Vertical relationships between retailers and manufacturers

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1 Objectives, background and structure of the report

The primary objective of work package 4 is to produce an in-depth analysis of retailers strategies and to assess how these strategies influence price adjustment across several EU Member States. In this report we focus on the vertical relationships between manufacturers and retailers. This is particularly relevant in the food industry as, in a large number of cases, a small number of large suppliers of processed food are facing a small number of large retailers. In the food industry, the market share of the top four manufacturers is frequently greater than 50%. For instance, in Europe the concentration ratio for the top four ice cream manufacturers was over 58% and was 64% for soft drink (SD) manufacturers (Bukeviciute et al., 2009) in 2001.[1] Moreover, the top five retailers now account for over 50% of the grocery market in many EU countries. Food supply chains are therefore frequently composed of a chain of oligopolies. In such a configuration (chain of oligopolies), price transmission is affected by strategic pricing by firms, and depends depends, among other elements, on the form of contracts between suppliers and retailers.

Following the peak of agricultural commodity prices in 2007-2008, food price inflation in the EU has displayed considerable discrepancies across countries (Bukeviciute et al., 2009). Thus, the elasticity of consumer food prices to producer food prices was approximately 25% in the UK, which was lower than the 30% observed in Sweden and larger than the 15-20% observed in the Eurozone on average. The speed of adjustment in the consumer price to a change in the producer price is also quite variable. The OECD (2011) has predicted that the real prices for many agricultural products could increase by 20-30% over the coming decade compared with prices in 2001-2010. It has also forecasted an increased price volatility.

[1] Note that when evaluated at the member state level rather than the EU level, the concentration ratio is generally higher.

In such a context, a better understanding of the determinants of transmission of prices along the chain will aid in anticipating the impact of changes in the prices of agricultural products on final food prices. Finally, even for apparently homogenous goods such as drinking milk or butter, there are significant price differences at the retail level between national brands and private labels or between different retail outlets such as supermarkets, consumer markets or discounters.

We have addressed the issue of price transmission and vertical relationships between manufacturers and retailers in the food chain by developing two different strategies. A first one is based on the New Empirical Industrial Organization (NEIO) literature. The idea is to model vertical relationships between manufacturers and retailers along the vertical channel and to estimate structural econometric models of price transmission without observing wholesale prices. The second one is based on time series analyis. Its aim is to provide statistical relationships between observed wholesale prices and consumer prices. Using the results of this statistical analysis on a large number of products, we are able to analyze some of the determinants of cost pass through.

The report is structured as follows. In the synthesis report, we provide an overview of the methodologies used to analyse how upstream cost shocks are transmitted to consumer prices and we briefly report the main results. Then four independent contributions are gathered. The first three studies are based on structural estimates of models derived from the NEIO whereas the fourth one is based on time series analysis. The four studies are relative to:

- The soft drink market in France. The issue is to determine which type of contract links soft drink manufacturers and retailers, and to estimate how a change in the price of sugar might be transmitted to consumer prices.

- The coffee industry in France. The issue is to estimate how a change in the price of coffee beans might be transmitted to consumer prices, and to determine if positive or negative cost shocks are identically transmitted to consumer prices.

- The dairy industry in France. The analysis is similar to the one developed for the soft drink industry but is applied to the fresh dairy products industry, and to the drinking milk industry. In that case, cost shock originate in changes of milk price.

- The dairy industry in Germany. The issue is to determine how changes in wholesales prices of dairy products (butter, liquid milk) were transmitted to consumer prices. The analysis is performed for a large number of brands.

2 Methods used to assess the impact of cost shocks on consumer prices in vertically related markets

Two complementary strategies have been used to address the issue of price transmission in food chains focusing on the role of manufacturers and retailers. The first one is based on NEIO methodology whereas the second one uses time-series analysis.

2.1 Structural models of vertical relationships

The economic literature has shown that under conditions of imperfect competition the cost pass-through might be less than or greater than 100% depending on the curvature of the demand function (Stern, 1987; Delipalla and Keen, 1992; Anderson et al., 2001).[2] Numerous studies have quantified pass-through of upstream cost changes. For example, Nakamura and Zerom (2010) studied the US coffee industry and reported a long-run pass-through of coffee commodity prices to retail prices of 0.916. Interestingly, this research showed that the markup adjustment explained a significant part of the pass-through in this market. Hellerstein (2008) showed that markup adjustments at the manufacturer and retailer levels play an important role in explaining the pass-through of cost changes in the US beer industry. These papers suggest that firms should strategically adjust their markups when facing a change in their input costs. Moreover, as shown by Bonnet et al. (2013), the pass-through rate for upstream cost shocks to downstream retail prices depends on the form of the contracts between manufacturers and retailers. Overall, this literature suggests that to assess price transmission along a particular food supply chain, it is necessary to consider key characteristics such as the structure of the chain, consumers' substitution

[2] Following (Kim and Cotterill, 2008, p. 32), we assume that the "cost pass-through rate is defined as the proportion of a change in input cost that is passed through to the final price of the product."

patterns, and the type of contracts linking manufacturers and retailers.

To study strategic pricing in the food supply chain, we follow a general methodology that was recently developed to analyze the vertical relationships between manufacturers and retailers (e.g., Berto Villas-Boas, 2007; Bonnet and Dubois, 2010). The methodology includes four steps:

- DEMAND MODEL. We use a demand model to obtain the price elasticities of the demand for every product. The model must be as flexible as possible, and we therefore opt for a random coefficients logit model (Berry et al., 1995; McFadden and Train, 2000).

- SUPPLY MODEL. Strategic pricing in the supply chain can be modified by the nature of the contracts between firms in the industry or by the vertical restraints considered. Thus, we design alternative models for the vertical relationships between the manufacturers and retailers. In practice, we defined seven different possibilities (linear contract and six forms of two-part tariff contracts).

- SELECTION OF THE 'BEST MODEL'. Using the first-order conditions derived from the supply model and the estimates of demand, we are able to calculate the price-cost margins for the manufacturers and retailers, from which we deduce the cost estimates. To choose the vertical relationship model that best fits the data, we estimate a cost equation for each vertical relationship model. The endogenous variable in the cost equation is the estimated cost deduced from the model of the vertical relationship. Next, we use a non-nested Rivers and Vuong (2002) test to select the best supply model among all the alternatives.

- SIMULATION OF COST SHOCK. Using the selected model, we simulate the impact of the alternative cost shocks on consumers' prices.

The above methodology was applied to different industries (soft drink industry, coffee industry, fresh dairy products industry, and drinking milk industry). For each of these studies, we use data from a French representative consumer panel data of 19,000 households collected by KANTAR Worldpanel. It is a home-scan data set providing detailed information on all the purchases of food products. Among other things the data set provides characteristics of the good (brand, size, ...), the store where it was purchased, the quantity, and the price. The data set also provides information on households such as the composition of the household, the household's socio-economic status, the household's income class. This dataset is used to estimate the demand model. We consider a large number of products competing on the same market. This allows to analyse in details the competition between brands as well as competition between retailers on the market.

2.2 Time-series analysis

There is an extensive literature using time series techniques for the analysis of asymmetric cost pass through or vertical price adjustments (ref. to the TRANSFOP Working Paper 6, at the end of this report). However, those works suffer from some limitations for our purpose. First they generally do not explicitly consider the links between processing and retail activities; second they are based on the use of relatively highly aggregated monthly data which might lead to erroneous conclusions; third they generally focus on statistical significance and ignore in some sense the economic importance of the shocks.

The analysis of asymmetric price transmission relies on the work by Granger and Lee (1989) who adopted the concept of asymmetric adjustments to the error correction representation. The basic idea is that the speed of returning back to the equilibrium differs with respect to the sign of the deviation from the long-run equilibrium.

The two main characteristics of the asymmetric price transmission process are the speed of adjustment back to the long-run equilibrium and its parameters indicating the average margin. For asymmetric processes the speed of price adjustment varies with respect to the sign of the deviation from the long-run equilibrium. Asymmetries are classified into positive and negative. A positive asymmetry implies adjusting retail prices faster when wholesale prices rise compared to when they fall. Negative asymmetries describe the opposite. Traditionally asymmetric models have one threshold (two regimes) which is a priori set at zero. In more recent papers the threshold is determined endogenously in a separate procedure. For vertical price transmission models two thresholds (three regimes) are often used to represent the theoretical idea of menu costs that prevent or limit adjustments of small deviations from the equilibrium in the inner regime (Balke and Fomby, 1997). The thresholds are estimated following a procedure developed by Chan (1993) who proposes an iterative (grid) search using all potential values for the transition variable and selecting thresholds based on minimizing the residual sum of squares of all potential threshold autoregressive models.

For this study we use German milk and butter prices at the retail and the wholesale level. Both products are well defined. All butter prices apply to a fat content of more than 82 percent and a package size of 250 g (paper packed). For milk all prices apply to a fat content of 3.5 percent and a package size of 1 liter (cartons). Retail prices cover private labels and national brands. While butter is the same quality for all brands in the sample, milk is either fresh or ultra-high temperature milk. The data set includes 919 (1724) individual store retail price series covering 71 (90) brands for milk (butter) in 327 (447) stores belonging to the 5 different store formats. The data are collected weekly starting in the first week of 2005 to the last week in 2008 (n =208) by SYMPHONYIRI GROUP GMBH.

3 Main results

From the methodological side, we have proposed improvements in the modeling of vertical relationships between manufacturers and retailers. First we have extended the model to the case where private labels are used by retailers as a strategic tool in the negotiation with upstream manufacturers. Second, we have extended the analysis to deal with asymmetric price response (coffee case). From the empirical side, according to our analysis, in France, the type of contracts linking manufacturers and retailers is two-part tariff contract with resale price maintenance.[3] Such a contract is the association of a standard two-part tariff contract, which consists of a wholesale price and a fixed fee, with resale price maintenance (RPM).[4] Such contracts maximize the total profit of the entire chain in the absence of PLs.[5] It is important to note that the fixed fees are used to share the profit between retailers and manufacturers.

As a general result, we find that the pass-through rate of PLs is about 1 whatever the market (table 1). This means that retailers transmit 100% of the cost shocks to consumers prices. On the contrary, for

[3]Note that in the coffee market case, we did not select the best model of contract, rather we assumed that the contract was of that type.

[4]RPM is a practice in which a manufacturer imposes onto a retailer the selling price of the manufacturer's products.

[5]Moreover, Rey and Tirole (2007) showed that a producer which faces several retailers could use this type of contract to implement a monopoly situation.

Table 1: **Synthesis of the results**

Market	Type of contracts	Pass through	Impact of cost changes	
			% change in input price	% change in consumer price
Soft drink	Two part tariff with RPM	1.20 (NB)	-36%	-5.3% (NB)
		1.06 (PL)	-36%	-6.8% (PL)
Coffee	Two part tariff with RPM	positive schock : > 1		
		negative schock : about 1		
Fresh dairy products	Two part tariff with RPM	0.77 (NB)	-10%	-0.9%
		0.98 (PL)	-10%	-1.6%
Drinking milk	Two part tariff with RPM	1.15 (NB)	-10%	-2.21%
		0.97 (PL)	-10%	-2.08%

NB and PL stand for National Brands and Private Labels respectively.

For the soft drink case we consider a change in the price of sugar.

For the fresh dairy products case and drinking milk case, we consider a change in the price of raw milk.

NBs, the pass through rate is lower or greater than one depending on the market. In the soft drink and drinking milk industries, the pass-through is larger than 1 whereas it is lower than one in the fresh dairy products market. A pass-through larger than 1 means that the retailers transmit to the consumers more than the cost variation.

The impact on consumer prices of a change in the cost of the agricultural raw material (sugar in the case of soft drink, milk in the case of fresh dairy products and drinking milk) depends on the relative importance of the agricultural input in the production costs, on the pass through rate and on the margins of the industry. In the soft drink market, a 36% decrease in the sugar price (which corresponds to the percent decrease of the reference price of sugar in the EU from 2006 to 2009) would cause a decrease in the consumer price of soft drinks by about 5 to 7 percent. In the drinking milk industry, a 10% decrease in the milk price would lead to a decrease in the consumer price by about 2% (which is roughly the same proportion as it is in the soft drink industry). In the fresh dairy product industry, a 10% decrease in the milk price would lead, on average, to a decrease in the consumer price by 1% to 1.6% depending on the type of brands.

