# « Organic label, bargaining power, and profit sharing in the French fluid milk market »

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April 2014[‡]

## Abstract

The market for organic products increases continuously over time. Because consumers are willing to pay a premium for organic goods, firms may have an interest in developing organic production strategies and entering a profitable market segment. The objective of this paper is to assess the profitability of such a strategy and to determine how the value added created by the existence of an organic label is shared in a vertical chain among manufacturers and retailers. Using purchase data on the French fluid milk sector, we develop a structural econometric model of demand and supply that takes into account the relative bargaining power between manufacturers and retailers. Our results suggest that the organic label segment is more profitable as it permits the existence of higher margins. Moreover, an organic label allows manufacturers to achieve more bargaining power relative to retailers and hence to obtain a higher share of total margins. The econometric model is then used to assess the impact of an environmental policy in favor of the organic segment based on a mechanism of price support. Our results suggest that while a subsidy policy towards organic products benefits both manufacturers and retailers, a tax policy toward conventional products benefits manufacturers at the expense of retailers. Moreover, the environmental impact of the policy is mitigated and depends on the environmental issues at stake.

**Key words: fluid milk market, bargaining power, organic, environmental policy, manufacturers, retailers, structural econometrics**

# 1 Introduction

The market for organic products increases continuously over time. Organic food and drink sales have grown from 22.1 billion US dollars in 2002 to almost 63 billion US dollars in 2011, while the global economy has slowed down during the same period (Sahota, 2013). The demand for organics is concentrated in North America (the US mainly) as well as in many European countries (Germany and France, the United-Kingdom and Italy mainly) with 96 percent of organic food sold in those two regions. Organic sales account for 3 percent of total US food sales but the market share of organic products varies depending on the food category and is much larger for categories such as fruit and vegetables and dairy with, respectively, 37 percent and 16 percent of US organic food sales in 2008.[1] This trend can also be observed in the largest organic markets in Europe. The market share of organic food in Europe represented 1.9 percent of total food expenses in 2007 and reached almost 5 percent in Austria and 3.7 percent in Germany, Denmark, and Luxembourg. As in the US, fruit and vegetables is the most important category, with a share in total organic sales of between 15 percent and 36 percent, and dairy products are the second most important category, with shares between 16 percent and 24 percent (European-Commission, 2010).

The growth in organic markets is driven by a positive willingness to pay for those products (Griffith and Nesheim, 2008). Various consumers' motives explain this premium. Organic food is considered by consumers to be healthier, of higher quality, and less harmful to the environment compared to conventional food as it uses fewer pesticides and artificial fertilizers. Most studies actually find that health and taste are the primary concerns for organic food purchases (Hughner et al., 2007). Griffith and Nesheim (2008) show that product quality is the first concern of English consumers of organic products followed by health and environmental concerns. In addition to health and environmental motives, consumers' sociodemographics as well as social features are also key determinants of organic consumption.

Because consumers are willing to pay a premium for organics, firms may have an interest in developing organic production strategies and enter a profitable market segment. Such a strategy would be profitable

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[1]Source: USDA website (http://www.ers.usda.gov/topics/natural-resources-environment/organic-agriculture/organic-market-overview.aspx#.Uylt8oWE-8w)

only if they can get higher price margins and if these margins are large enough to compensate for the additional costs and investments involved in the organic production process. Total margins seem to be higher for organic compared to conventional products. For instance, an analysis conducted in a large retail chain in northeastern US (Bezawada and Pauwels, 2013) shows that margins are, on average, 25 percent higher for organic food products.

Who benefits, however, from the introduction of these new products and how the margin is split between manufacturers and retailers are issues that are more difficult to assess and remain open questions. On the one hand, retailers play a key role in organic markets. Even if organic products were traditionally sold by specialty shops, conventional retailers have contributed to the expansion of organic markets. First, they list organic products in their stores and account for a large share of the organic food market for many products such as eggs and milk. Second, they are now offering organic products under their own retail brands. They can exert market power from their oligopsonistic position and their buying power relative to manufacturers. This power can rely on alternative market opportunities through the development of their own brands (Inderst and Mazzarotto, 2008; Bergès-Sennou, 2006; Dobson et al., 2001). In this case, manufacturers may not benefit from the value added created in the organic chain. On the other hand, the ability of manufacturers to benefit from organic sales depends on their ability to exercise some market power with respect to retailers. If the supply of organic products is limited and retailers cannot rely on alternative procurement markets for their organic supply, manufacturers may be able to extract a larger share of the margin. For instance, Richards et al. (2011) show that organic growers do earn a larger share of the total margin than nonorganic growers.

In this paper, we want to analyze whether organic products can confer higher net total margins compared to conventional ones, how these margins are split between retailers and manufacturers, and how the organic attributes influence the relative bargaining powers of participants in the food chain. We apply our analysis to the French fluid milk market. This food sector is relevant for the analysis of the organic supply chain. First, milk and dairy products comprise one of the main organic food categories. Milk and dairy products represent 15 percent of the total French market for organic products, just behind

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fruit and vegetables, which represent 17 percent of organic market sales (Agence-Bio, 2011). The organic milk market share has increased steadily over the last ten years. It multiplied by a factor of five between 1998 and 2009. In 2009, it accounted for 8 percent of all fluid milk purchases. Second, organic fluid milk may benefit from a price premium as studies focusing on the fluid milk market show that consumers are willing to pay more for organic characteristics of milk (Kiesel and Villas-Boas, 2007; Dhar and Foltz, 2005). Third, 80 percent of fluid milk sales (in value) occur in conventional stores (Agence-Bio, 2011), which makes the use of a French representative consumer panel data set collected by KANTAR on household purchases at retailers' stores appropriate to investigate empirically how organic characteristics influence margin outcomes.

We develop a structural econometric model of the fluid milk vertical chain and estimate retail and wholesale margins for organic and conventional brands as well as the bargaining power of manufacturers and retailers. Contrary to previous structural econometric studies that consider that manufacturers (respectively retailers) have all the bargaining power (Bonnet and Dubois, 2010) and propose take it or leave it contracts to retailers (manufacturers) or act as Stackelberg leaders (Villas-Boas, 2007), we allow for non unilateral bargaining power and model the price negotiation between retailers and manufacturers using a recent methodology developed in Draganska et al. (2010). This methodology enables us to estimate the bargaining power for each pair of manufacturers and retailers and infer the resulting retail and wholesale margin share. Moreover, because organic food is expected to have a positive environmental impact, we assess the environmental impact of organic-friendly policies given the strategic behavior of manufacturers and retailers in the fluid milk sector.

We show that total margins are effectively higher for organic brands (58.6 percent) compared to conventional ones (49.3 percent). The organic products are then more profitable for the milk chain. We also find that organic milk products allow manufacturers to obtain more bargaining power with respect to retailers and hence get a higher share of the total margin on organic products. This result could be explained by the unbalanced procurement market for organic raw milk in favor of manufacturers due to a capacity constrained supply. Finally, results from our simulation show that a price support policy in

favor of organic products has a mitigated environmental impact. A subsidy on organic products slightly reduces the impact on eutrophication, acidification, and energy use but increases CO2 emissions, while a tax on conventional milk improves the climate change index but worsens the other types of environmental damage, including eutrophication.

The paper is organized as follows. We first describe the econometric structural model. We then present the data in section 3. In section 4, we discuss the results of the demand and supply models and we use our framework to simulate the impact of an organic-friendly price policy for both firms and retailers. Finally, section 5 gives the main conclusions of the paper.

# 2 Econometric model of the fluid milk market

We model the market for fluid milk using a structural model of demand as well as strategic behavior of retailers and manufacturers. The econometric methodology is as follows. We first estimate consumers' preferences in the fluid milk market. Consumers face a choice set composed of the offers of different milk products and each product is defined as the combination of a brand and a retailer. Using demand estimates and modeling retailers' competition, we recover retail margins. We are then able to estimate the relative bargaining power of firms with respect to retailers using exogenous cost variables of fluid milk products. From the estimation of retail margins and bargaining power parameters, we infer the wholesale margins and therefore the total margins for the fluid milk channel.

