*
2. *If K is much larger than a, there exists a threshold $f_2^{es}(\cdot)$ such that firm 2 accepts (or rejects) the uniform price if $p >$ (or $<$)$f_2^{es}(\cdot)$, where $f_2^{es}(\cdot)$ is function of all the other parameters: γ, K, a and b.*[21]
3. *If the difference between K and a is not large, then $w_2^s < w^e$. Thus firm 2 always deviates from the uniform price scheme.*

[21]The function $p = f_2^{es}(\cdot)$ is not monotonic in γ. According to different values of K and a, it presents different shapes. Therefore the role of γ is indeterministic. What is sure is that if p is above the threshold (providing that it exists), firm 2 gains larger profit in situation "E" than "S".

Therefore, firm 1 always sticks to the downstream union when the manager negotiates a uniform price with firm 0. This can be explained by the conventional motive of unionizing to enhance the bargaining position. However, firm 2 accepts the outcome of the union only if both the potential quantity of raw milk for him is large (remember, firm 1 will not demand more than a quantity of raw milk, so the difference between K and a measures the minimum quantity of raw milk that firm 2 can access) and the intervention price is high. In this case, the conflict between the downstream firms is mild and firm 2 is strong enough to avoid being sacrificed.

4.2 The decision of the manager on price schemes

The choice of the manager depends on the comparison of the profits that the downstream union obtain in situation "D" and "E". If the manager is indifferent to the equal milk price scheme and the different price scheme, we have $\pi_u^d = \pi_u^e$. Again this condition defines a relationship of parameters which can be expressed by $\gamma = g^{de}(\cdot)$. Lemma 3 shows the comparison of profits:

Lemma 3 *The downstream union gains a higher profit in structure "D" if* $\gamma < g^{de}(\cdot)$. *Other things equal,* $g^{de}(\cdot) > g_2^{ds}(\cdot)$.

Therefore, if the structure "D" is chosen by both downstream firms, i.e. if $g_1^{ds}(\cdot) < \gamma < g_2^{ds}(\cdot)$, it is also chosen by the manager since $\gamma < g^{de}(\cdot)$. Intuitively, the total industry profit is higher in situation "D" than in situation "E", because bargaining over two raw milk prices is more efficient than bargaining on only one. Therefore, the manager benefits a larger profit from negotiating two different raw milk price. If γ is out of the range $(g_1^{ds}(\cdot), g_2^{ds}(\cdot))$, structure "D" can not be sustained by the two downstream firms. Thus the only choice of the manager is the equal milk price scheme. Yet, whether this price scheme survives in equilibrium depends on the choice of the two downstream firms, which is irrelative to $g^{de}(\cdot)$. The next section derives the equilibrium structures.

5 The equilibrium bargaining structures

In this section, we analyze how the equilibrium structure is decides by the value of parameters. First, we look at the case, where K is much larger than a. Fixing other parameters, we illustrate the equilibrium structures in the $\gamma - p$ space (see Figure 3). Thus the parameter space is divided into five regions. In region I, the manager thus negotiates two different raw milk prices and both downstream firms accept the outcome of negotiation. γ and p are counterbalanced. In region II and III, both downstream firms form a union and accept equal raw milk prices, while in region IV and V, they prefer to bargain separately.

The influence of γ and p on the equilibrium bargaining structures reflects the important role of relative strongness of the two downstream firms. Indeed, γ represents the relative influence of firm 1 in the downstream union and p measures the potential profit that firm 2 can contribute to the downstream union. Therefore, the relative strongness of firm 1 and firm 2 in the downstream union depends on the comparison of the two parameters. In region I, γ and p are counterbalanced. The two downstream firms with similar strongness thus stick to the union to enhance their bargaining positions vis-a-vis the upstream firm and accept the different price scheme which is more efficient than the uniform one. In region II, where γ small is compared to p, firm 1 is weaker and his interest is subject to be sacrificed under the different price scheme (see Lemma 1). Therefore, in spite of