From the analysis, based on time series, of the cost pass-through between the wholesale and retail market for milk and butter in Germany, we conclude that the non-linear nature of many of these price relationships is best captured by a bivariate three regime thresholds error correction mechanism. For milk we find an average margin of €0.28 per liter, the lower threshold is €-0.028, the upper threshold is €0.066 in the reference group.[6] Thus deviations in the range of -10 to +23 percent of the average margin fall into the inner regime in which deviations are reduced at a rate of only 1.6 percent on average. Low margins (below average) are expanded at a rate of 14.4 percent per period; high margins (above average) are reduced at a rate of 4.7 percent back to equilibrium. The contemporaneous adjustment is rather low at 0.08. For butter we find an average margin of €0.41 per 250 g, the lower threshold is €-0.094, the upper threshold is €0.091 in the reference group. Thus deviations in the range of -20 to +20 percent of the average margin fall into the inner regime in which deviations are reduced at a rate less than 1 percent on average. Lower margins are expanded at a rate of 26.6 percent per period and higher margins are reduced at a rate of 12.5 percent. The contemporaneous adjustment is rather low at 0.10.

Private labels are marketed at lower margins and deviations from the long-run cost-price equilibrium (margin) are reduced much faster than for national brands. Though the dynamic cost-price adjustment shows significant asymmetries, the economic impact is offset by strong symmetric contemporaneous reactions and large inner regimes of almost zero response. Interestingly, we find significant asymmetries that might be used to expand margins, but strong brands with high margins show less economically significant asymmetric cost-price adjustments. The results imply that firms with strong market power do not use asymmetric price responses to expand their margin. Thus, the starting hypothesis that stronger brands or companies with more market power use asymmetric cost-price adjustments more excessively to generate higher margins has to be reconsidered. Strong brands enforce significant markups (margins) without excessively using asymmetric cost-price adjustments; their cost-price response is sluggish but mostly symmetric.

[6] The reference groups are ultra-high temperature milk and standard butter of cooperative brands sold in all discounters available.

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List of papers / contributions

- Bonnet C. and V. Réquillart. 2013. Impact of cost shocks on Consumer prices in vertically related markets: the case of the French soft drink market. Forthcoming in *American Journal of Agricultural Economics.*

- Bonnet C. and S.B. Villas Boas. 2013. An analysis of asymmetric consumer price responses and asymmetric cost pass-through in the French coffee market. *Work in progress.*

- Bonnet C., T. Corre and V. Réquillart. 2013. Price transmission in the dairy industry: the cases of the French dairy desserts and fluid milk markets. *Work in progress.*

- Holm T., J.P. Loy and C. Steinhagen. 2012. Cost pass-through in differentiated product markets: a disaggregated study for milk and butter. TRANSFOP Working Paper, n°6 (submitted to *European Review of Agricultural Economics*).

Impact of Cost Shocks on Consumer Prices in Vertically Related Markets: The Case of the French Soft Drink Market

Céline Bonnet and Vincent Réquillart

We develop a structural econometric model of the vertical contracts between soft-drink manufacturers and retailers to assess the impact of pricing policies on consumer prices. Using individual data on food purchases, we estimate consumer demand using a random utility approach. Among a set of possible vertical relationships, we select the model that best fits the data. We evaluate the pass-through rate cost shocks and show that the industry over-shifts cost changes or excise taxes to the consumers. This result challenges the belief that firms do not pass on the full extent of cost changes or excise taxes to consumers.

Key words: vertical contracts; two-part tariffs; competition; differentiated products; soft drinks; pass-through.

JEL codes: H32; L13; Q18; I18.

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Introduction

A significant portion of the population, even in developed countries, is extremely concerned about food price inflation. In 2005, food expenditure accounted for 22.2% of the total expenditures of European Union (EU) consumers in the first income quintile. An even larger proportion of 30% is observed in eight EU countries.[1] Following the peak of agricultural commodity prices in 2007-2008, food price inflation in the EU has displayed considerable discrepancies across countries (Bukeviciute, Dierx, and Ilzkovit 2009). Thus, the elasticity of consumer food prices to producer food prices was approximately 25% in the UK, which was lower than the 30% observed in Sweden and larger than the 15-20% observed in the Eurozone on average. The speed of adjustment in the consumer price to a change in the producer price is also quite variable. Although the price transmission along the food supply chain using time-series analysis has been relatively well documented (e.g., Vavra and Goodwin 2005), the main determinants of food price transmission remain unclear. Few structural analyses have addressed the behavior of the food supply chain and its implications for price transmission (recent contributions include Kim and Cotterill 2008; Nakamura and Zerom 2010; Bonnet et al. 2012). The OECD (2011) has predicted that the real prices for many agricultural products could increase by 20-30% over the coming decade compared with prices in 2001-2010. It has also forecasted an increased price volatility. In such a context, a better understanding of the determinants of transmission of prices along the chain will aid in anticipating the impact of changes in the prices of agricultural products on final food prices.

Food supply chains typically consist of large firms with significant market power. In the food industry, the market share of the top four manufacturers is frequently greater than 50%. For instance, in Europe the concentration ratio for the top four ice cream manufacturers was over 58% and was 64% for soft drink (SD) manufacturers (Bukeviciute, Dierx, and Ilzkovit 2009) in 2001.[2] Moreover, the top five retailers now account for over 50% of the grocery market in many EU countries. Food supply chains are therefore frequently composed of a chain of oligopolies.

The literature on taxation under conditions of imperfect competition has shown that in the context of Cournot competition with homogenous goods, the cost pass-through might be less than or greater than 100% depending on the curvature of the demand function (Stern 1987; Delipalla and Keen 1992).[3] Anderson, de Palma, and Kreider (2001) found similar results for price transmission in a Bertrand competition framework with differentiated products. Numerous studies have quantified pass-through of upstream cost changes. For example, Nakamura and Zerom (2010) studied the US coffee industry and reported a long-run pass-through of coffee commodity prices to retail prices of 0.916. Interestingly, this research showed that the markup adjustment explained a significant part of the pass-through in this market. Hellerstein (2008) showed that markup adjustments at the manufacturer and retailer levels play an important role in explaining the pass-through of cost changes in the US beer industry. Overall, these papers suggest that firms should strategically adjust their markups when facing a change in their input costs. Campa and Goldberg (2006) showed that the pass-through rate in the food retailing industry can vary across countries. They found pass-through rates equal to 0.21 in the US, 0.48 in Germany, and 1.41 in France. Moreover, as shown by Bonnet et al. (2012), the pass-through rate for upstream cost shocks to downstream retail prices depends on the form of the contracts between manufacturers and retailers. Overall, this literature suggests that to assess price transmission along a particular food supply chain, it is necessary to consider key characteristics such as the structure of the chain, consumers' substitution patterns, and the type of contracts linking manufacturers and retailers.

In this paper, we develop a structural econometric model that allows for the assessment of the price transmission of a cost change taking into account horizontal and vertical interactions between manufacturers and retailers. As vertical contracts linking upstream and downstream firms are not observed, we assume they can take different forms. First we consider linear contracts as in Berto Villas-Boas (2007). However, linear contracts lead to the double-marginalization problem and do not allow for profit maximization of the whole industry (e.g., Tirole 1988). Moreover, the existence of slotting allowances, quantity rebates, or other arrangements between manufacturers and retailers suggests that firms use non-linear contracts. We thus allow for two-part tariff contracts. We consider the standard two-part tariff contract which consists of a wholesale price and a fixed fee, and a two-part tariff contract with resale price maintenance (RPM).[4] In the latter type of contract, the manufacturer also sets the consumer price. We consider two possibilities for each two-part tariff contract. The first possibility involves assuming that private labels (PLs) do not play a strategic role; as in Bonnet and Dubois (2010), the buyer power of retailers is exogenous. The second possibility involves extending the non-linear contracts case to allow for the endogenous buyer power of retailers. In this case, a retailer uses its PL sales in its negotiation with the manufacturers. Each type of contract, linear or two-part tariff contracts, leads to a set of structural equations coming from the first-order conditions of profit maximization and defining price-cost margins in the chain. Using estimates of consumer demand and the structural conditions, we are able to recover the total marginal costs from each supply model. Finally, from the total marginal costs and using non-nested tests, we are able to select the type of contract that best fits the data. Using the selected model, we then perform policy simulations.

As an example, we investigate the potential effect on consumer prices of reforms that occurred in the French SD industry. SDs include three main categories of products: colas (54% of all SDs), fruit drinks (25% of all SDs; note that fruit juices and nectars are not included in this category) and iced tea drinks (8%).[5] The SD industry is highly concentrated and sells approximately 80% of its production to a highly concentrated retail industry.[6] This context underscores the particular importance of the analysis of vertical relationships in the chain and its consequences in order to assess transmission to the consumer price of cost changes or taxes. In the US, the empirical literature on the SD industry has focused on the impact of existing taxes (e.g., Fletcher, Frisvold, and Tefft 2010) or has involved conducting ex-ante simulations of the impact of additional taxes (Runge 2011). Most frequently, when simulating the impact of a tax, researchers assume that the industry is passive and passes on 100% of the tax onto consumer prices (e.g., Miao, Beghin, and Jensen 2012). From this literature it is evident that it is important to consider substitution between diet and sugar-based versions of SD products, that it is necessary for there to be a better analysis of the substitution patterns among beverages, and that there needs to be integration of the possible responses of the industry to taxation.

We choose to analyze two different reforms that might affect consumer prices. The first reform is that of the European sugar policy, which was agreed upon in February 2006 (Union Européenne 2006). The reference price, which roughly acts as a floor price, was reduced by 36% over a four-year period starting in 2006 because the sugar price in the EU was well above the world market price.[7] The second reform is the taxation of SDs that was established in January 2012. Beginning on that date, an excise tax of €0.0716/liter has been levied on SD sales in France.[8]

Our results suggest that manufacturers and retailers use two-part tariff contracts and over-transmit cost changes or excise taxes to consumers. Depending on the scenario, the average pass-through rate varies from 1.16 to 1.22. This result is crucial, particularly when analyzing the impact of taxes on prices and consumption. In general, researchers assume a 100% pass-through rate of a tax, arguing that this rate is the upper bound for price changes (e.g., Allais, Bertail, and Nichele 2010). This assumption is true in the absence of strategic pricing, but our results suggest that strategic pricing does play a role, and that this assumption is thus wrong. We conclude that ignoring strategic pricing leads to an under-estimate rather than an over-estimate of the price changes induced by upstream cost shocks or excise taxes in the SD industry.

This paper is organized as follows. Section 2 presents the data and provides descriptive statistics about SD consumption. Section 3 describes the model and methods used to analyze consumers' demand and to infer the vertical relationships between manufacturers and retailers. Section 4 discusses the demand and supply results and the cost estimates, and Section 5 presents the results of the policy simulations. Section 6 concludes the paper.

Data

We use consumer panel data collected by the TNS WorldPanel, a representative survey of 19,000 French households. This survey records information about every purchase of food products (e.g., quantity, price, brand, characteristics of goods, and retailer from which products are purchased) by every household in the panel. Due to limitations of the data, we consider only household purchases for home consumption, thus excluding out-of-home consumption, which represents only 20% of all SD sales. The SD market is generally divided into three categories: colas, fruit drinks (which are different, as noted above, from fruit juices and nectars), and iced tea drinks.[9] We selected the 13 primary national brands (NBs) as well as four PLs, one for each of the three categories of regular products and one that aggregates diet PLs. We consider purchases from all retailers over a one-year period (2005). The retailers are grocery store chains that differ in the size of their outlets as well as the services provided to consumers. In addition to the top four retailers,[10] we define two aggregates of retailers: one that aggregates 'discounters', which typically have outlets of small to intermediate size and provide only basic services, and another that aggregates the remaining retailers. All the retailers are national chains and are present in all regions in France. Therefore, consumers from different regions are presented with the same assortment of products when shopping at a given retailer.[11]

From the consumer's perspective, a 'product' is a combination of a brand and a retailer. Thus, brand 1 purchased at retailer 1 is different from brand 1 purchased at retailer 2. Making such a distinction allows us to analyze the vertical contracts between manufacturers and retailers as well as the pricing strategies. Considering the set of brands carried by each retailer, we obtain 97 differentiated products that compete in the market. In addition, we define an 'outside option' that aggregates all remaining alternatives (such as fruit juices or nectars) that a consumer might choose.