## 2.1 The demand model: a random coefficients logit model

We use a random coefficients logit model to estimate the demand and the related price elasticities. The indirect utility funtion $V_{ijt}$ for consumer $i$ buying product $j$ in period $t$ is given by:

$$V_{ijt} = \beta_{b(j)} + \beta_{r(j)} + \alpha_i p_{jt} + \rho_i l_j + \varepsilon_{ijt}$$

where $\beta_{b(j)}$ and $\beta_{r(j)}$ are, respectively, brand and retailer fixed effects that capture the (time invariant) unobserved brand and retailer characteristics, $p_{jt}$ is the price of product $j$ in period $t$, $\alpha_i$ is the marginal disutility of the price for consumer $i$, $l_j$ is a dummy related to an observed product characteristic (which

takes the value of 1 if product $j$ is an organic label product and 0 otherwise), $\rho_i$ captures consumer $i$'s taste for this organic label, and $\varepsilon_{ijt}$ is an unobserved error term.

We assume that $\alpha_i$ and $\rho_i$ vary across consumers. Indeed, consumers can have different price disutilities or different tastes for the organic characteristic. We assume that distributions of $\alpha_i$ and $\rho_i$ are independent and that the parameters have the following specification:

$$
\begin{pmatrix} \alpha_i \\ \rho_i \end{pmatrix} = \begin{pmatrix} \alpha \\ \rho \end{pmatrix} + \Sigma v_i
$$

where $v_i = (v_i^\alpha, v_i^\rho)'$ is a 2x1 vector that captures the unobserved consumers' characteristics. $\Sigma$ is a $2 \times 2$ diagonal matrix of parameters $(\sigma_\alpha, \sigma_\rho)$ that measures the unobserved heterogeneity of consumers. We assume a parametric distribution for $v_i$ denoted by $P_v(.)$ and $P_\nu$ is independently and normally distributed with means of $\alpha$, $\rho$, and standard deviations of $\sigma_\alpha$, $\sigma_\rho$.

We can then break down the indirect utility into a mean utility $\delta_{jt} = \beta_{b(j)} + \beta_{r(j)} + \alpha p_{jt} + \rho l_j + \xi_{jt}$ where $\xi_{jt}$ captures all unobserved product characteristics and a deviation from this mean utility $\mu_{ijt} = [p_{jt}, l_j] (\sigma_\alpha v_i^\alpha, \sigma_\rho v_i^\rho)'$. The indirect utility is given by $V_{ijt} = \delta_{jt} + \mu_{ijt} + \varepsilon_{ijt}$.

The consumer can decide not to choose one of the considered products. Thus, we introduce an outside option that permits substitution between the considered products and a substitute. The utility of the outside good is normalized to zero. The indirect utility of choosing the outside good is $V_{i0t} = \varepsilon_{i0t}$.

Assuming that $\varepsilon_{ijt}$ is independently and identically distributed like an extreme value type I distribution, we are able to write the market share of product $j$ at period $t$ in the following way (Nevo, 2001):

$$
s_{jt} = \int_{A_{jt}} \left( \frac{\exp(\delta_{jt} + \mu_{ijt})}{1 + \sum_{k=1}^{J_t} \exp(\delta_{kt} + \mu_{ikt})} \right) dP_\nu(\nu) \tag{1}
$$

where $A_{jt}$ is the set of consumers who have the highest utility for product $j$ in period $t$, a consumer being defined by the vector $(\nu_i, \varepsilon_{i0t}, ..., \varepsilon_{iJt})$.

The random coefficients logit model generates a flexible pattern of substitutions between products that is driven by the different consumer price disutilities $\alpha_i$. Thus, the own- and cross-price elasticities

of the market share $s_{jt}$ can be written as:

$$\frac{\partial s_{ijt}}{\partial p_{kt}}\frac{p_{kt}}{s_{ijt}} = \begin{cases} -\frac{p_{jt}}{s_{jt}}\int \alpha_i s_{ijt}(1-s_{ijt})\ \phi(v_i)dv_i & \text{if } j=k \\ \frac{p_{kt}}{s_{jt}}\int \alpha_i s_{ijt}s_{ikt}\ \phi(v_i)dv_i & \text{otherwise.} \end{cases} \tag{2}$$

## 2.2 Supply models: vertical relationships between processors and retailers

We consider the fluid milk vertical channel as a two-tier industry consisting of $n_f$ upstream firms and $n_r$ downstream retailers. Each upstream firm produces a set of goods $G^f$ and each downstream firm sells $R^r$ products. We consider the market is composed of J differentiated products where a product is a brand sold by a retailer. The marginal cost of producing a product $j$ is denoted by $\mu_j$ while the marginal cost at the retail level is denoted $c_j$. We denote as $p_j$ the retail price of the product $j$ and $w_j$ its wholesale price. Retailers' profit functions are given by:

$$\Pi^r(p) = \sum_{j \in R^r}(p_j - w_j - c_j)Ms_j(p) \tag{3}$$

where the subscript $t$ is omitted to simplify the notation and $M$ is the total market size.

The profit of the firm $f$ from all products sold to retailers is denoted by $\Pi^f$:

$$\Pi^f = \sum_{j \in G^f}(w_j - \mu_j)Ms_j(p). \tag{4}$$

As in Draganska et al. (2010), we first derive the retail margins. Retail margins result from the retailers' choice of final prices. We assume that retailers compete with each other in Bertrand-Nash fashion in the final fluid milk market and set prices for each product. We then turn to the wholesale price equilibrium, which results from the negotiation between firms and retailers. We assume that the negotiation on wholesale prices is modeled as a Nash bargaining game. We follow Draganska et al. (2010) and consider that each pair of firms and retailers secretly and simultaneously contracts over the wholesale price of the product $j$. Moreover, we assume that firms and retailers have rational expectations, such that the ultimate equilibrium outcome is anticipated by both parties.[2]

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[2]In in this case, the wholesale prices are determined independently of possible changes to retail prices. For a discussion on the wholesale price negotiation and retailer competition games and the justification of the related assumptions, one might refer to Draganska et al.(2010) and the literature mentioned therein.

**Retail Bertrand-Nash equilibrium condition:** each retailer $r$ maximizes its profit $\Pi^r(p)$. The subgame Nash equilibrium prices of products sold by the retailer $r$ can thus be derived from the first-order conditions of the retailer's maximization program:

$$s_k(p) + \sum_{j \in R^r} (p_j - w_j - c_j) \frac{\partial s_j(p)}{\partial p_k} = 0, \forall k \in R^r. \tag{5}$$

Using equation (5), the vector of margins $\gamma_j = p_j - w_j - c_j$ for retailer $r$ can be written in matrix notation:

$$\gamma_r = (I_r S_p I_r)^{-1} I_r s(p) \tag{6}$$

where $I_r$ is an ownership matrix $(J \times J)$ with element 1 if products $j$ and $k$ are sold by the retailer $r$ and 0 otherwise, $S_p$ is the matrix $(J \times J)$ of the market share derivatives with respect to retail prices with general element $\frac{\partial s_j(p)}{\partial p_k}$, and $s(p)$ is the vector of market shares.