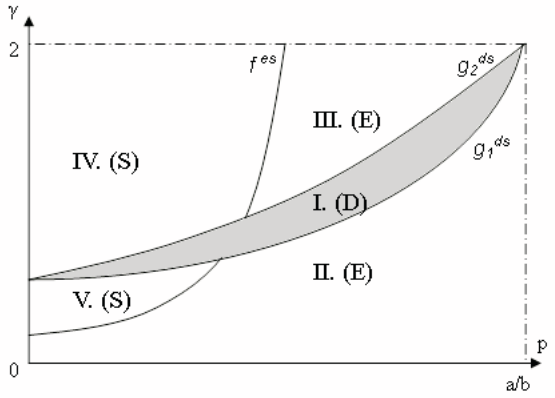

Figure 3: Equilibrium structures

a higher profit for the downstream union under the different price scheme, the manager has to chooses a "second-best" price scheme, i.e. structure "E", to prevent firm 1 from separating from the union. The similar argument is applied to region III, where both γ is large relative to p. Structure "E" appears in equilibrium to keep the relative weak firm 2 staying in the union. Note that the equal price scheme also creates conflict between the two downstream firms (see subsection 3.2.3). Especially when p is in a small level, the bargaining outcome of structure "E" benefits firm 1 at cost of the firm 2. Therefore, firm 2 deviates from the equal price scheme in region IV and V, where p is small. In region IV, where γ is large compared to p, the two downstream firms separate because of deviation of firm 2 in both situation "E" and "D", while in region V, where both γ and p is small, the union is not sustained because firm 2 deviates in structure "E", and firm 1 deviates in structure "D".

If K is not too large compared to a, firm 2 is ex ante unprofitable for the downstream union. The bargaining on equal milk price makes him to pay a higher raw milk price and process less raw milk than the outcome of bargaining separately. Therefore firm 2 rejects always the equal price scheme. Hence the structure "E" does not appear in equilibrium, i.e. region II and III disappear. The general result is summarized by Proposition 1:

Proposition 1 *The two downstream firms form a union and accept two different raw milk prices only if they have similar strongness in the downstream union, i,e. p counterbalances γ. Otherwise, they accept an equal raw milk price if both the potential supply of raw milk and the price support for firm 2 is large enough to make him highly profitable. If firm 2 is unprofitable, firm 1 separates from the union if γ is small and firm 2 deviates if γ is large.*

5.1 Policy implication

Now we investigate impact of the policy reform which reduces gradually the intervention price of the Industry Product (IP). Relating to the current change, we consider the case that the amount of potential raw milk for firm 2 is large and that firm 1 has relatively large political power in the downstream union ($\gamma \geq 1$). From figure 3, the bargaining structure changes from structure "E" to "D", and then to "E", and finally to "S". In so far, the current change in price scheme from "E" to "D" can be explained by the fact that

the downstream association switch to a more efficient price scheme as the policy reform weakens the strongness of firm 2 to be balanced with firm 1. However, further reduction in p makes firm 2 too weak to sustain the different price scheme, therefore, the equal milk price scheme might be reapplied to keep firm 2 staying in the union. This scheme fails to be accepted by firm 2 when p is reduced to be in a small level.

The result derived above also allows us to investigate the impact of potential supply and demand shocks in dairy sector. The potential shock in supply of raw milk comes from the policy reform of increasing the raw milk quota (K). In this model, the demand of raw milk of firm 1 is independent of the amount of raw milk quota. Thus the enlargement of the quota increases the potential quantity of raw milk that is available for firm 2. Providing that firm 2 is ex ante weaker than firm 1, the enlargement of quota makes firm 2 as strong as firm 1. Therefore, from proposition 1, the likelihood of forming the downstream union is larger when the raw milk supply increases. The potential shock in demand of processed goods stems from the increasing demand of products for final consumption (in our model, a increases). This increases the demand of raw milk of firm 1 and thus decreases the quantity of raw milk available for firm 2. Therefore, firm 2 gets weaker and it is more likely that he breaks away from the union.

6 Conclusion

The recent CAP reform to reduce gradually the intervention price of some industry product induces changes in both the raw milk price schemes and the structures of bargaining among the interprofessional associations in the French dairy sector. This paper investigates the reason of the current and potential changes in milk price schemes and bargaining structures by analyzing the impact of the policy reform on the equilibrium bargaining outcomes. In doing so, we develop a bargaining model that captures the main characteristics of the French dairy sectors.

Relating to the current changes, the model analyzes three possible bargaining situations, distinguished by price schemes applied by the downstream union and presence of the union. We find that because of the raw milk quota, the two representative processors compete in demanding raw milk. Therefore, there is conflict in the interest of the two processors when the union negotiates the raw milk price for them. Thus, the relative strongness of the two processors has great influence on the bargaining outcomes and thus the equilibrium bargaining structures.

A priori, the union's bargaining on different raw milk prices benefits both downstream processors since it is more efficient than the bargaining on just one price and it enhances the bargaining position of the two processors vis-a-vis the milk supplier. However, if the strongness of the two processors is unbalanced, the interest of the weaker processor is subject to be sacrificed. This induces the separation of the weaker processor and forces the downstream union to choose a "second-best" price scheme. Hence, the policy reform of reducing the intervention price of the industry product changes the relative strongness of downstream processors in the downstream association and therefore, induces the change in the equilibrium price schemes and bargaining structures.

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