According to our sample, the average consumption of regular SD, fruit juices, and nectars is 34 liters/person/year, and the average consumption of diet products is 8 liters/person/year. The products selected for our analysis represent 49.9% of the entire market.[12] The outside option represents 50.1% of the entire market on average and is mainly composed of purchases of fruit juice and nectar (about 42% of the entire market).[13] The remaining portion (about 8%) is composed of the purchases of other SD products with very low market shares.

The average price of an SD is €0.71/liter.[14] Regular products dominate because they represent approximately 76% of all SD purchases (Table 1). On average, diet and regular products are sold at similar prices. The main difference is observed between the NBs and PLs. Although the NB prices are much higher than the PL prices (€0.92/liter and €0.36/liter on average, respectively), the NBs dominate the market with a 63% market share. This dominance is most certainly due to the fact that the NBs are perceived by consumers to be of higher quality than the PLs, a consequence of high advertising expenditures by the NB manufacturers in the SD market. Among the NBs, regular and diet products are sold at similar prices (€0.93/liter and €0.90/liter, respectively). In contrast, the price of regular PLs is higher than the price of diet PLs (€0.40/liter and €0.25/liter, respectively).

Table 1 about here

The NB prices range from €0.67 to €1.13/liter, which is quite a large variation. The market shares of the NBs are unevenly distributed, with two products dominating the market. However, there is no clear correlation between prices and market shares. The prices of the PLs are also heterogeneous, varying from €0.25 to €0.47/liter. All brands are available in every retail chain, except in retailer 6, which mainly sells PLs (Table 2). Retailers 1 to 5 set similar prices. Therefore, the average price within a given retailer is mostly explained by the relative shares of NBs and PLs sold by the retailer. Retailer 6 is a special case because it is an aggregate of discounters which generally offer fewer products with lower services (only eight NBs among the thirteen available are sold by retailer 6). Prices for both NBs and PLs are lower for this retailer than for the other retailers.

Table 2 about here

Models and methods

To study strategic pricing in the food supply chain, we follow a general methodology that was recently developed to analyze the vertical relationships between manufacturers and retailers (e.g., Berto Villas-Boas 2007; Bonnet and Dubois 2010). We use a demand model to obtain the price elasticities of the demand for every product. The model must be as flexible as possible, and we therefore opt for a random coefficients logit model (Berry, Levinsohn, and Pakes 1995; McFadden and Train 2000). Strategic pricing in the supply chain can be modified by the nature of the contracts between firms in the industry or by the vertical restraints considered. Thus, we design alternative models for the vertical relationships between the manufacturers and retailers. From the first-order conditions and estimates of demand, we are able to calculate the price-cost margins for the manufacturers and retailers, from which we deduce the cost estimates. To choose the vertical relationship model that best fits the data, we estimate a cost equation for each vertical relationship model. The endogenous variable in the cost equation is the estimated cost deduced from the model of the vertical relationship. Next, we use a non-nested Rivers and Vuong (2002) test to select the best supply model among all the alternatives. Finally, using the selected model, we simulate the impact of the alternative price policies on consumers' prices. In the following subsection, we provide a brief summary of the main assumptions and methods. The interested reader will find more extensive explanations and details of the methods in Bonnet and Dubois (2010).

The demand model: a random coefficients logit model

We use a random coefficients logit model to estimate the demand model and related price elasticities. We estimate the model using individual data and incorporate observed heterogeneity of consumers by including household characteristics. The indirect utility function U_{ijt} for consumer i who buys product j in period t is given by

$$(1) \qquad U_{ijt} = \beta_{b(j)} + \beta_{r(j)} - \alpha_i p_{jt} + \rho_i l_j + \varepsilon_{ijt}$$

where $\beta_{b(j)}$ and $\beta_{r(j)}$ are the brand and retailer fixed effects respectively, which capture the (time-invariant) unobserved brand and retailer characteristics, p_{jt} is the price of product j in period t, α_i is the marginal disutility of the price for consumer i, l_j is a dummy variable related to an observed product characteristic (which takes on the value of one if product j is a diet product and zero otherwise), ρ_i captures consumer i's taste for the diet characteristic, and ε_{ijt} is an unobserved error term.

We assume that α_i and ρ_i vary across consumers. Indeed, consumers can have different price disutilities or different tastes for the diet characteristic. We assume that the distributions of α_i and ρ_i are independent and that the parameters have the following specification

$$(2) \qquad \begin{pmatrix} \alpha_i \\ \rho_i \end{pmatrix} = \begin{pmatrix} \alpha \\ \rho \end{pmatrix} + \Pi D_i + \Sigma v_i$$

where D_i is a set of demographics, Π is a $2 \times d$ matrix of associated parameters (where d is the number of demographics), $v_i = (v_i^\alpha, v_i^\rho)'$ is a 2x1 vector that captures the unobserved characteristics of consumers, and Σ is a 2×2 diagonal matrix of parameters $(\sigma_\alpha, \sigma_\rho)$ that measures the unobserved heterogeneity of consumers. We assume that v_i follows a parametric distribution.

The consumer can decide against choosing one of the SD products. Thus, we introduce an outside option that permits substitution between the SD products and a substitute. The utility of the outside good is normalized to zero, and thus, $U_{i0t} = \varepsilon_{i0t}$.

Assuming that ε_{ijt} is independently and identically distributed as an extreme value type I distribution, following Nevo (2001) we can write the market share of product j in period t as

$$(3) \qquad s_{jt} = \int_{A_{jt}} \left(\frac{\exp V_{ijt}}{1 + \sum_{k=1}^{J_t} \exp V_{ijt}} \right) dP_v(v)$$

where $V_{ijt} = \beta_{b(j)} + \beta_{r(j)} - \alpha_i p_{jt} + \rho_i l_j$, A_{jt} is the set of consumers who have the highest utility for product j in period t, a consumer i is defined by the vector $(v_i, D_i, \varepsilon_{i0t}, ..., \varepsilon_{iJt})$, and P_v is the cumulative distribution function of independent bivariate normal distributions.

The random coefficients logit model generates a flexible pattern of substitutions between products driven by the different consumer price disutilities α_i. Thus, the own- and cross-price elasticities of the market share s_{jt} can be written as

$$(4)\qquad \frac{\partial s_{jt}}{\partial p_{kt}}\frac{p_{kt}}{s_{jt}} = \begin{cases} -\frac{p_{jt}}{s_{jt}}\int \alpha_i s_{ijt}(1-s_{ijt})\,dP_v(v) & \text{if } j=k \\ \frac{p_{kt}}{s_{jt}}\int \alpha_i s_{ijt}s_{ikt}\,dP_v(v) & \text{otherwise.} \end{cases}$$

Identification and estimation method

We estimated the demand model using the individual data and randomly choose 100,000 observations among the 450,000 available.[15] We use the simulated maximum likelihood method as in Revelt and Train (1998).[16] This method relies on the assumption that all product characteristics $X_{jt} = (p_{jt}, l_j)$ are independent of the error term ε_{ijt}. However, assuming $\varepsilon_{ijt} = \xi_{jt} + e_{ijt}$ where ξ_{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 ξ_{jt} (and hence in ε_{ijt}), such as advertising, are correlated with the observed characteristics X_{jt}. For instance, we do not know how much each firm invests in advertising for their brands. This effect is thus included in the error term because advertising might play a role in the households' choices of SDs. Because advertising represents an appreciable share of the costs of producing SDs, it is clearly correlated with prices. To address the issue that the omitted product characteristics might be correlated with prices, we use a two-stage residual inclusion as in Terza, Basu, and Rathouz (2008) and Petrin and Train (2010). We regress prices on instrumental variables (W_{jt}) and the exogenous variables of the demand equation (brand $\delta_{b(j)}$ and retailer $\delta_{r(j)}$) fixed effects as well as diet characteristic (l_j))

$$(5)\qquad p_{jt} = W_{jt}\gamma + \delta_{b(j)} + \delta_{r(j)} + \mu l_j + \eta_{jt}$$

where η_{jt} is an error term that captures the remaining unobserved variations in prices. The estimated error term $\widehat{\eta}_{jt}$ of this price equation includes certain omitted variables, such as variations in advertising and promotions. Introducing this error term in the mean utility of consumers δ_{jt} allows us to capture unobserved product characteristics that may vary across time. Prices are now uncorrelated with the new product-specific error term varying across periods ($\zeta_{jt} = \xi_{jt} - \lambda\widehat{\eta}_{jt}$). We then write

$$(6)\qquad \delta_{jt} = \beta_{b(j)} + \beta_{r(j)} - \alpha p_{jt} + \rho l_j + \lambda\widehat{\eta}_{jt} + \zeta_{jt}$$

where λ is the estimated parameter associated with the estimated error term of the price equation.

In practice, we use the input price indices of wages, plastic, aluminum, sugar, and gasoline because it is unlikely that the input prices are correlated with unobserved determinants of demand for SDs.[17] The SD industry represents only a very small share of the demand for these inputs, which justifies the absence of correlation between the input prices and unobserved determinants of the demand for SDs. These variables are interacted with the manufacturer dummies or PL/NB dummies because we expect that the manufacturers obtain different prices from suppliers of raw materials and that certain characteristics of the inputs (e.g., quality of plastic) depend on the manufacturers. Moreover, the correlation between instruments is not high because we have introduced interactions between certain variables (e.g., sugar) and product characteristics.

Supply models: Vertical relationships between processors and retailers

In food supply chains, the upstream and downstream industries are highly concentrated, and it is well known that linear contracts are not efficient in a chain of oligopolies because the profit of the chain is not maximized. In fact, this inefficiency provides incentives to agents to design more sophisticated contracts such as two-part tariff contracts. Two-part tariff contracts were only recently integrated into the analysis in the empirical literature (Bonnet and Dubois 2010). In this paper, we consider linear pricing and a set of two part-tariff contracts in which the manufacturers hold all of the bargaining power.[18] The general framework of the vertical relationships is described by the following game:

- Stage 1: Manufacturers simultaneously propose 'take-it or leave-it' contracts to retailers. In the case of linear pricing, the contract simply consists of a set of wholesale prices because the manufacturers produce a set of different brands. In this case, the manufacturers compete à la Bertrand-Nash as they compete on prices. With a two-part tariff, the contract includes a set of wholesale prices and fixed fees. Finally, in the case of RPM, the contract is composed of a set of wholesale prices, fixed fees, and consumer prices.

- Stage 2: Retailers simultaneously accept or reject the offers, which are public information. If a retailer rejects one offer, it earns some profit from an 'outside option'. We consider two possibilities. In the first case, the outside option is exogenously set to a positive fixed value. In the second case, the outside option is determined endogenously and its amount is equal to the profit that a retailer obtains from selling its own PLs.

- Stage 3: Retailers set the consumer prices and thus compete à la Bertrand-Nash.

Depending on the assumptions regarding contracts and the outside options of retailers, we specify seven different cases: linear pricing and six cases of non-linear contracts. The six cases of non-linear pricing are the combination of three types of contracts proposed by manufacturers with the two possibilities for the outside option of the retailers. The three non-linear contracts correspond to a two-part tariff contract without RPM and two possibilities for a two-part tariff contract with RPM. With RPM we consider the two polar cases for price-cost margins: zero wholesale margins for the NBs or, alternatively, zero retail margins for the NBs.