**Wholesale price Nash bargaining solution:** As emphasized by Shaffer (2001), the main difficulty comes from the linkage across negotiations, which raises arduous questions: a key difficulty is identifying what each manufacturer knows about its rivals' contract terms. Indeed, when negotiating, each manufacturer must conjecture the set of terms its rivals have or have been offered. In equilibrium, this conjecture must be correct but out-of-equilibrium beliefs may be important in determining the bargaining outcome. In the cooperative bargaining approach, this problem is solved by assuming that any bargaining outcome must be bilaterally renegotiation-proof, i.e., no manufacturer-retailer pair can deviate from the bargaining outcome in a way that increases their joint profit, taking as given all other contracts. Following Marx and Shaffer (1999) and Shaffer (2001), we thus assume that bargaining between each retailer-manufacturer pair maximizes the two players' joint profit, taking as given all other negotiated contracts. Moreover, we assume that each player earns its disagreement payoff (i.e., what it would earn from the sales of its other products if no agreement on this product is reached) plus a share $\lambda_j \in [0, 1]$ (respectively $1 - \lambda_j$) of the incremental gain from trade going to the retailer (respectively to the manufacturer). We follow Draganska et al. (2010) and we assume that a manufacturer negotiates with a given retailer for each of its brands, and that each brand is negotiated separately with the manufacturer. We also assume that retail

prices are not observable when bargaining over the wholesale prices. Then, retail prices are considered as fixed when solving for the bargaining solution (cf. Draganska et al. (2010) for a detailed justification of this assumption).

The equilibrium wholesale price for product $j$ is derived from the bilateral bargaining problem between a firm and a retailer such that each firm and retailer pair maximizes the Nash product:

$$\left[\pi_j^r(w_j) - d_j^r\right]^{\lambda_j} \left[\pi_j^f(w_j) - d_j^f\right]^{(1-\lambda_j)} \tag{7}$$

where $\pi_j^f(w_j)$ and $\pi_j^r(w_j)$ are, respectively, the profits of the firm and the retailer for product $j$. They are given by:

$$\pi_j^f(w_j) = (p_j - w_j - c_j)\, Ms_j(p) = \gamma_j Ms_j(p) \tag{8}$$

$$\pi_j^r(w_j) = (w_j - \mu_j)\, Ms_j(p) = \Gamma_j Ms_j(p).$$

The payoffs the manufacturer and the retailer can realize outside of their negotiations are denoted, respectively, $d_j^f$ and $d_j^r$. The retailer could gain $d_j^r$ if it delists the supplier's product $j$ from its stores but contracts with other suppliers. Similarly, the firm could get profits $d_j^f$ from the sales of its other products as well as from the sales of products to other retailers if the negotiation fails. If the retail prices are fixed during the negotiation process, the disagreement payoffs $d_j^f$ and $d_j^r$ are given by:

$$d_j^r = \sum_{k \in R^r - \{j\}} \gamma_k M\Delta s_k^{-j}(p) \tag{9a}$$

$$d_j^f = \sum_{k \in G^f - \{j\}} \Gamma_k M\Delta s_k^{-j}(p)$$

where the term $M\Delta s_k^{-j}(p)$ is the change in market shares of product $k$ that occurs when the product $j$ is no longer sold on the market. Those quantities can be derived through the substitution patterns estimated in the demand model as follows:

$$\Delta s_k^{-j}(p) = \int \frac{\exp(\delta_{kt} + \mu_{ikt})}{1 + \sum_{l=1 \setminus \{j\}}^{J_t} \exp(\delta_{lt} + \mu_{ilt})} - \frac{\exp(\delta_{kt} + \mu_{ikt})}{1 + \sum_{l=1}^{J_t} \exp(\delta_{lt} + \mu_{ilt})} dP_\nu(\nu).$$

Solving the bargaining problem in equation (7) leads to the following first-order condition:

$$\lambda_j \left(\pi_j^f - d_j^f\right) \frac{\partial \pi_j^r(w_j)}{\partial w_j} + (1 - \lambda_j)\left(\pi_j^r - d_j^r\right) \frac{\partial \pi_j^f(w_j)}{\partial w_j} = 0. \tag{10}$$

Under the assumption that the matrix of prices for final commodities is treated as fixed when the wholesale prices are decided during the bargaining process, we have $\frac{\partial \pi_j^r(w_j)}{\partial w_j} = -Ms_j(p)$ and $\frac{\partial \pi_j^f(w_j)}{\partial w_j} = Ms_j(p)$ from equation (8). Equation (10) can thus be written $\pi_j^f - d_j^f = \frac{1-\lambda_j}{\lambda_j}(\pi_j^r - d_j^r)$. Using equations (8) and (9a) the following expression can be derived for the bargaining solution:

$$\Gamma_j Ms_j(p) - \sum_{k \in R^r - \{j\}} \Gamma_k M\Delta s_k^{-j}(p) = \frac{1-\lambda_j}{\lambda_j}\left[\gamma_j Ms_j(p) - \sum_{k \in G^f - \{j\}} \gamma_k M\Delta s_k^{-j}(p)\right]. \quad (11)$$

Using equation (11) for all products $j$, we obtain the matrix of firms' margins:

$$\Gamma = \sum_{f=1}^{n_f}\sum_{r=1}^{n_r}\frac{1-\lambda}{\lambda} * \left[(I_f SI_f)^{-1}(I_r SI_r)\gamma\right].^3 \quad (12)$$

The vector of retail margins of general element $\gamma = \sum_{r=1}^{n_r}(I_r S_p I_r)^{-1} I_r s(p)$ is derived from equation (6), $I_f$ is the $(J \times J)$ ownership matrix with element 1 if products $j$ and $k$ are sold by the firm $f$ and 0 otherwise, and $S$ is the $(J \times J)$ matrix with market shares as diagonal elements and changes in market shares otherwise:

$$S = \begin{bmatrix} s_1 & -\Delta s_2^{-1} & \cdots & -\Delta s_J^{-1} \\ -\Delta s_1^{-2} & s_2 & \cdots & -\Delta s_J^{-2} \\ \vdots & \vdots & \ddots & \vdots \\ -\Delta s_1^{-J} & -\Delta s_2^{-J} & \cdots & s_J \end{bmatrix}.$$

Equation (12) shows the relationship between the wholesale margin on the one hand and the retail margin on the other hand. This relationship first depends on the disagreement payoffs and thus on the market share changes that are determined by the substitution patterns estimated in the demand model. It also depends on the exogenous parameter $\lambda_j$, the relative power of the retailer relative to the firm when bargaining over the wholesale price. The higher $\lambda_j$, the lower the share of the joint profit the firm will get from the bargaining.

Adding equations (12) and (6) yields the total margin of the firm/retailer pair over product $j$:

$$p - c - \mu = \left[\sum_{f=1}^{n_f}\sum_{r=1}^{n_r}\frac{1-\lambda}{\lambda}(I_f SI_f)^{-1}(I_r SI_r) + I\right](I_r S_p I_r)^{-1} I_r s(p)$$

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[3] The $*$ means an element by element multiplication between the vectors $\frac{1-\lambda}{\lambda}$ and $\left[(I_f SI_f)^{-1}(I_r SI_r)\gamma\right]$.

where $I$ is the $(J \times J)$ identity matrix.

Because we do not directly observe firms' marginal production costs as well as retailers' marginal distribution costs, we are not able to determine analytically the bargaining power parameter $\lambda_j$. We rather conduct an estimation specifying the overall channel marginal cost $C_{jt}$ for each product $j$. We follow the following specification for the total marginal cost:

$$C_{jt} = \theta \omega_{jt} + \eta_{jt}$$

where $\omega$ is a vector of cost shifters and $\eta$ is a vector of error terms that accounts for unobserved shocks to marginal cost. The final equation to be estimated is thus given by:

$$p = \theta \omega + \left[ \frac{1-\lambda}{\lambda} \sum_{f=1}^{n_f} \sum_{r=1}^{n_r} (I_f SI_f)^{-1} (I_r SI_r) + I \right] (I_r S_p I_r)^{-1} I_r s(p) + \eta. \tag{13}$$

We are then able to get an estimate of $\lambda$ for each product. Hence, we can deduce manufacturers' margins from equation (12). Moreover, from the estimates of the cost shifters and the error term of equation (13), we get the estimated total marginal cost, which is the sum of the marginal cost of production and the marginal cost of distribution for each product $j$ at each period $t$.