In the following, we consider there are N_f manufacturers and N_r retailers. The profit of a retailer r is given by

$$\Pi^r = \sum_{j \in S_r} [M(p_j - w_j - c_j)s_j(p) - F_j] \tag{7}$$

where M is the size of the market, S_r is the set of products that retailer r sells, w_j and p_j are the wholesale and retail prices of product j, respectively, $s_j(p)$ is the market share of product j, c_j is the constant marginal cost to distribute product j and F_j is the fixed fee associated with the retailing of product j. In the specific case of PLs, we assume that these products are sold to retailers at the marginal cost of production.[19]

Assuming price competition among the retailers and assuming the existence of equilibrium, the first-order conditions are given by

(8) $$s_k + \sum_{j \in S_r} [(p_j - w_j - c_j)] \frac{\partial s_j}{\partial p_k} = 0 \quad \forall k \in S_r, \qquad \text{for } r = 1, ..., N_r$$

These are the standard conditions that define the Bertrand-Nash equilibrium at the third stage of the game.[20] These conditions are valid regardless of whether manufacturers propose linear prices or two-part tariffs. However, these conditions do not hold with RPM since in that case a retailer no longer chooses the consumer price of the NBs.

We focus on two-part tariff contracts because the linear pricing case, leading to double marginalization, is well known (refer to Sudhir 2001; Berto Villas-Boas 2007; Bonnet and Dubois 2010). Let us define μ_j as the constant marginal cost to produce product j and G_f as the set of products that are sold by manufacturer f. A manufacturer f maximizes its profit

(9) $$\Pi^f = \sum_{j \in G_f} [M(w_j - \mu_j)s_j(p) + F_j]$$

subject to the participation constraint of each retailer, i.e., for all $r = 1, .., N_r$, $\Pi^r \geq \sum_{j \in \widetilde{S}_r} M(\widetilde{p}_j^r - w_j - c_j)s_j(\widetilde{p}^r)$ where $\widetilde{S}_r$ is the set of PLs belonging to retailer r and $\widetilde{p}^r = (\widetilde{p}_1^r, ..., \widetilde{p}_J^r)$ is the vector of prices when retailer r sells only its PLs, i.e., retailer r does not sell any NBs. By convention, we have $\widetilde{p}_j^r = +\infty$ for all NBs sold by retailer r. The vector of the market shares $s(\widetilde{p}^r)$ thus corresponds to the market shares when retailer r sells only its PLs. In this setting, the participation constraint of each retailer is made endogenous. This participation constraint is the profit that a retailer r gets from selling the PLs when it does not sell the NBs.

Manufacturers can adjust the fixed fees such that all constraints are binding. The use of the participation constraint of retailer r allows us to re-write the profit of manufacturer f as (see details in the Appendix)

(10)

$$\Pi^f = \sum_{j \in G_f} M(w_j - \mu_j)s_j(p) + \sum_{j=1}^{J} M(p_j - w_j - c_j)s_j(p) - \sum_{r=1}^{R} \sum_{j \in \widetilde{S}_r} M(\widetilde{p}_j^r - \mu_j - c_j)s_j(\widetilde{p}^r) - \sum_{j \notin G_f} F_j$$

The profit of a manufacturer is no longer a function of the fixed fees attached to its products. Instead, the profit depends on the fixed fees set by the other manufacturers. The maximization problem becomes simple to solve since the manufacturer only chooses prices, i.e., wholesale prices when there is no RPM, or consumer prices when there is RPM.

We first consider the case in which manufacturers can use RPM in their contracts with retailers. In this case, manufacturers propose to retailers the fixed fees F as well as the retail prices p.[21] The program of manufacturer f is given by

$$\max_{\{p_k\}_{k \in G_f}} \sum_{j \in G_f} M(w_j - \mu_j)s_j(p) + \sum_{j=1}^{J} M(p_j - w_j - c_j)s_j(p) - \sum_{r=1}^{R} \sum_{j \in \widetilde{S}_r} M(\widetilde{p}_j^r - w_j - c_j)s_j(\widetilde{p}^r) \tag{11}$$

The first-order conditions of the manufacturer's maximization program are

$$\sum_{j \in G_f} (w_j - \mu_j)\frac{\partial s_j(p)}{\partial p_k} + s_k(p) + \sum_{j=1}^{J} (p_j - w_j - c_j)\frac{\partial s_j(p)}{\partial p_k} - \sum_{r=1}^{R} \sum_{j \in \widetilde{S}_r} (\widetilde{p}_j^r - w_j - c_j)\frac{\partial s_j(\widetilde{p}^r)}{\partial p_k} = 0 \tag{12}$$

$$\forall k \in G_f, \quad \text{for } f = 1, ..., N_f.$$

The above conditions only apply for the NBs. For the PLs, a retailer r maximizes its profits with respect to the retail prices of the PLs

$$\max_{\{p_k\}_{k \in \widetilde{S}_r}} \sum_{j \in \widetilde{S}_r} (p_j - \mu_j - c_j)s_j(p) + \sum_{j \in S_r \backslash \widetilde{S}_r} (p_j^* - w_j - c_j)s_j(p^*) \tag{13}$$

where p_j^* represents the equilibrium price of the NBs chosen by the manufacturers. The first-order conditions of the retailer's profit maximization program are:

$$\sum_{j \in \widetilde{S}_r} (p_j - \mu_j - c_j)\frac{\partial s_j(p)}{\partial p_k} + s_k(p) + \sum_{j \in S_r \backslash \widetilde{S}_r} (p_j^* - w_j - c_j)\frac{\partial s_j(p^*)}{\partial p_k} = 0 \tag{14}$$

$$\forall k \in \widetilde{S}_r, \quad \text{for } r = 1, ..., N_r.$$

The system of equations (12) and (14) characterizes the equilibrium, which depends on the structure of the industry at both the manufacturer and retailer levels and also on the shape of the demand curve. As Rey and Vergé (2010) argue, a continuum of equilibria exists in this general case with RPM, with one equilibrium corresponding to each possible value of the vector of wholesale prices w. Then, to identify both retail and wholesale margins from the system of equations (12) and (14), one needs additional assumptions. It is important to recognize that with RPM the wholesale prices have only a strategic role. In this paper, we consider the two extreme cases as in Bonnet and Dubois (2010). The first extreme case is where retail margins for the NBs are set to zero, that is $p_j - w_j - c_j = 0$. According to Biscourp, Boutin, and Vergé (2008), the Galland Act, which prohibits below-cost pricing in France, has led to a situation where it is, in practice, possible to implement RPM. Thus, manufacturers have chosen 'high' wholesale prices and retailers have set prices that are very close to the wholesale prices. Thus, retailers get zero margins. The fixed fees are used to share the profits between manufacturers and retailers. The second extreme case is where manufacturers get zero margins, that is: $w_j - \mu_j = 0$. In this case, manufacturers set wholesale prices equal to marginal costs as in a standard case of two-part tariff. As shown by Rey and Vergé (2010), in the absence of PLs, this contract leads to the maximization of the profit of the whole industry.

When RPM is not allowed, manufacturer f maximizes its profit by choosing the wholesale prices:

$$(15) \qquad \max_{\{w_k\}_{k\in G_f}} \sum_{j\in G_f} M(w_j - \mu_j)s_j(p) + \sum_{j=1}^{J} M(p_j - w_j - c_j)s_j(p) - \sum_{r=1}^{R}\sum_{j\in \widetilde{S}_r} M(\widetilde{p}_j^r - w_j - c_j)s_j(\widetilde{p}^r).$$

from which we deduce the following first-order conditions:

(16)

$$\sum_{j\in G_f}(w_j - \mu_j)\frac{\partial s_j(p)}{\partial w_k} + \sum_{j=1}^{J}\frac{\partial p_j}{\partial w_k}s_j(p) + \sum_{j=1}^{J}(p_j - w_j - c_j)\frac{\partial s_j(p)}{\partial w_k} - \sum_{r=1}^{R}\sum_{j\in \widetilde{S}_r} M(\widetilde{p}_j^r - w_j - c_j)\frac{\partial s_k(\widetilde{p}^r)}{\partial w_k} = 0$$

$\forall k \in G_f, \quad \text{for } f = 1, ..., N_f.$

The equilibrium is characterized by the system of equations (16) in which the retail price response matrix to the wholesale prices that contains the first derivatives of the retail prices with respect to the wholesale prices is obtained by totally differentiating (8), and the retail margins are deduced from (8).

Cost specification, testing between alternative models, and simulations

Once the demand model is estimated, for each model of vertical interactions between manufacturers and retailers, the price-cost margins can be estimated. As prices are known, we get the estimated marginal costs $C_{jt}^h = p_{jt} - \Gamma_{jt}^h - \gamma_{jt}^h$ for each product j in period t for any supply model h, where $\Gamma_{jt}^h = w_{jt}^h - \mu_{jt}^h$ is the manufacturer's margin for product j and $\gamma_{jt}^h = p_{jt}^h - w_{jt}^h - c_{jt}^h$ is the retailer's margin for product j. We specify the following model for the estimated marginal costs:

$$(17) \quad C_{jt}^h = \sum_{k=1}^{K} \lambda_k^h W_{jt}^k + w_{b(j)}^h + w_{r(j)}^h + \eta_{jt}^h$$

where W_{jt} is a vector of inputs, $w_{b(j)}^h$ represents the brand's fixed effects for model h, $w_{r(j)}^h$ is the retailer fixed effect for model h, and η_{jt}^h is the error term. We assume that $E(\eta_{jt}^h | W_{jt}', w_{b(j)}^h, w_{r(j)}^h) = 0$ to consistently identify and estimate $\lambda_k^h, w_{b(j)}^h$ and $w_{r(j)}^h$. To remain consistent with economic theory, as in Gasmi, Laffont, and Vuong (1992), we impose the positivity of parameters λ_k^h and therefore we use a non-linear least-squares method to estimate the parameters. We use this cost function specification to test any pair of supply models C_{jt}^h and $C_{jt}^{h'}$, and we infer which model is statistically best using a non-nested Rivers and Vuong (2002) test. In the following, we refer to this model as the preferred contract model.

Rivers and Vuong (2002) showed that the test statistics T_n asymptotically follows a standard normal distribution.[22] The null hypothesis H_0 is that the two non-nested models are *asymptotically equivalent*, the first alternative hypothesis H_1 is that h is *asymptotically better* than h', and the second alternative H_2 hypothesis is that h' is *asymptotically better* than h. Denoting α as the desired size of the test and $t_{\alpha/2}$ as the value of the inverse standard normal distribution evaluated at $\alpha/2$, if $T_n < t_{\alpha/2}$, then H_0 is rejected in favor of H_2; if $T_n > t_{1-\alpha/2}$, then H_0 is rejected in favor of H_1. Otherwise, H_0 is not rejected.

We can simulate some policy experiments using the estimated marginal costs from the preferred contract model and the estimated parameters from the demand model. In this paper, we analyze a decrease in sugar price due to the EU sugar reform and the introduction of an excise tax. We denote $C_t = (C_{1t}, .., C_{jt}, .., C_{Jt})$ as the vector of marginal costs for all products in period t. To model the impact of a change in the sugar price, we have to determine the vector of equilibrium prices consistent with the vector of marginal costs estimated using the new sugar price. We solve the following program:

$$(18) \qquad \min_{\{p^*_{jt}\}_{j=1,..,J}} \left\| p^*_t - \Gamma_t\left(p^*_t\right) - \gamma_t\left(p^*_t\right) - \widetilde{C}_t \right\|$$

where $\|.\|$ is the Euclidean norm in $\mathbb{R}^J$, γ_t and Γ_t correspond to the retailer and manufacturer margins, respectively, for the best supply model, and $\widetilde{C}_t$ is the vector of marginal costs estimated using the new sugar price in equation (17). Because an excise tax is equivalent to an increase in marginal cost, the taxation of SDs is modeled by adding a constant term to the marginal cost of production of the taxed products. Next, modeling of the impact of a tax in addition to a change in sugar price is carried out by adding the amount of the tax to $\widetilde{C}_t$.

Results for the demand and vertical relationships

Demand results

In this study, we estimated two models (Table 3). In model 1, we do not control for the price endogeneity problem, whereas in model 2 we control for it. First, the exogeneity test of price, where the null hypothesis is that the coefficient of the error term of the price equation is not significantly different from zero, reveals the need to control for the endogeneity problem. Moreover, the coefficient of the error term is positive and significant, indicating that the unobserved portion that explains prices is positively correlated with the choice of the alternative. Thus we can infer that some unobserved variables such as promotions, displays, and advertising (which positively affect prices) might be included in the error term of model 1 (we provide results for the price equation in Table 10 of the appendix). The weak test of instruments, which is the partial F test of instrumental variables in the price equation, suggests that the instrumental variables are not weak. A comparison of the results from models 1 and 2 reveals that the estimates of the model parameters (other than the price sensitivity parameters) are robust to instrumentation.

To obtain a more flexible demand model, we introduced some observed household heterogeneities into the price sensitivity and the taste for the diet characteristic using income categories (four categories) and the proportion of overweight or obese people in the household (three categories). On average, price has a significant and negative impact on utility. Consumers are more sensitive to the price variations of the PLs than to those of the NBs, an observation that is consistent with the belief that consumers might have more loyalty to the NBs than to the PLs. The results suggest that households prefer regular products to diet products because the mean coefficient of the diet characteristic is negative and the standard deviation is quite low. We also introduced brand and retailer fixed effects. The reference brand is a PL diet product. Consumers prefers the diet NBs (brands 2, 4, 6, and 9) rather than the PL diet product because the associated coefficients are positive. Among the regular products, it is the brands 3 and 8 which are preferred.[23] On the whole, the preferred product is brand 3, which has the largest fixed effect coefficient and is the leading brand in the market, with a 28% market share. The reference retailer is the aggregate of discounters. All retailer fixed effect coefficients are positive, which means that consumers prefer retail chains that offer more services than the discounters.

Table 3 about here

Using the structural demand estimates, we compute the elasticities for each of the differentiated products (Table 4). The own-price elasticities of the demand for a brand vary between -2.13 and -3.95, with an average value of -3.52. The demand for regular products is more elastic than the demand for diet products.[24] Other studies of the SD market report own-price elasticities of a similar magnitude. Thus, Gasmi, Laffont, and Vuong (1992) estimated own-price elasticities of -2 for both Coca-Cola and Pepsi-Cola. For the carbonated SD market in the US, Dhar et al. (2005) distinguished four brands and found own-price elasticities between -2 and -4. However, using a higher level of disaggregation (approximately 20 brands) for the US market, Dubé (2005) found elasticities ranging from -3 to -6 in the Denver area. The demand at the category level is less elastic as the elasticity at the brand level partly comes from substitution with brands in the same category. A recent review of food demand reported own-price elasticities for sodas and other beverages of -0.8 to -1.0 depending on the category definitions (Andreyeva, Long, and Brownell 2010).

Preferred contract model, price-cost margins and cost estimates

Using the demand estimates, we compute the price-cost margins as well as marginal costs for each supply model (we report the marginal cost equation for the preferred contract model in Table 11 of the appendix). Based on the Rivers and Vuong tests (see the results in Table 12 of the appendix), the best supply model is model 2, in which the manufacturers and retailers use two-part tariff contracts with RPM, the wholesale margin is equal to zero, and the PLs have no strategic role in the manufacturer-retailer relationships.[25] There is evidence of the use of two-part tariff contracts in the food industry (e.g., the use of slotting allowances). On the other hand, RPM is prohibited by the competition authorities. However, specific French laws (such as the Galland Act, which prohibits below-cost pricing) for the retail industry have led to a situation where it is possible to implement RPM in practice (Biscourp, Boutin, and Vergé 2008). It is interesting to note that Bonnet and Dubois (2010) found that in the French bottled water market firms use two-part tariff contracts with RPM. Such contracts maximize the total profit of the entire chain in the absence of PLs. Moreover, Rey and Tirole (2007) showed that a producer which faces several retailers could use this type of contract to implement a monopoly situation. This result is consistent with the idea that in the SD industry, the brands are strong and thus provide market power to the upstream manufacturers. The existence of a two-part tariff contract with RPM is also important for the analysis of how a cost change or an excise tax are passed through to consumer prices. Thus, Delipalla and Keen (1992) showed that under imperfect competition the cost pass-through of an excise tax could be less than or greater than 100% depending on the curvature of the demand function.

Marginal costs, which include processing and retailing costs, are brand-specific (Table 5). On average, they amount to €0.35/liter. The average marginal cost of the PLs (€0.21/liter) is lower than that of the NBs (€0.44/liter). Among the retailers, the marginal costs of retailer 6 have the lowest values. This observation is consistent with the strategy of retailer 6, which offers only a few services to consumers. The heterogeneity of the marginal costs among retailers is larger for the PLs than the NBs. This might be due to the fact that a PL is retailer-specific while an NB is not. In that case, the heterogeneity of the PLs' marginal costs would be explained by the difference in the characteristics of the PLs. On average, the price-cost margins are 47.1% of the consumer price. The heterogeneity of the percentage margins across brands is lower than the heterogeneity of the percentage margins across the PLs (Table 6). The average price-cost margins for the PLs (42.0%) are lower than those for the NBs (50.1%). Those margins are shared between manufacturers and retailers through the use of fixed fees. As fixed fees are not observed, we cannot draw conclusions about the relative profitability of NBs and PLs for the retailers. As a general rule, it is likely that retailers can capture a larger share of the total margins when negotiating with the PL manufacturers rather than the NB manufacturers.

Table 5 and Table 6 about here

Simulations

We define three policy scenarios. Scenario 1 simulates the impact of a 36% decrease in the sugar price because it represents a bound of the price decrease that might be induced by the sugar policy reform (cf. Introduction). Scenario 2 simulates the impact of an excise tax of €0.0716/liter for SDs. We assume that the tax only applies to regular products. Finally, scenario 3 represents the combination of scenarios 1 and 2 because the associated changes act in opposite directions and are thus likely to partially offset each other.[26]

The impact of the sugar policy reform

Using Eq. (17), we compute the change in the marginal cost for each product. On average, the 36% decrease in the sugar price causes a €0.026/liter decrease (approximately 8.3%) in the total marginal cost of regular SDs. This impact is very close to that calculated using accounting data (approximately €0.02/liter).[27] The marginal cost decreases are brand-specific (Table 7). First, the sugar content differs among brands, implying a difference in the value of the cost change. Second, the percentage change in the marginal cost also depends on the total marginal cost, which partly explains the larger percentage decrease in the marginal cost of the PLs.

Table 7 about here

On average, consumer prices decrease by 5.2% for regular products in response to the price cut. Note that the percentage price decrease for the PLs is larger than that for the NBs because the PLs are priced lower than the NBs. The pass-through has an average value of 1.16 for regular products. Therefore, if the marginal cost decreases by €0.01/liter, the retail price decreases by an average of €0.0116/liter. The industry thus over-shifts the cost decrease.

The pass-through is brand-specific and varies from 1.05 to 1.29. The pass-through for the PLs is lower than that of the NBs, indicating that the retailers choose a lower pass-through rate than the manufacturers. The manufacturers choose a pricing policy for the entire set of products, thereby internalizing the substitution among their own set of products. While the marginal costs of diet products are not affected by the reform, the price of diet NBs increases by 1.2%. As a result of these strategic price reactions, the aggregate market share of the regular products increases by 13.9% by replacing diet products (the market share of which decreases by 10.6%) and the outside option (the market share of which decreases by 8.3%).

Impact of an excise tax on soft drinks

The excise tax does not depend on the sugar content of the product and amounts to approximately 10% of the price of the SDs. In reaction to the tax, the prices of regular products increase by 12% on average (Table 8). Strategic pricing increases the price effect of the tax because the average pass-through rate is 1.22. As observed in scenario 1, the (percentage) price increase is much larger for the PLs than for the NBs. Thus, the market share of the PLs decreases to a larger extent than that of the NBs. The price of the diet products is slightly adjusted and decreases by 1.7%. This price adjustment mainly stems from the NB manufacturers. The price changes lead to dramatic changes in market shares of all products. Thus, the market share of regular products decreases by 27% to the benefit of diet products (+23.5%) and the outside good (+15.9%).

Table 8 about here

The impact of an excise tax and the sugar reform

We finally simulate the combined impact of the sugar reform and an excise tax on regular products. Although the sugar reform decreases the marginal cost of production of regular products, the excise tax is equivalent to an increase in the marginal cost of these products. The excise tax affects all products in a similar manner whereas the sugar reform provides larger benefits to products with high sugar content. However, because for every product the excise tax is larger than the cost decrease, the combined impact of the sugar reform and an excise tax results in an increase in the cost of regular SDs. We find that the prices of regular products increases by approximately 7% on average. Strategic pricing leads to transmission of an amount greater than the cost changes to consumers. Thus, any €0.01 increase in the cost generates an increase in the consumer price of €0.012, on average. Strategic pricing also leads to a slight adjustment of the prices of diet products. While their marginal costs remain unchanged, their prices decrease by 1%.

As observed in the previous scenarios, the PLs are affected more extensively than the NBs. The sales of the different brands are significantly impacted. The market share of regular products decreases by 16.3% to the benefit of diet products (+13.2%) and the outside good (+9.8%) (Table 9).

Table 9 about here

Discussion of the results

Due to strategic pricing, the cost changes or excise taxes are over-transmitted to the consumer in the SD industry. As explained previously, this result is consistent with the theoretical findings and the supply model that best fits the data. This observation is also consistent with the analysis of Campa and Goldberg (2006), who found that the pass-through rates in the food industry in France are greater than one (1.41). In the case of the US, Besley and Rosen (1999) found that the SD industry also over-shifts tax changes to the consumer. According to their work, this over-shifting is a consequence of imperfect competition.

Empirical papers on the impact of taxation in the cigarette industry provide useful information on how taxes are transmitted to final consumers by a concentrated industry. Keeler et al. (1996) found that state excise taxes are more than passed on to consumers because a \$0.01 state tax increase results in a price increase of \$0.0111 cents. Hanson and Sullivan (2009) analyzed the impact of a \$1 increase in the state excise tax in Wisconsin that occurred in January 2008 (the tax on a pack of cigarettes rose from \$0.77 to \$1.77) and found that the excise tax was over-shifted to consumers by 8 to 17%.

In the French case, Berardi et al. (2012) analyzed the impact on prices for the soda tax introduced in January 2012 and used a difference-in-difference approach to evaluate the pass-through rate of the tax. They found that the pass-through rate for the soda market was 49% in January, 92% in March, 101% in May, and 98% in July. Moreover, for products that experienced a price increase (86% of all products), the average pass-through was 1.24. These results suggest that a certain amount of heterogeneity exists in the price response, there is a delay in the way prices are adjusted, and over-shifting is not uncommon. Our results also support the concept of a certain amount of heterogeneity in the price response because the pass-through rates do differ among brands and retailers. To explore this issue, we regress the pass-through rate on the dummy variables that identify the manufacturers and retailers. The results indicate that one manufacturer over-transmits the shock to a larger extent than the other and that the PL products experienced a significantly lower pass-through rate. Among retailers, the results show that the pass-through rate of retailer 6 is significantly lower than those chosen by the other retailers because retailer 6 sells a larger share of PLs.

From our analysis it appears that cost decreases (scenario 1) or 'cost' increases (scenario 2) are transmitted in the same manner, i.e., we predict over-transmission of the shock to consumer prices in both cases. The possibility of asymmetric price transmission is abundant in the literature that used time-series analysis. The general finding is that positive cost shocks are transmitted at a faster rate than negative cost shocks (for a recent survey, refer to Frey and Manera 2007). Our study focuses more specifically on what occurs at the equilibrium. The model that we employ is static, and we focus on the change in equilibrium rather than on the speed or the path of adjustment. In that case, the results of an asymmetric price response (from time-series analysis) might be less clear. For example, in his study, Peltzman (2000, pp.486-487) stated that: "The important result is that there is no evidence of any permanent effect of asymmetries on the long-run trend of output prices: none of the relevant coefficients differ from zero. These results imply that the asymmetries do ultimately disappear but that it takes longer than five or eight months for this to happen."