# 3    Data on fluid milk purchases

We use the 2009 data from a French representative consumer panel data of 21,605 households collected by KANTAR. It is a home-scan data set providing detailed information on all the purchases of food products. Among other benefits, the data set provides characteristics of the good's purchases (brand, size, organic label product), the store in which it was purchased, the quantity purchased, and its price. The database is composed of 322,755 purchases of fluid milk products. According to our sample, the average household consumption of conventional fluid milk is 72 liters per person per year and 6 liters of organic fluid milk per person per year.

In France, two major food companies, Lactalis and Sodiaal, face competition from store brands in the fluid milk market. Retailer brands account for 52 percent of the market on average over the 13

periods[4] considered in 2009 while Lactalis and Sodiaal represent 28 percent of the fluid milk market.[5] The existence of a large market share for store brands makes possible the analysis of their role in the share of margins between retailers and manufacturers. We consider purchases that occur in all retailers' stores in 2009. Retailers are grocery store chains that differ by the size of their outlets as well as by the services they provide to consumers. Five main retailers operate in the French retail sector. Among them, three retailer chains are characterized by large outlets while the two other chains have intermediate sized outlets. In addition, we define two aggregates: an aggregate of discounters that typically have outlets of small to intermediate size and provide only basic services and an aggregate of the remaining retailers.

Retailers offer a set of brands to consumers including national brands (NBs) and private labels (PLs). For each brand, we distinguish between the conventional brand and the organic one. Retailers purchase the different brands by negotiating price contracts with each manufacturer. We consider the two main brands produced by Lactalis (Lactel and Bridel) as well as the main brand for Sodiaal (Candia). For store brands, retailers are also supposed to negotiate a contract with private firms for their fluid milk brand. Moreover, because we do not have any information on the identity of the manufacturer that provides the product sold under the label of the retailer in our dataset, we assume that each retailer deals with a different firm. This assumption is not restrictive as this modeling strategy allows us to test for the relative bargaining position of retailers with respect to manufacturers when negotiating their own brand. It is often assumed in the literature that retailers vertically integrate with the manufacturing firms for the production of their PLs and have all the bargaining power. Estimating the bargaining power for PLs will allow us to test if retailers do have all the bargaining power and if they have it for all their brands or if it depends on the organic feature of the brands.

Other firms' brands represent only a small market share. Purchases of these other firms' NBs are aggregated in an outside good that represents 20 percent of the market. This outside option also includes

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[4] We divided the 2009 year into thirteen periods of four weeks. We then computed the average price across products and those thirteen periods.

[5] Market shares are defined as follows. We first consider the total market for fluid milk. The market share of a given brand at a given retailer is defined as the ratio of the sum of the quantities of the brand purchased at the selected retailer during a given period and the sum of the quantities of all brands purchased at all of the retailers in the relevant market during the same period.

Table 1: **Descriptive statistics for prices and market hares**

|  | Prices (in euros per litre) Mean (standard deviation) | Market shares (Mean in %) |
|---|---|---|
| Outside good |  | 20.0 |
| Fluid milk | 1.07 (0.30) | 80.0 |
| Non-organic products | 0.87 (0.15) | 74.4 |
| Organic products | 1.35 (0.24) | 5.6 |
| National brands | 1.13 (0.32) | 27.8 |
| Private labels | 0.92 (0.20) | 52.2 |

soya milk. Consumers can thus substitute one of the NB or PL fluid milk brands with an alternative product. Taking into account the set of products carried by each retailer, we obtain 46 differentiated products (combination of a brand and a retailer) that compete on the market.

The average price over all products and all periods is 1.07 euros per liter (Table 1). Organic products represent less than 8 percent of the fluid milk purchases. Their market shares have, however, increased over time during the last ten years. The average price of organic products exceeds the average price of conventional brands (NBs and PLs) by 55 percent and this price difference is larger for NBs than for PLs. These numbers are in line with the observed price premium observed in the US with a premium of 60 percent for NBs and 75 percent for PLs in the late 1990s (Glaser and Thompson, 2000). More generally, Bezawada and Pauwels (2013) show that the price premium for organic food products sold in a US retail chain ranges from 5 percent to 182 percent, with higher premiums found for dairy, meat, and poultry. We can also note from our data that PLs are, on average, approximately 20 percent cheaper than NBs.

# 4 Results on demand, profit sharing, and environmental policies

In this section, we first present the results of the random coefficients logit model and thus the consumer substitution patterns in the French fluid milk market. Given the results on price elasticities, we are able to compute retail margins. Using exogenous cost variables, we then estimate the bargaining power of

retailers relative to manufacturers that allows us to compute manufacturer margins. Second, we discuss manufacturer, retail, and total margins as well as bargaining power estimates. Finally, using the framework developed in relation to consumers, firms, and retailers' behaviors, we implement environmental policies in favor of organic products. We describe the method used and then the results of three scenarios aiming at organic and/or conventional products.

## 4.1 Demand results

We estimated the demand model using individual data and the simulated maximum likelihood method as in Revelt and Train (1997).

This method relies on the assumption that all product characteristics $X_{jt} = (p_{jt}, l_j)$ are independant of the error term $\varepsilon_{ijt}$. However, assuming $\varepsilon_{ijt} = \xi_{jt} + e_{ijt}$ where $\xi_{jt}$ is a product-specific error term varying across periods and $e_{ijt}$ is an individual specific error term, the independence assumption cannot hold if unobserved factors included in $\xi_{jt}$ (and hence in $\varepsilon_{ijt}$) such as promotions, displays, and advertising are correlated with observed characteristics $X_{jt}$. For instance, we do not know the amount of advertising that firms expend each month for their brands. This effect is thus included in the error term because advertising might play a role in the choice of fluid milk by households. As advertising is an appreciable share of fluid milk production costs, it is obviously correlated with prices. To solve the problem that omitted product characteristics might be correlated with prices, we use a two-stage residual inclusion approach as in Petrin and Train (2010) and Terza et al. (2008). We then regress prices on instrumental variables, that is input prices, as well as exogenous variables of the demand equation:

$$p_{jt} = W_{jt}\gamma + \kappa_{b(j)} + \kappa_{r(j)} + \tau l_j + \eta_{jt}$$

where $W_{jt}$ is a vector of input price variables, $\gamma$ is the vector of associated parameters, $\eta_{jt}$ is an error term that captures the remaining unobserved variations in prices, and $\kappa_{b(j)}$, $\kappa_{r(j)}$ and $l_j$ are the exogenous variables from the demand equation. The estimated error term $\widehat{\eta}_{jt}$ of the price equation includes some omitted variables such as advertising variations, promotions, and shelf displays that are not captured by the other exogenous variables of the demand equation and by the cost shifters. Introducing this term in

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the mean utility of consumers $\delta_{jt}$ allows us to capture unobserved product characteristics varying across time. Prices are now uncorrelated with the new error term $\xi_{jt} + \varepsilon_{jht} - \pi\widehat{\eta}_{jt}$. We then write:

$$\delta_{jt} = \beta_{b(j)} + \beta_{r(j)} + \alpha p_{jt} + \rho l_j + \xi_{jt} + \pi\widehat{\eta}_{jt} \tag{14}$$

where $\pi$ is the estimated parameter associated with the estimated error term of the first stage.

In practice, we use the price indexes for the main inputs used in the production of fluid milk, that is, raw milk, energy, and packaging. Cost variables in equation (14) include the price indexes of cardboard, cow milk, and gazole as it is unlikely that input prices are correlated with unobserved determinants of demand for fluid milks.[6] The fluid milk industry only represents a very small share of the demand for those inputs, which justifies the absence of a correlation between input prices and unobserved determinants of the demand for fluid milks. These variables are interacted with the manufacturer dummies or PL/NB dummies because we expect that manufacturers obtain different prices from suppliers for raw materials and that some characteristics of the inputs (e.g., quality of cardboard) depend on the manufacturers. Estimation results of the price equation (14) are presented in Table 10 in the Appendix. We can see that the instruments are not weak since almost all of them are significant.

We estimated two models (Table 2). The first model (Model 1) is the demand model without controlling for the endogeneity problem of prices whereas the second model (Model 2) controls for it.[7] First, the coefficient of the error term is positive and significant. It means that the unobserved part explaining prices is positively correlated with the choice of the alternative and justifies the need to control for the endogeneity problem. Comparison of results from Models 1 and 2 reveals that the price coefficients would be underestimated (in absolute terms) without controlling for the endogeneity problem and the estimates of the parameters of the model are robust to the two-stage residual inclusion approach.

On average, the price has a significant and negative impact on utility. Consumers are more sensitive to the price variations of PLs compared to NBs. This is consistent with the idea that consumers might have more loyalty with respect to NBs than to PLs. Results suggest that households prefer organic

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[6] These indexes are provided by the French National Institute for Statistics and Economic Studies.

[7] Models were estimated using 100 draws for the parametric distribution that represents the unobserved consumer characteristics.

products to non-organic products, since the mean coefficient is positive. The mean value, however, is very low and the standard deviation is relatively higher, meaning that half of the households slightly value this characteristic while the others do not. Those results are consistent with previous studies on organic food consumption. For instance, the survey conducted by Hughner et al. (2007) shows that even though consumers have favorable attitudes toward organic food, there is a discrepancy between consumer attitudes and actual consumer purchase behavior and some consumers are not willing to pay as much as the market price premium for organic food (Millock and Hansen, 2002). In an experimental analysis conducted in Germany, van Doorn and Verhoef (2011) show that some consumers are unwilling to pay a price premium for organic products.

The brand fixed effects reveal that the PL products give the highest utility to the households with respect to the other products. This might be explained by the fact that consumers are more sensitive to the level of prices than to the brand they consume when purchasing fluid milk. One reason could be that fluid milk is a quite homogeneous product. The preferences for purchasing in one of the seven major retailers are quite heterogeneous. For the four main retailers, the average consumer values the retailer channel more than the hard discount stores (which is the reference for the retailer fixed effect).

From the demand equation estimation results reported in Table 2, own- and cross-price elasticities of demand among products can be computed. Average own-price elasticities by brands and retailers are given in Table 3. Results show that purchases of fluid milk are more sensitive to changes in own prices for organic milk compared to conventional milk. That result is in line with previous studies on fluid milk consumption in the literature (Glaser and Thompson (2000), Dhar and Foltz (2005), and Alviola and Capps (2010) for the US and Jonas and Roosen (2008) for Germany). Moreover, average own-price elasticities for NB and PL products suggest that PL purchases are more sensitive to own-price changes compared to NB products: -8.02 and -4.16 respectively. Own-price elasticities are more homogeneous across retailers since they vary on average between -5 for the hard discounter aggregate and -5.8 for the aggregate of other retailers.

Table 2: **Results of the random coefficients logit model**

| | Model 1 | | Model 2 | |
| --- | --- | --- | --- | --- |
| | Mean | Standard deviation | Mean | Standard deviation |
| Price ($p_{jt}$) | | 0.0001 (0.0000) | | 0.0004 (0.0000) |
| $\times$ PL | -8.7441 (0.0001) | | -9.1017 (0.0002) | |
| $\times$ NB | -3.1223 (0.0001) | | -3.7164 (0.0002) | |
| Organic label ($l_j$) | 0.0013 (0.0000) | 0.0000 (0.0000) | 0.0015 (0.0000) | 0.2148 (0.0001) |
| Brand fixed effects | | | | |
| B1 | 0.1471 (0.0000) | | 0.6835 (0.0002) | |
| B2 | -1.2851 (0.0001) | | -0.6184 (0.0002) | |
| B3 | 0.0358 (0.0000) | | 0.6429 (0.0002) | |
| PL | 5.5131 (0.0001) | | 5.7055 (0.0002) | |
| Retailers fixed effects | | | | |
| R1 | 0.3115 (0.0000) | | 0.2897 (0.0000) | |
| R2 | -0.3318 (0.0000) | | -0.3473 (0.0000) | |
| R3 | 0.2765 (0.0000) | | 0.2863(0.0000) | |
| R4 | 0.1037 (0.0000) | | 0.1217 (0.0000) | |
| R5 | 0.9707 (0.0000) | | 0.9697 (0.0000) | |
| R6 | -0.1806 (0.0000) | | -0.1140 (0.0000) | |
| R7 | - | | - | |
| Error term ($\widehat{\eta}_{jt}$) | | | 0.8407 (0.0003) | |
| Log likelihood | -920,309 | | -920,176 | |
| Number of observations | 322,755 | | 322,755 | |

Standard errors are in parentheses.

Cross-price elasticities patterns for conventional versus organic products (cf. Table 11 in the Appendix) show that conventional and organic milks are substitutes and that the price response is asymmetric as in Alviola and Capps (2010). We, however, find that organic milk purchases are less sensitive to a change in the conventional milk price than conventional milk purchases to a change in the price of organic milk. Actually, when the price of a conventional milk product increases by 1 percent, the demand for other conventional milk increases by 0.29 percent while it has only a marginal impact on the demand for organic milk (0.02 percent). On the contrary, an increase in the price of an organic milk product will have a significant impact on the purchases of conventional milk products (0.34 percent) and a limited effect on the demand for other organic milk products.

Table 12 in the Appendix presents price elasticities for national and store brands. We find that the demand for PLs always increases more than the demand for NBs when the price of a national or store brand product increases. Moreover, as for the organic/conventional product substitution patterns, substitution patterns between PL and NB products are asymmetric and PL purchases are more sensitive

Table 3: **Average own-price elasticities of the brands**

| Brands | Characteristic | Own-price elasticity | Retailers | Own-price elasticity |
|--------|----------------|----------------------|-----------|----------------------|
| NB1 | C | -3.18 (0.47) | R1 | -5.15 (2.14) |
| NB2 | O | -5.28 (0.27) | R2 | -5.37 (2.44) |
| NB3 | C | -3.77 (0.60) | R3 | -5.42 (2.42) |
| NB4 | C | -3.34 (0.41) | R4 | -5.45 (2.28) |
| NB5 | O | -5.90 (0.86) | R5 | -5.39 (2.47) |
| PL1 | C | -6.07 (0.75) | R6 | -5.87 (2.21) |
| PL2 | O | -10.16 (0.51) | R7 | -5.06 (2.88) |

C: Conventional, O: Organic; the numbers in brackets are standard deviations.

to changes in the price of NB products than vice versa.

## 4.2 Bargaining power and price-cost margins

Using demand estimates, we compute the retail margins using equation (6). We then estimate the parameters of equation (13) using retailers' margins in order to get the estimated bargaining power parameters of the Nash bargaining game and the total margins. Given the bargaining power estimates, we are then able to recover manufacturers' margins thanks to equation (12). The corresponding total marginal cost estimates are consistent with the observed costs. They are equal on average to 0.43 euros per liter for non organic fluid milk and 0.54 euros per liter for organic milk. The difference in the cost (0.11 euros per liter) is explained by the difference in the price of milk (0.115 euros per liter).[8] Other costs are similar (0.12 /0.13 euros per liter), which is consistent as they correspond to processing, packaging, and retailing costs.

As expected, the total margin is higher for NB products compared to PL products. As shown in Table 4, the highest total margin obtained for NB products is more than twice as high as the total margin for the PLs. The total margin is always lower for the conventional milk brands compared to the organic ones. When splitting these margins between retailers and manufacturers, however, results with respect to the brand and conventional/organic features differ for firms and retailers. Results suggest that

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[8]The average observed milk production prices over the period 2009-2011 are respectively equal to 0.301 euros/liter for conventional milk (France Agrimer, 2014) and 0.416 euros/liter for organic milk (France Agrimer, 2013). The gap between the organic and conventional average milk prices is thus equal to 0.115 euros per liter.

retailers' margins are higher for conventional fluid milk than for organic ones: 29 percent and 17 percent respectively on average.