Conclusion

This paper provides a general methodology for evaluating price transmission in vertically related markets. This method allows us to assess the effects of changes in input prices and tax policies on consumer prices by considering the pricing strategies of the manufacturers and retailers in the food supply chain. As an example, we analyze the impact on the French SD industry of a change in the sugar price or the introduction of an excise tax. Using recent developments in the empirical industrial organization literature, we have estimated a flexible demand model, a random coefficients logit model, and several models for the vertical relationships within the industry. We have shown that the most likely supply model is the model in which the manufacturers and retailers use two-part tariff contracts with RPM and in which the PLs play no role in manufacturer/retailer relationships. In this case, the manufacturers hold significant market power due to the strength of their brands. This result is consistent with anecdotal evidence with respect to this specific industry because the firms use investments in advertising to build strong reputations. Using this model, we have simulated the impact on prices for alternative policy scenarios taking into consideration strategic choices of the agents. We have shown that the pass-through is greater than 1 on average; in this case, the industry would subsequently transmit an amount greater than the change in cost or an excise tax to consumers. These results are consistent with the theoretical predictions, which indicate that over-shifting of a tax is possible under conditions of imperfect competition (Stern 1987; Delipalla and Keen 1992; Anderson, de Palma, and Kreider 2001). Moreover, a recent analysis of the actual impact of the soda tax in France showed that, for products that experience a price increase, the tax is over-transmitted to consumers in the soda market (Berardi et al. 2012). Our results thus suggest that the assumption of passive pricing by the SD industry would result in an under-estimation of the change in retail prices. This conclusion is important because the general belief assumes that ignoring strategic pricing leads to over-estimates of price changes.

According to these results, any analysis of the impact of food price policies requires that the strategic pricing of firms be addressed. However, we cannot easily extrapolate our results to other industries. Neither the type of contracts used by a specific industry nor the qualitative results (e.g., the over-shifting of cost changes) can be generalized. First, the structure of the upstream industry plays a role in the choice of contracts between the manufacturers and retailers. In the specific case of food markets, the structure of the upstream industry varies significantly from a low level of concentration (e.g., the meat industry or the wine industry) to a high level of concentration (e.g., the processed cheese industry or the bottled water industry). Second, the strategic response depends on the curvature of the demand function, which is also market-specific. As a consequence, the empirical analysis of price transmission in a given industry requires that the vertical relationships of this particular industry and the substitution patterns of consumers be evaluated first.

Our analysis is based on 2005 data, i.e., before any of the simulated reforms were enacted. It should be noted that certain limits exist in the extrapolation of the study results to the current situation. The size of the market has changed, and new products have emerged. However, the global hierarchy of prices has not changed significantly, and we thus argue that our general results about price transmission are likely to be robust.

A first limitation of our analysis is the implicit assumption that the price of the outside option does not change, regardless of the policy. With this assumption, the products included in the outside option are assumed to be directly unaffected by the policy scenarios. In our case, many goods in the outside option will not be affected by a decrease in the sugar price because these goods do not contain any added sugar and similarly will be unaffected by the proposed excise tax. However, this assumption also means that the producers and retailers of the outside good do not strategically react to any changes in the prices of the market under scrutiny. This option is acceptable if the market for the outside option is sufficiently competitive.

A second limitation relies on the relative homogeneity in the strategic behavior of the different retailers. In reality, it appears that some heterogeneity exists in the way in which retailers adjust their prices. This observation stems from the fact that in the models constructed retailers have similar vertical arrangements with manufacturers, while this might not always be the case in practice.

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Notes

[1]Eurostat data: structure of consumption expenditure by income quintile; http://epp.eurostat.ec.europa.eu/portal/page/portal/household_budget_surveys/Data/database (accessed 2012, September 12).

[2]Note that when evaluated at the member state level rather than the EU level, the concentration ratio is generally higher.

[3]Following (Kim and Cotterill 2008, p. 32), we assume that the "cost pass-through rate is defined as the proportion of a change in input cost that is passed through to the final price of the product."

[4]RPM is a practice in which a manufacturer imposes onto a retailer the selling price of the manufacturer's products.

[5]SD consumption represents approximately 11% of the consumption of beverages in France: Canadean (2004) http://www.canadean.com/.

[6]The top two manufacturers (the alliance of Coca Cola Enterprises and Cadbury Schweppes and the alliance of Unilever and PepsiCo) shared 88.6% of all French production in 2004.

[7]The reference price for white sugar was €631.9/t from July 1, 2006 to September 30, 2008. The price was €541.5/t from October 1, 2008 to September 30, 2009, and €404.4/t after October 1, 2009.

[8]Originally, in September 2011, the French government proposed a tax on sugar-sweetened SDs and argued that this tax will aid in combating obesity. However, representatives of the food industry were strongly opposed to the targeting of the tax; they did not accept the idea of an 'obesity' tax and preferred that the tax be applied to all SDs, including diet products.

[9]For each category, there is a sugar-based version which hereinafter we refer to as 'regular', and a diet one (low calorie).

[10]Three retailers have mostly large outlets whereas the other retailer has outlets of intermediate size.

[11]This finding is true for the NBs we consider, which are the main brands. In certain small outlets, the assortment may be reduced, but we do not have such information. However, the sales in small outlets are less than 3% of the total sales of SDs.

[12]The market share of product j (brand x retailer) is defined as the ratio of the sum of the quantities of the product j during a period of four weeks over the quantity of all products purchased during the same period in the entire market.

[13]To determine the outside option we primarily use the recent results from Allais, Bertail, and Nichele (2010). These authors found that the main substitute for SDs in France is fruit juice and that milk is a weak substitute. Moreover, they found no substitution between SDs and bottled water. As a result we do not integrate drinking milk and bottled water in the outside option.

[14]The dataset reports the price of a purchased product but does not provide information on the choice set faced by a consumer. We then make some assumptions to determine the choice set of consumers. First we assume that each consumer can shop in every retail chain. This is consistent with the fact that we consider national chains, which have outlets in every French region. We assume that the choice set for a consumer is the set of brands sold during the same period in the other outlets of the same retail chain. This is a realistic assumption as we consider the main brands. To infer the price a consumer faces during a given period, we compute the average price for the 97 differentiated products during that period.

[15]Due to computer-related constraints, we are not able to estimate the demand model using the entire sample. The sample used is representative of the entire sample over all products and periods.

[16]Models were estimated using 100 draws for the parametric distributions that represent the unobserved consumer characteristics.

[17]These indices are taken from the French National Institute for Statistics and Economic Studies.

[18]This assumption primarily affects how profits are shared (through the fixed fees) rather than the choices of prices, which is the focus of this study. According to Rey and Vergé (2010), the equilibrium prices would be the same if retailers hold all of the bargaining power conditional on the fact that retailers have an outside option.

[19]A retailer defines the characteristics of its own PL and delegates the production of this product to a manufacturer. In this process, the retailer organizes competition among producers. This competition is interpreted as a price competition with a homogenous product that leads to a selling price equal to the marginal cost. For additional information on PLs, refer to Bergès-Sennou, Bontems, and Réquillart (2004). In the specific case of the French SD market, as far as we know, the two leading firms do not produce the PLs. On the contrary, they are produced by smaller firms which do not have strong brands. It is thus very likely that retailers buy the PLs at marginal cost.

[20]We do not consider the case of collusion between retailers because two recent studies on the French market have concluded the absence of collusion (Turolla 2012; Heller 2012).

[21]The wholesale prices of manufacturer f have no direct effect on profits, but they play a strategic role in the retail price choices because they affect the profits of the other manufacturers.

[22]The test statistics for the Rivers and Vuong test is $T_n = \frac{\sqrt{n}}{\hat{\sigma}_n^{hh'}} \left\{ Q_n^h(\widehat{\lambda_k}^h, \widehat{\omega}_{b(j)}^h, \widehat{\omega}_{r(j)}^h) - Q_n^{h'}(\widehat{\lambda_k}^{h'}, \widehat{\omega}_{b(j)}^{h'}, \widehat{\omega}_{r(j)}^{h'}) \right\}$ where $Q_n^h(.)$ (resp. $Q_n^{h'}(.)$) is the sample lack-of-fit criterion evaluated for model h (resp. h') at the estimated values of the parameters of this model, denoted by $\widehat{\lambda_k}^h, \widehat{\omega}_{b(j)}^h, \widehat{\omega}_{r(j)}^h$ (resp. $\widehat{\lambda_k}^{h'}, \widehat{\omega}_{b(j)}^{h'}, \widehat{\omega}_{r(j)}^{h'}$). We have $Q_n^h(\widehat{\lambda_k}^h, \widehat{\omega}_{b(j)}^h, \widehat{\omega}_{r(j)}^h) =$

$\frac{1}{n}\sum_{j,t}\left(\eta_{jt}^{h}\right)^{2}$, where η_{jt}^{h} is the error term of the cost function for model h and $\hat{\sigma}_{n}^{hh'}$ denotes the estimated value of the variance of the difference in lack-of-fit.

[23]To compare a regular product with a diet product, the fixed effect of the diet product has to be corrected by the coefficients attached to the diet taste.

[24]The average own-price elasticity of the demand for regular brands is -3.46, whereas it is -3.23 for diet brands; these values are statistically different.

[25]Consider row 2: all statistics of the Rivers and Vuong test are greater than 1.96, which means that model 2 is better than models 3, 4, 5, 6, and 7. In addition, the test statistics in column 2 are lower than -1.96, which means that model 1 is not preferred over model 2. Thus, model 2 is the preferred model.

[26]Note that the validity of the simulation exercise hinges on the fact that the data used are prior to both the changes in sugar price floor and the proposition to tax SDs.

[27]The accounting calculation is based on the average sugar price and average sugar content of regular SDs (Observatoire de la qualité, http://www.oqali.fr/oqali/publications_oqali/etudes_sectorielles; accessed 2012, September 12).

Appendices

Detailed proof of the manufacturers' profit

We take into account the fact that manufacturers can adjust the fixed fees such that all constraints are binding. We also use the fact that retailers acquire PLs at marginal cost. The participation constraint for the retailer r becomes

$$\sum_{j\in S_r}[M(p_j-w_j-c_j)s_j(p)-F_j]=\sum_{j\in\widetilde{S}_r}M(\widetilde{p}_j^r-\mu_j-c_j)s_j(\widetilde{p}^r)$$

$$\sum_{j\in S_r}F_j=\sum_{j\in S_r}M(p_j-w_j-c_j)s_j(p)-\sum_{j\in\widetilde{S}_r}M(\widetilde{p}_j^r-\mu_j-c_j)s_j(\widetilde{p}^r)$$

$$\sum_{j\in G_f}F_j+\sum_{j\notin G_f}F_j=\sum_{r=1}^{R}\sum_{j\in S_r}F_j=\sum_{j=1}^{J}M(p_j-w_j-c_j)s_j(p)-\sum_{r=1}^{R}\sum_{j\in\widetilde{S}_r}M(\widetilde{p}_j^r-\mu_j-c_j)s_j(\widetilde{p}^r)$$

$$\sum_{j\in G_f}F_j=\sum_{j=1}^{J}M(p_j-w_j-c_j)s_j(p)-\sum_{r=1}^{R}\sum_{j\in\widetilde{S}_r}M(\widetilde{p}_j^r-\mu_j-c_j)s_j(\widetilde{p}^r)-\sum_{j\notin G_f}F_j$$

Therefore, we can re-write the profit of the manufacturer as

$$\Pi^f=\sum_{j\in G_f}M(w_j-\mu_j)s_j(p)+\sum_{j=1}^{J}M(p_j-w_j-c_j)s_j(p)-\sum_{r=1}^{R}\sum_{j\in\widetilde{S}_r}M(\widetilde{p}_j^r-\mu_j-c_j)s_j(\widetilde{p}^r)-\sum_{j\notin G_f}F_j$$

Additional tables

Table 10 about here

Table 11 about here

Table 12 about here

Table 1 Descriptive Statistics by Brands Including Prices (€/liter) and Market Shares (%)

Product	Characteristic	Sugar Content (g/l)	Number of Retailers	Prices Mean (std)	Market Shares Mean (std)
Soft Drinks				0.71 (0.01)	100
Regular				0.72 (0.01)	75.70 (0.72)
Diet				0.70 (0.02)	24.30 (0.72)
National Brands				0.92 (0.01)	63.04 (1.14)
Regular NB				0.93 (0.01)	46.06 (0.01)
Diet NB				0.90 (0.03)	16.97 (0.01)
Brand 1	R	110	6	0.67 (0.02)	1.81 (0.29)
Brand 2	D		6	0.70 (0.02)	2.66 (0.50)
Brand 3	R	106	6	0.91 (0.01)	27.96 (2.46)
Brand 4	D		6	0.93 (0.02)	10.93 (0.68)
Brand 5	R	69	6	1.06 (0.04)	2.63 (0.58)
Brand 6	D		5	1.05 (0.03)	0.54 (0.17)
Brand 7	R	90	6	1.03 (0.03)	2.84 (0.34)
Brand 8	R	105	5	1.13 (0.02)	2.76 (0.60)
Brand 9	D		5	0.95 (0.02)	2.82 (0.42)
Brand 10	R	92	6	0.89 (0.06)	3.43 (0.41)
Brand 11	R	102	5	0.96 (0.03)	1.79 (0.21)
Brand 12	R	98	6	0.85(0.03)	0.97 (0.19)
Brand 13	R	113	5	0.96 (0.02)	1.83 (0.31)
Private Labels				0.36 (0.01)	36.96 (1.14)
Brand 14	R	78	6	0.33 (0.01)	7.58 (0.40)
Brand 15	R	68	6	0.47 (0.02)	4.62 (0.67)
Brand 16	R	79	6	0.39 (0.01)	17.43 (0.94)
Brand 17	D		6	0.25 (0.01)	7.31 (0.55)

R stands for Regular and D for Diet. For PLs, we provide the average sugar content.