We also find that retailers' margins vary across retailers and range between 10 percent and 48 percent. They are higher for NBs (28 percent) than for PLs (15 percent).[9] On the contrary, manufacturers' margins are higher for organic brands (42 percent compared to 21 percent for conventional brands), which suggests that manufacturers may benefit more from their organic brand compared to their conventional brands. While the margins at the manufacturing stage are quite low for conventional fluid milk sold under PLs, manufacturers seem to be able, on the contrary, to extract a greater margin from the sales of organic milk.

To get more insight into the impact of conventional/organic attributes of fluid milk on the relative bargaining power of manufacturers, we provide in Table 5 the bargaining power estimates, that is, the shares of the joint profit that are captured by retailers.[10] The estimated bargaining power of manufacturers is much higher for their organic products than for their conventional ones. Indeed, the bargaining power of retailers is lower for the NBs NB2 and NB5 as well as for PL2. Retailers thus have less bargaining power than manufacturers for organic brands whatever the retailer/manufacturer pair, including for store brands. While the supply of conventional milk is large enough to cover the market,[11] retailers have to secure their procurement of organic milk to satisfy the demand for their organic brand. They have to face an unbalanced procurement market for raw milk in favor of manufacturers due to a capacity constrained supply (the supply was limited while the demand was high at that period). This may allow the upstream sector to exercise more bargaining power in relation to organic brands with respect to retailers. One might ask why retailers should have an incentive to offer organic products on their shelves as they seem to be able to exert less bargaining power for organic milk and their margins are lower for these products. As emphazised by Bezawada and Pauwels (2013) and Aertsens et al. (2009), when offering organic products

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[9]Kusum and Ailawadi (2004) show that the retail margin in per unit value can be smaller for PLs compared to NBs because of their lower retail price.

[10]Cost estimates are given in Table 13 in the Appendix. The cost shifters used to estimate equation (13) are: the plastic price index, the raw milk price index interacted with a dummy for NB products, a dummy for PL products, a dummy for organic products, and the diesel price index. To be consistent with economic theory, as in Gasmi et al. (1992), we impose the positivity of parameters (except for the additional effect of the organic label). We use, therefore, a non-linear least-squares method to estimate them. All estimated parameters are significant.

[11]Retailers make use of auctions for their procurement of conventional milk.

Table 4: **Manufacturers and retailers' margins**

| Brands | Characteristic | Manufacturers' margins | Retailers' margins | Total margins |
|--------|----------------|------------------------|--------------------|---------------|
| NB1 | C | 20.33 (10.76) | 34.22 (5.75) | 54.56 (7.43) |
| NB2 | O | 45.26 (2.93) | 20.35 (1.51) | 65.61 (3.15) |
| NB3 | C | 31.20 (14.35) | 29.28 (5.68) | 60.49 (9.32) |
| NB4 | C | 25.35 (6.06) | 32.41 (4.31) | 57.76 (6.21) |
| NB5 | O | 51.50 (8.58) | 18.59 (2.94) | 70.09 (9.57) |
| PL1 | C | 7.93 (6.55) | 18.32 (2.84) | 26.26 (5.45) |
| PL2 | O | 31.94 (2.89) | 11.81 (1.18) | 43.76 (2.76) |

C: Conventional, O: Organic; the numbers in brackets are standard deviations.

on their shelves, retailers may not only increase their sales in the fluid milk product category but they can also increase their store profits by enhancing their long-term image through the supply of organic products and differentiate their stores from other retailers' channels. Retailers have an incentive to use organic production as a strategy for product differentiation so as to avoid losing some customers who want to purchase organic products but also to show that they rely on a social responsibility policy.

For conventional brands, results are more contrasted. As expected, retailers have a very high bargaining power for the PLs, even though this retailer advantage is not clear for some retailers.[12] For NB1 and, to a lesser extent, NB4, retailers seem to have more bargaining power while the opposite result seems to prevail for NB3. In addition, we can observe a large heterogeneity of the bargaining power parameters across brand-retailer pairs.

In order to shed light on the determinants of the bargaining power estimates, we regress the bargaining power parameters on manufacturers and retailers' characteristics. Table 6 presents the results for two models. The first one (Model A) allows for manufacturer fixed effects and retailer fixed effects and thus allows for an assessment of whether significant differences exist across firms, as well as for the organic label. We find some significant heterogeneity in bargaining power estimates across firms and across retailers. We see that three of the manufacturers of store brands have a significantly lower bargaining power than manufacturers of NBs (coefficients associated with the manufacturers M3, M4, and M6 are

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[12]This results from the fact that PL manufacturers have relatively low market power, in contrast to NBs. They sell their products at a price that is close to the marginal cost as they operate in a more competitive market with more homogeneous products compared to NBs. In addition, a retailer may have monopoly power in respect of its PL because competing retailers do not carry the same PL while they all sell the NBs (see Kusum and Ailawadi (2004) for a discussion about this result).

Table 5:  **Brand-retailer estimates of bargaining power**

|     | NB1  | NB2  | NB3  | NB4  | NB5  | PL1  | PL2  |
|-----|------|------|------|------|------|------|------|
| R1  | 0.74 | 0.30 | 0.42 | 0.56 | 0.30 | 0.82 | 0.29 |
| R2  | 0.52 | 0.28 | 0.98 | 0.50 | 0.22 | 0.98 | 0.23 |
| R3  | 0.66 | 0.29 | 0.42 | 0.51 | 0.26 | 0.57 | 0.23 |
| R4  | 0.50 | 0.31 | 0.39 | 0.60 | 0.22 | 0.64 | 0.24 |
| R5  | 0.57 | 0.32 | 0.45 | 0.64 | 0.28 | 0.58 | 0.23 |
| R6  | 0.44 | 0.27 | 0.34 | 0.42 | 0.21 | 0.42 | 0.22 |
| R7  | 0.98 |      |      | 0.57 |      | 0.99 | 0.30 |

significantly positive) while there is no significant impact for the other store brand manufacturers.

In the second model (Model B), we thus determine the effect of firms' characteristics rather than fixed effects on the level of bargaining power. The market share of manufacturers and retailers as well as the dummy for hard discounters do not have any significant impact on the bargaining power of brand-retailer pairs. Two brands, however, seem to be strong enough to influence the bargaining power of retailers. On the contrary, the market share of store brands explains positively the bargaining power estimates, as suggested in the literature (cf. Inderst and Mazzarotto (2008), Kadiyali et al. (2000) and Sudhir (2001)). This is also in line with the empirical results found by Meza and Sudhir (2010). The higher the store brand market share, the higher the bargaining power of the retailer. The proxy of the fluid milk shelf exerts a negative role on the bargaining power estimates. This result can be interpreted as follows. When the fluid milk shelf in a retailer store is limited, the retailer may have more bargaining power as the sale area devoted to NBs is reduced in favor of PLs. On the contrary, when this area is larger, retailers have to display more NBs in order to offer a wider variety to consumers, which increases the bargaining power of manufacturers.

## 4.3   Counterfactual experiments

In this section, we use the framework and the results presented above to analyze what the impact of an environmental tax/subvention would be for manufacturers and retailers. Organic farming systems are supported in many countries for their environmental benefits and the ecosystem services they provide.