Market shares are in percent of the SD market which is 49.9% of the entire market.

Standard deviation (std) refers to variation over time (13 periods).

Table 2 Descriptive Statistics by Retailers including Prices (€/liter) and Market Shares (%)

Retailer	Number of brands		Share of PL	Price of NB	Price of PL	Price	Market Shares
	NB	PL	Mean (std)	Mean (std)	Mean (std)	Mean (std)	Mean (std)
Retailer 1	13	4	31.40 (2.34)	0.88 (0.01)	0.41 (0.01)	0.77 (0.01)	23.52 (1.18)
Retailer 2	13	4	32.22 (2.11)	0.88 (0.01)	0.38 (0.02)	0.76 (0.02)	11.29 (0.68)
Retailer 3	13	4	14.89 (1.45)	0.86 (0.02)	0.46 (0.02)	0.85 (0.01)	12.52 (0.63)
Retailer 4	13	4	17.30 (1.81)	0.90 (0.02)	0.37 (0.01)	0.85 (0.01)	19.45 (0.49)
Retailer 5	13	4	18.88 (1.84)	0.91 (0.01)	0.44 (0.02)	0.86 (0.01)	10.62 (0.37)
Retailer 6	8	4	82.88 (1.60)	0.71 (0.01)	0.28 (0.01)	0.37 (0.01)	22.57 (0.85)

Standard deviation (std) refers to variation over time (13 periods).

Table 3 Results of the Random Coefficients Logit Model

Variable	Model 1		Model 2	
	Mean	StD	Mean	StD
Price (p_{jt})		6.416 (0.001)		2.554 (0.001)
× PL	-7.942 (0.001)		-9.317(0.002)	
× NB	-8.205 (0.001)		-6.896 (0.003)	
× Obesity class II	0.339 (0.000)		0.121 (0.000)	
× Obesity class III	0.231 (0.000)		0.121 (0.000)	
× Income class a	0.568 (0.000)		0.286 (0.000)	
× Income class b	0.643 (0.000)		0.336 (0.000)	
× Income class c	0.676(0.000)		0.330 (0.000)	
Diet (l_j)	-2.516 (0.000)	0.004 (0.000)	-2.366 (0.000)	0.003 (0.000)
× household's weight status	0.117 (0.000)		0.145 (0.000)	
× household's income	0.199 (0.000)		0.159 (0.000)	
B1	-2.491 (0.001)		-2.530 (0.002)	
B2	0.669 (0.001)		0.415 (0.002)	
B3	0.646 (0.001)		1.155 (0.001)	
B4	2.591 (0.001)		2.841 (0.001)	
B5	-1.311 (0.001)		-0.241 (0.002)	
B6	0.131 (0.001)		1.001 (0.002)	
B7	-1.505 (0.001)		-0.411 (0.003)	
B8	-1.310 (0.001)		0.354 (0.003)	
B9	1.803 (0.001)		2.185 (0.002)	
B10	-1.122 (0.001)		-0.727 (0.002)	
B11	-1.430 (0.001)		-0.492 (0.003)	
B12	-2.360 (0.001)		-1.962 (0.002)	
B13	-1.521 (0.001)		-0.903 (0.003)	
B14	-2.443 (0.000)		-2.102 (0.001)	
B15	-2.004 (0.000)		-1.074 (0.001)	
B16	-1.013 (0.000)		-0.387 (0.001)	
B17	-		-	
R1	0.551 (0.000)		0.753 (0.000)	
R2	-0.170 (0.000)		0.034 (0.000)	
R3	-0.088 (0.000)		0.123 (0.000)	
R4	0.308 (0.000)		0.560 (0.000)	
R5	-0.211 (0.001)		0.078 (0.000)	
R6	-		-	
Log Likelihood	–229,184		-228,922	
Weak test for instruments				
F test (p value)			2.97 (0.00)	
Exogeneity test ($H_0 : \lambda = 0$)			4.74 (0.00)	
Number of observations	100,000		100,000	

Standard errors are in parenthesis

Table 4 Own-Price Elasticities of Brands

Brands	Characteristic	Own Price Elasticities Mean (std)	Brands	Characteristic	Own Price Elasticities Mean (std)
B1	R	-3.25 (0.06)	B10	R	-3.71 (0.09)
B2	D	-3.34 (0.06)	B11	R	-3.81 (0.05)
B3	R	-3.66 (0.02)	B12	R	-3.65 (0.07)
B4	D	-3.75 (0.04)	B13	R	-3.81 (0.03)
B5	R	-3.90 (0.04)	B14	R	-2.75 (0.07)
B6	D	-3.91 (0.04)	B15	R	-3.65 (0.16)
B7	R	-3.88 (0.04)	B16	R	-3.10 (0.06)
B8	R	-3.95 (0.02)	B17	D	-2.13 (0.05)
B9	D	-3.80 (0.02)			

Standard deviation (std) refers to variation over time (13 periods).

Table 5 Average Marginal Costs (€/liter) by Brand and Retailer

	Retailer						
Brand	1	2	3	4	5	6	Total
1	0.28	0.32	0.29	0.36	0.39	0.26	0.32
2	0.31	0.33	0.31	0.34	0.34	0.25	0.31
3	0.42	0.43	0.43	0.45	0.45	0.41	0.43
4	0.44	0.46	0.43	0.45	0.47	0.38	0.44
5	0.54	0.50	0.50	0.54	0.57	0.41	0.51
6	0.56	0.46	0.51	0.53	0.50	-	0.51
7	0.50	0.51	0.48	0.55	0.52	0.53	0.51
8	0.55	0.57	0.57	0.59	0.60	-	0.57
9	0.47	0.47	0.44	0.46	0.46	-	0.46
10	0.42	0.43	0.43	0.43	0.44	0.34	0.41
11	0.46	0.45	0.49	0.47	0.45	-	0.47
12	0.37	0.40	0.47	0.43	0.42	0.32	0.40
13	0.50	0.47	0.45	0.44	0.45	-	0.46
14	0.20	0.22	0.25	0.15	0.15	0.18	0.19
15	0.32	0.44	0.45	0.27	0.40	0.25	0.35
16	0.27	0.23	0.33	0.36	0.33	0.17	0.28
17	0.25	0.24	0.23	0.10	0.23	0.06	0.19

Table 6 Margins by Brands and Retailers for the Preferred Contract Model

Brands	Total margins in % Mean (std)	Brands	Total margins in % Mean (std)	Retailers	Total margins in % Mean (std)
B1	56.32 (1.20)	B10	50.43 (1.03)	R1	45.92(0.49)
B2	55.22 (1.07)	B11	49.33 (0.59)	R2	45.07 (1.01)
B3	50.04 (0.43)	B12	51.35 (1.18)	R3	47.29 (0.62)
B4	49.74 (0.58)	B13	49.30 (0.54)	R4	48.23 (0.75)
B5	48.18 (0.66)	B14	42.14 (1.23)	R5	46.85 (0.56)
B6	48.28 (0.52)	B15	32.95 (1.52)	R6	48.37 (1.21)
B7	48.45 (0.47)	B16	38.08 (0.72)		
B8	47.40 (0.22)	B17	57.01 (1.16)		
B9	49.38 (0.30)				

Standard deviation (std) refers to variation over time (13 periods).

Table 7 Impact on Prices and Market Shares of a Decrease in the Sugar Price

Product	NB/PL	R/D	Change in cost ($\triangle c$) in % Mean (std)	Change in price ($\triangle p$) in % Mean (std)	Pass-through $\triangle p/\triangle c$ Mean (std)	Change in MS in % Mean (std)
Brand 1	NB	R	-13.31 (0.67)	-6.88 (0.13)	1.19 (0.01)	14.80 (0.36)
Brand 2	NB	D	-	1.39 (0.03)	-	-12.08 (0.18)
Brand 3	NB	R	-8.16 (0.16)	-5.05 (0.08)	1.23 (0.01)	11.64 (0.27)
Brand 4	NB	D	-	1.17 (0.02)	-	-11.88 (0.17)
Brand 5	NB	R	-4.43 (0.20)	-2.54 (0.06)	1.11 (0.01)	1.95 (0.16)
Brand 6	NB	D	-	1.11 (0.02)	-	-11.60 (0.19)
Brand 7	NB	R	-5.96 (0.33)	-3.72 (0.15)	1.21 (0.01)	6.59 (0.31)
Brand 8	NB	R	-6.15 (0.19)	-4.18 (0.11)	1.29 (0.01)	9.22 (0.36)
Brand 9	NB	D	-	1.15 (0.02)	-	-11.84 (0.19)
Brand 10	NB	R	-7.32 (0.73)	-4.31 (0.30)	1.19 (0.01)	8.38 (0.63)
Brand 11	NB	R	-7.37 (0.33)	-4.62 (0.14)	1.24 (0.01)	10.14 (0.33)
Brand 12	NB	R	-8.40 (0.67)	-4.87 (0.20)	1.20 (0.01)	10.07 (0.28)
Brand 13	NB	R	-8.17 (0.29)	-5.25 (0.12)	1.27 (0.01)	13.00 (0.33)
Brand 14	PL	R	-13.66 (1.03)	-8.26 (0.43)	1.06 (0.00)	24.95 (0.75)
Brand 15	PL	R	-7.27 (0.53)	-5.12 (0.23)	1.05 (0.00)	13.50 (0.28)
Brand 16	PL	R	-10.99 (0.43)	-7.18 (0.21)	1.06 (0.00)	18.30 (0.55)
Brand 17	PL	D	-	0.19 (0.01)	-	-7.65 (0.16)
OG						-8.25 (0.30)

NB/PL stand for National Brands/Private Labels; R/D stands for regular/Diet; MS stands for Market Share.

Standard deviation (std) refers to variation over time (13 periods).