Table 6: **Regression of the bargaining power on manufacturers and retailers' characteristics**

| | Model A | Model B | |
|---|---|---|---|
| Manufacturers | | Manufacturer size | -0.043 (0.228) |
| M1 | - | Retailer size | -0.538 (0.497) |
| M2 | -0.032*** (0.011) | Private label share | 1.587*** (0.739) |
| M3 | 0.108*** (0.027) | | |
| M4 | 0.125*** (0.027) | | |
| M5 | -0.011 (0.027) | | |
| M6 | 0.052* (0.027) | | |
| M7 | -0.027 (0.027) | | |
| M8 | 0.007 (0.027) | | |
| M9 | 0.021 (0.33) | | |
| Retailers | | Assortment depth | -0.009*** (0.002) |
| R1 | | Hard discounter | 0.029 (0.041) |
| R2 | 0.036* (0.020) | Brand | |
| R3 | -0.036* (0.020) | B1 | - |
| R4 | -0.058*** (0.020) | B2 | -0.122*** (0.018) |
| R5 | -0.013 (0.020) | B3 | -0.069*** (0.016) |
| R6 | -0.129*** (0.020) | PL | 0.004 (0.018) |
| R7 | 0.181*** (0.027) | | |
| Organic label | -0.326*** (0.010) | Organic label | -0.349*** (0.011) |
| Constant | 0.613*** (0.015) | Constant | 0.627*** (0.030) |
| R-squared | 0.72 | R-squared | 0.68 |

***significant at 5%; *significant at 10%, Standard errors are in parentheses.

Manufacturer size is the total market share of each manufacturer in each period, Retailer size is similarly defined,

and the assortment depth is a proxy of the fluid milk shelf using the mean surface of each retailer.

In particular, organic farming generates fewer residues of pesticides than conventional agriculture and contributes to reducing the contamination of water sources and wildlife extinction. Pesticide exposure may also be harmful to farm workers. In this context, an environmental tax/subvention can be used as a tool to adress environmental problems and provide incentives for manufacturers to promote sustainability.

More precisely, we simulate some policy experiments using the estimated marginal costs from the supply contract model and the estimated parameters from the demand model. We consider a possible excise subvention on organic products and/or a tax on conventional ones. We denote by $C_t = (C_{1t}, .., C_{jt}, .., C_{Jt})$ the vector of marginal costs for all products in period $t$. To model the impact of a subvention or a tax, we assume that the environmental policy does not affect the bargaining power of retailers on manufacturers and hence we assume that the parameters $\lambda$ have the same values as in Table 5. As wholesale prices depend on retail prices, demand estimates, and the bargaining power between firms and retailers as seen in equation (12), we then only have to determine the vector of equilibrium retail prices consistent with the vector of new marginal costs. We solve the following program:

$$\min_{\{p_{jt}^*\}_{j=1,..,J}} \|p_t^* - \Gamma_t(p_t^*) - \gamma_t(p_t^*) - (C_t + \pi)\| \tag{15}$$

where $\|.\|$ is the Euclidean norm in $\mathbb{R}^J$, $\gamma_t$ and $\Gamma_t$ correspond respectively to the retailer and manufacturer margins for the supply model, and $\pi$ is a fixed positive or negative shock on total marginal cost.

We simulate three scenarios: a subsidy on organic products only, a tax on conventional products only, and a mix of taxes/subsidies. The first scenario consists of decreasing the total marginal cost by 0.04 euros per liter for organic products. The second scenario implements an increase in the total marginal cost of 0.04 euros per liter for conventional products. The third scenario combines scenarios 1 and 2.[13]

Table 7 presents the impact of the three scenarios on prices and market shares. Given our simulations, it seems that when we implement a subsidy only or a tax only, the subsidy/tax is almost fully transmitted in the final price for consumers. When a subsidy on organic products and a tax on conventional products are implemented simultaneously, the tax is again fully transmitted while the subsidy on organic products

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[13] Given the specification of our demand model, note that the price policy will not change the total milk quantity purchased in our framework but rather reallocate the purchases between the differents brands including the outside good. In the case of fluid milk, considering that the total quantity purchased remains unchanged is justified as the fluid milk market is inelastic (the demand price elasticity is equal to -0.15 for fluid milk in France (Bouamra et al., 2008)).

Table 7: **Subvention/taxation effect on price transmission and market shares**

| Brands | Initial MS in % | Scenario 1 Subsidy on organic milk | | Scenario 2 Tax on conventional milk | | Scenario 3 Mix of tax and subsidy | |
|---|---|---|---|---|---|---|---|
| | | Pass-through | New MS in % | Pass-through | New MS in % | Pass-through | New MS in % |
| NB1 | 10.98 (0.95) | - | 10.87 (0.93) | 1.005 (0.025) | 11.96 (0.97) | 1.007 (0.029) | 11.81 (0.96) |
| NB2 | 1.24 (0.15) | 0.995 (0.003) | 1.43 (0.17) | - | 1.56 (0.18) | 0.950 (0.025) | 1.79 (0.20) |
| NB3 | 1.50 (0.13) | - | 1.48 (0.12) | 1.025 (0.018) | 1.63 (0.13) | 1.028 (0.019) | 1.61 (0.13) |
| NB4 | 8.77 (1.01) | - | 8.68 (0.99) | 1.002 (0.03) | 9.55 (1.06) | 1.003 (0.025) | 9.43 (1.04) |
| NB5 | 0.76 (0.22) | 0.996 (0.004) | 0.87 (0.25) | - | 0.96 (0.27) | 0.958 (0.026) | 1.10 (0.31) |
| PL1 | 60.39 (2.61) | - | 59.81 (2.67) | 0.982 (0.016) | 53.62 (2.72) | 0.983 (0.019) | 52.96 (2.78) |
| PL2 | 1.48 (0.35) | 0.998 (0.005) | 2.11 (0.49) | - | 1.95 (0.45) | 1.090 (0.064) | 2.76 (0.63) |

Standard errors are in parentheses.

is undertransmitted, which suggests that firms may strategically make use of the interactions between organic and conventional products. As expected, a subsidy on organic products increases the market share of organic brands and decreases the market shares of conventional ones, but the impact is quite small and this is true for both NBs and PLs. The tax on conventional milk generates a larger increase in the market share of organic products. This increase, however, does not generate a decrease in the market share of NBs. PLs are the ones that are affected by this policy with a decrease in the market share of their conventional brands of between 6 percent and 7 percent. Actually, the tax makes their own conventional label more expensive and because their margin on this product is low, they cannot reduce the price, which makes the NBs more attractive to consumers (the market share of NBs increases slightly). As a result, if we combine a subsidy on organic brands and a tax on conventional ones, we get the highest increase in the market share of organic products and the lowest market share for conventional retailers' brands. By limiting the decrease in the price of organic products, firms can increase the market share of conventional products more.

Given these substitution patterns induced by the taxation/subvention policy, we are able to compute the total impact of the policy scenarios on firms and retailers' profits (cf. Table 8). Both retailers and firms can increase their profits with the subsidy (scenario 1) but this is mainly to the benefit of manufacturers. With the taxation on conventional products, contrary to what we could expect, the total

Table 8: **Subvention/taxation effect on welfare**

| Variations in millions of euros | Scenario 1<br>Subsidy on organic milk | Scenario 2<br>Tax on organic milk | Scenario 3<br>Mix of tax and subsidy |
|---|---|---|---|
| Total chain profit | 7.41 | 6.12 | 15.42 |
|    Total chain profit for NBs | 3.57 | 26.86 | 30.92 |
|    Total chain profit for PLs | 3.84 | -20.74 | -15.50 |
| Manufacturer profit | 6.75 | 9.81 | 18.24 |
|    Manufacturer profit for NBs | 3.05 | 13.43 | 17.05 |
|    Manufacturer profit for PLs | 3.70 | -3.62 | 1.19 |
| Retailer profit | 0.66 | -3.69 | -2.82 |
|    Retailer profit for NBs | 0.52 | 13.43 | 13.86 |
|    Retailer profit for PLs | 0.14 | -17.12 | -16.68 |

profit of manufacturers increases because they are able to increase their market share for both their organic and conventional brands to the detriment of PLs. It transpires that retailers' profits decrease but the reduction in their profit is more than compensated by the increase in firms' profits. Finally, when we combine a tax and a subsidy policy, firms benefit from the subsidy on their organic brands and from a positive report from PL to NB products.

To evaluate the effective environmental impact of these scenarios, we evaluate the change in some environmental impact indexes. We use the study of van der Werf et al. (2009) that provides information on four environmental impact indexes for both conventional and organic milk in France. The climate change index measures the impact on carbon emissions ($CO_2$). Gas emissions negatively influence the quality of air and increase the greenhouse effect, which has a direct impact on the environment (weather changes and loss of ecosystems mainly). Gas emissions are slighly higher for organic than conventional milk (respectively 985 kg-eq / 1000 kg of milk for organic and 982 kg-eq / 1000 kg for conventional farming systems).[14]  On the contrary, the eutrophication index, which measures the impact on water quality, is lower for organic compared to conventional farms (5.0 versus 7.1 kg PO4-eq). Similarly, the acidification index, which measures the impact on air pollution, is lower for organic farms (7.9 versus 8.5 kg SO2-eq). Finally, organic farming requires slightly less energy than conventional farming (2.6 vs 2.8

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[14]Emissions are lower for organic production than for conventional farming systems when they are measured per unit of land. They are, however, higher when emissions are given per milk production unit. This is explained by the lower productivity  of organic systems compared to organic ones. CO2 emissions are higher because organic farming requires a larger share of long-term grasslands.

Table 9:  **Environmental impact of subvention/taxation scenarios**

|  | Unit | Scenario 1 | Scenario 2 | Scenario 3 |
|---|---|---|---|---|
| **Climate change** | $10^6$ kg $CO_2$ equivalents | +2,1 (0.13%) | -70.5 (-4.54%) | -85.5 (-5.05%) |
| **Eutrophication** | $10^6$ kg $NO_3^-$ equivalents | -0.9 (-0.81%) | +1.4 (+12.15%) | +1.6 (+14.18%) |
| **Acidification** | $10^6$ kg $SO_2$ equivalents | -0.7 (-0.50%) | +1.8 (+12.79%) | +2.1 (+15.50%) |
| **Energy use** | $10^6$ Gj | -0.2 (-0.50%) | +0.6 (+12.79%) | +0.7 (+15.50%) |

GJ).

Given these values, the simulated environmental impact of implementing a subsidy on organic products is small and mitigated (cf. Table 9). It slightly reduces the impact on eutrophication, acidification, and energy use but slightly increases the CO2 emissions. A tax on conventional milk provides larger effects because it affects larger quantities of milk products. Because the main impact of the tax is to reallocate the market shares among products, the global impact of a tax is positive for the climate change index but negative for the other forms of environmental damage, including eutrophication. When we combine the two instruments, it increases the benefits with respect to climate change but the impacts are worsened for the other environmental indexes.

# 5    Conclusion

In this paper, we assess how the value added created by the existence of an organic label in a vertical chain is shared among manufacturers and retailers in the French fluid milk market. First of all, our study contributes to the literature on the consumption of organic products. We show that French consumers slightly value the organic attribute of fluid milk products on average but only half of households (slightly) value this characteristic positively while the others do not. Moreover, cross-price elasticity estimates suggest an asymmetric pattern for organic and fluid milk purchasing such that organic milk purchases are less sensitive to a change in the conventional milk price than conventional milk to a change in the price of organic milk.

Second, we estimate the relative bargaining power of upstream firms with respect to retailers using exogenous cost variables of fluid milk products and next infer the total margins and how these margins

are split into a wholesale margin and a retail margin. Given the substitutability patterns between the different brands that have different characteristics (NB, PL, conventional milk, organic milk), we show that an organic label leads to higher total margins and provides a higher level of bargaining power to manufacturers. It transpires that firms' margins (respectively retailers' margins) are higher (lower) for organic products compared to conventional milk. Moreover, we show that retailers' margins on PLs are lower for organic milk and that their relative bargaining power is low even if they sell the products using their own label. Furthermore, the bargaining power is more in favor of retailers for conventional products but there exists a large heterogeneity depending on the retailer and the product pair.

Based on the estimated margins for retailers and manufacturers, we infer the impact of an environmental policy on this market. Interestingly, we show that a subsidy policy benefits both manufacturers and retailers while a tax policy benefits manufacturers at the expense of retailers.

This study thus yields insights into the ability of firms to countervail the buying power of retailers through the use of organic labeling. It is based on a structural econometric model. This model assumes a Nash bargaining between retailers and manufacturers to take explicitly into account the relative bargaining power of each actor. It also assumes a linear contract between each of the retailer and manufacturer pairs with unobservability of retail prices at the time of the negotiation. These assumptions, even if they may appear restrictive, allow for the estimation of bargaining power. In future works, we first want to specify an econometric model that relaxes some of these asumptions. More particularly, we want to determine how results are changed when retail prices can be observed by firms. Second, we also want to consider how results are affected when the manufacturer/retailer pair has the possibility of negotiation on the bundle of brands produced by the retailer compared to a separate negotiation product by product. When negotiating on a bundle, the manufacturer may increase its bargaining power not only in relation to the organic brand but also in relation to its non organic brands.

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# 6  Appendix

## 6.1  Results on price equation

## 6.2  Results on price elasticities

## 6.3  Results on equation (13)[15]

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[15]Résults for $\lambda$ are presented in Table 5 and they are all significant.

Table 10: **Results on price equation**

|  | Coefficient (standard error) |
|---|---|
| Cow milk | -0.002*** (0.001) |
| Cow milk×PL | 0.001 (0.001) |
| Cow milk×OL | 0.002 (0.002) |
| Diesel | -0.005*** (0.001) |
| Diesel×PL | 0.005*** (0.002) |
| Cardboard | 0.023*** (0.010) |
| Cardboard×Manuf2 | -0.022* (0.012) |
| Cardboard×PL | -0.0261 (0.016) |
| Brand fixed Effects | 12.88*** (0.000) |
| Retailer fixed Effects | 17.87*** (0.000) |
| Organic label | 0.437*** (0.108) |
| F-test of IVs | 2.35*** (0.017) |
| R-squared | 0.988 |
| Number of observations | 590 |

*** significant at 5%; * significant at 10%

Table 11: **Own and cross-price elasticities for conventional and organic products**

|  | Own-price elasticities | Aggregated cross-price elasticities | |
|---|---|---|---|
|  |  | Conventional | Organic |
| Conventional | -4.06 | 0.29 | 0.02 |
| Organic | -7.24 | 0.34 | 0.02 |

Own-price elasticities for conventional and organic milk are computed as the average over products

and time periods of own-price elasticities of conventional or organic products respectively.

Aggregated cross-price elasticities are computed as the global change

either for other conventional milks (the third column) or other organic milk (the fourth column)

when the price of a conventional product (the third row) or the price of an organic product (the fourth row) varies.

Table 12: **Own and cross-price elasticities for national brand and store brand products**

|  | Own-price elasticities | Aggregated cross-price elasticities | |
|---|---|---|---|
|  |  | National brands | Private labels |
| National brands | -4.16 | 0.04 | 0.27 |
| Private labels | -8.02 | 0.12 | 0.63 |

Own-price elasticities for conventional and organic milk are computed as the average over products

and time periods of own-price elasticities of conventional or organic products respectively.

Aggregated cross-price elasticities are computed as the global change

either for other conventional milks (the third column) or other organic milk (the fourth column)

when the price of a conventional product (the third row) or the price of an organic product (the fourth row) varies.

Table 13: **Results on the final equation (13)**

|  | Coefficient (standard error) |
|---|---|
| Plastic price | 0.001*** (0.000) |
| Cow milk×NB | 0.002*** (0.000) |
| Cow milk×PL | 0.003*** (0.000) |
| Cow milk×OL | 0.001*** (0.000) |
| Diesel | 0.001*** (0.000) |
| Wage | 0.001*** (0.000) |
| Parameters $\frac{1-\lambda}{\lambda}$ not shown | |
| R-squared | 0.890 |
| Number of observations | 590 |
| *** significant at 5%; | |