Table 8 Impact on Prices and Market Shares of an Excise Tax

Product	NB/PL	R/D	Change in cost ($\triangle c$) in % Mean (std)	Change in price ($\triangle p$) in % Mean (std)	Pass-through $\triangle p/\triangle c$ Mean (std)	Change in MS in % Mean (std)
Brand 1	NB	R	26.06 (1.69)	14.09 (0.44)	1.25 (0.01)	-23.22 (0.65)
Brand 2	NB	D	-	-2.24 (0.08)	-	26.81 (0.55)
Brand 3	NB	R	16.58 (0.39)	10.87 (1.25)	1.31 (0.01)	-20.33 (0.24)
Brand 4	NB	D	-	-1.86 (0.05)	-	26.92 (0.50)
Brand 5	NB	R	13.82 (0.79)	9.68 (0.31)	1.35 (0.01)	-18.18 (0.47)
Brand 6	NB	D	-	-1.76 (0.05)	-	26.56 (0.60)
Brand 7	NB	R	14.24 (0.66)	9.87 (0.29)	1.34 (0.01)	-18.23 (0.49)
Brand 8	NB	R	12.62 (0.28)	9.14 (0.15)	1.37 (0.01)	-16.93 (0.43)
Brand 9	NB	D	-	-1.84 (0.03)	-	26.89 (0.49)
Brand 10	NB	R	17.13 (1.51)	11.07 (0.61)	1.30 (0.02)	-20.71 (0.96)
Brand 11	NB	R	15.56 (0.76)	10.44 (0.31)	1.32 (0.01)	-19.55 (0.46)
Brand 12	NB	R	18.50 (1.60)	11.55 (0.52)	1.29 (0.01)	-21.08 (0.52)
Brand 13	NB	R	15.51 (0.58)	10.42 (0.21)	1.32 (0.01)	-19.57 (0.36)
Brand 14	PL	R	39.64 (2.16)	24.25 (0.78)	1.06 (0.00)	-40.30 (0.19)
Brand 15	PL	R	24.91 (2.36)	17.68 (1.11)	1.07 (0.00)	-36.95 (0.35)
Brand 16	PL	R	32.99 (1.26)	21.40 (5.14)	1.07 (0.00)	-38.23 (0.20)
Brand 17	PL	D	-	-0.42 (0.04)	-	15.55 (0.38)
OG						+15.85 (0.28)

NB/PL stand for National Brands/Private Labels; R/D stands for regular/Diet; MS stands for Market Share.

Standard deviation (std) refers to variation over time (13 periods).

Table 9 Impact on Prices and Market Shares of the Combination of a Decrease in the Sugar Price and an Excise Tax

Product	NB/PL	R/D	Change in cost ($\triangle c$) in % Mean (std)	Change in price ($\triangle p$) in % Mean (std)	Pass-through $\triangle p/\triangle c$ Mean (std)	Change in MS in % Mean (std)
Brand 1	NB	R	12.75 (1.03)	6.65 (0.32)	1.20 (0.01)	-10.32 (0.51)
Brand 2	NB	D	-	-1.29 (0.06)	-	15.03 (0.46)
Brand 3	NB	R	8.41 (0.30)	5.36 (0.12)	1.27 (0.01)	-9.52 (0.21)
Brand 4	NB	D	-	-1.07 (0.04)	-	14.91 (0.45)
Brand 5	NB	R	9.39 (0.59)	6.75 (0.25)	1.39 (0.01)	-14.96 (0.38)
Brand 6	NB	D	-	-1.01 (0.03)	-	14.63 (0.51)
Brand 7	NB	R	8.28 (0.35)	5.73 (0.14)	1.34 (0.01)	-11.31 (0.30)
Brand 8	NB	R	6.46 (0.15)	4.55 (0.08)	1.34 (0.01)	-7.87 (0.24)
Brand 9	NB	D	-	-1.06 (0.02)	-	14.87 (0.42)
Brand 10	NB	R	9.80 (0.79)	6.31 (0.30)	1.30 (0.01)	-12.46 (0.52)
Brand 11	NB	R	8.18 (0.46)	5.38 (0.19)	1.30 (0.01)	-9.87 (0.32)
Brand 12	NB	R	10.09 (0.95)	6.21 (0.33)	1.28 (0.01)	-11.55 (0.41)
Brand 13	NB	R	7.33 (0.35)	4.71 (0.15)	1.27 (0.01)	-7.65 (0.27)
Brand 14	PL	R	25.98 (1.31)	15.86 (0.47)	1.06 (0.00)	-24.79 (0.32)
Brand 15	PL	R	17.64 (1.84)	12.45 (0.89)	1.07 (0.00)	-27.55 (0.35)
Brand 16	PL	R	21.99 (0.90)	14.11 (0.35)	1.07 (0.00)	-26.13 (0.23)
Brand 17	PL	D	-	-0.37 (0.03)	-	9.34 (0.30)
OG						+9.82 (0.12)

NB/PL stand for National Brands/Private Labels; R/D stands for regular/Diet; MS stands for Market Share.

Standard deviation (std) refers to variation over time (13 periods).

Table 10 Results of the Price Equation to Control for Endogeneity

Variable	Coefficient (Standard Error)
Plastic	-0.019** (0.008)
Plastic×PL	-0.000 (0.000)
Aluminum	-0.000 (0.000)
Water	0.012 (0.012)
Sugar	-0.000 (0.000)
Diesel	-0.002* (0.001)
Diesel×Manuf2	0.003** (0.001)
Diesel×Manuf3	0.002* (0.001)
Brand Fixed Effects (F test)	34.58 (0.000)
Retailer Fixed Effects (F test)	7.75 (0.000)
Diet	0.988 (1.272)
R-squared	0.977
Number of observations	1290

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

Table 11 Results of the Marginal Cost Function (Preferred Contract Model)

$\mathbf{C}_{jt}$	Coefficient (Standard error)
Wages	2.50 (0.15)
Plastic	9.10 (0.62)
Aluminium	2.17 (0.11)
Water	0.10 (0.02)
Gasoline	5.10 (0.30)
Sugar	0.14 (0.01)
Coefficients $w_{b(j)}^h$,and $w_{r(j)}^h$ not shown	
F test for $w_{b(j)}^h$ (p value)	426.34 (0.00)
F test for $w_{r(j)}^h$ (p value)	52.23 (0.00)

Table 12 Non-Nested Rivers and Vuong Tests for the Selection of the Preferred Contract Model: Test Statistic T_n

Models	**2**	3	4	5	6	7
1	**-7.02**	1.56	5.87	-4.62	2.27	8.81
2		**11.38**	**8.04**	**6.55**	**11.70**	**9.17**
3			3.89	-8.78	3.97	8.73
4				-6.99	-3.48	8.93
5					9.19	9.09
6						8.68

Model 1 is linear pricing

Model 2 is two part tariff with RPM and $w = \mu$

Model 3 is two part tariff with RPM and $p - w - c = 0$

Model 4 is two part tariff without RPM

Model 5 is two part tariff with RPM, $w = \mu$ and private labels buyer power

Model 6 is two part tariff with RPM, $p - w - c = 0$ and private labels buyer power

Model 7 is two part tariff without RPM and private labels buyer power

An Analysis of Asymmetric Consumer Price Responses and Asymmetric Cost Pass-Throught in the French Coffee Market*

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Résumé

The occurrence of asymmetric price transmission has important welfare and, hence, policy implications. The contribution of the present paper is to estimate in a structural model and then propose a formal framework to investigate one possible cause of asymmetric price transmission in the markets. In particular, we highlight the possible role of asymmetries in demand as causes of asymmetric firm price transmission of upstream cost shocks into retail prices consumers observe. The approach consists of two steps, where in the first we estimate a demand model allowing for the possibility of asymmetric demand price sensitivities and using consumers' actual purchase data and price variation in the French Coffee Market. In the second step, we account for the structure of this industry, and in particular the horizontal and vertical interactions between manufacturers and retailers. From estimates of consumers' demand on the French Coffee Market, we are able to recover price cost margins and estimated marginal costs from a supply model as in Bonnet and Dubois (2010). Thanks to simulations of cost shocks, we estimate cost pass-through and by implementing positive and negative cost shock simulations, we will test the asymmetry of cost pass-through. The results suggest that a positive cost shock is more transmitted than a negative one.

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1 Introduction

Although according to standard economic price theory, there is no foundation for prices to adjust asymmetrically to cost upturns relative to downturns, empirical findings suggest there to be in fact such asymmetric price responses in a variety of markets (for a survey see Meyer and Cramon-Taubadel, 2005). For example, Borenstein et al. (1997) in the U.S., and Noel (2009) for the Canadian market, found that gasoline prices tend to respond faster to crude oil increases than to decreases. In a cross market study for 77 consumer goods and 165 producer goods Peltzman (2000) finds there to be asymmetric price adjustment more generally than one would think : on average, the short term response to a positive cost shock is at least twice the magnitude of the response to a negative shock ; and that symmetry in price adjustments is rather an exception among the goods considered. Müller and Ray (2007) show that asymmetric price adjustment exists in a retail grocery chain of Chicago.

The occurrence of asymmetric price transmission has important welfare and, hence, policy implications. If for example, firms do not pass on the price reductions, consumers may not benefit as much expected from policy reforms involving say a tax reduction. Beyond documenting the occurrence, understanding the causes behind such a phenomenon is also an important step for policy. Although there are many potential causes advanced to explain the phenomenon of asymmetric and imperfect pass-through(such as menu costs, market power, inventory, as in Peltzman, 2000) to date there is a lack of empirical work establishing causal relationships between possible factors leading to asymmetric price transmission. In an attempt to investigate heterogeneity in the degree of asymmetric price transmissions across markets, Peltzman (2000) investigates in a reduced form setting possible correlates with asymmetric price transmission. He finds significant heterogeneity in the degree of asymmetry, moreover, the degree of asymmetry is negatively correlated with input price volatility, and his results find no significant correlation between the asymmetries and proxies measuring inventory costs, the existence of menu costs, and market power in these markets. In the policy debate asymmetric price transmission is very often considered a result of the abuse of market power (Cramon-Taubadel and Meyer, 2001).[1] In oil markets, for instance, the recent policy

[1] According to the survey in Cramon-Taubadel and Meyer (2001) asymmetric price transmission is related to concentration in the slaughter industry and retail sector.

debate centers on whether a reduction in gasoline taxes would result in gasoline price reductions at the pump. The concern there would be that the firms involved in refining and distributing gasoline would strategically adjust their margins resulting in a less than complete pass-through of the tax reduction into final gasoline prices (The New York Times, April 2008).

Since the empirical method used to detect this asymmetric price transmission in Peltzman (2000), and in similar past related studies (e.g. to be added), is reduced form, it does not allow us to investigate formally the possible causes of asymmetric price transmission. Indeed reduced form approaches find, at most, correlated factors and not causal factors. The contribution of the present paper is to estimate in a structural model and then propose a formal framework to investigate one possible cause of asymmetric price transmission in the markets. In particular, we highlight the possible role of asymmetries in demand as causes of asymmetric firm price transmission of upstream cost shocks into retail prices consumers observe. The intuition is that, if firms face demand asymmetries, in terms of a much larger response to a price increase than to a price reduction of similar magnitude, they be more reluctant to pass through price increases in the same rate as price savings into final retail prices.

Our work builds on the efforts by previous papers that find and document the existence of demand asymmetries but it is unclear that consumers will necessarily respond more to a price increase than to a price decrease. A psychological literature explains that consumers are generally more sensitive to price increases than to price decrease because when the consumer faces to a higher current price than the reference price[2], the price difference is perceived to be lower than it is and on the contrary, the price difference between a lower current price and the reference price appears higher to consumers than it is (Monroe, 1990 ; Doob et al., 1969 ; Delia Bitta and Monroe, 1974). A similar explanation is maintained in the economic literature through the prospect theory (Kahneman and Tversky, 1979). This is supported by empirical studies as Uhl and Brown (1971) that find a significant higher sentivity to price increases than price decreases. Krishnamurthi, Mazumdar and Raj (1992) suggest that consumers would react more to perceived prices losses than to price gains in their quantity choice and that only loyal consumers responds differently

[2] The economic theory on consumer purchase behavior (Thaler, 1985 ; Winer, 1986) suggests that consumer price response depends not only on the retail current price but also on the comparaison with the reference price. The reference price is the price they expect to pay for a product at a given trip occasion.

to gains and losses in brand choice decisions. Kalwani et al. (1990) also support the prospect theory. On the contrary, some other empirical studies (Bultez, 1975) found the opposite result in Europe that could be explained by the consumer loyalty. Indeed, when consumers are loyal to their brand, they react less to a price increase than to a price decrease. Moreover, they stock their favorite product. Some other empirical analysis tried to understand more precisely the purchase behavior of consumers that face price variations. Kalyanaram and Little (1994) identify a region of indifference such that changes in price within this region produce no changes in perception (price thresholds) due to historical benchmark price (consumers remember the price encountered on past purchase occasions) or competitive benchmark price (a benchmark price is formed during the purchase occasion on the basis of the price observed, ie shelf prices of competing products). Han, Gupta, Lehmann (2001) find asymmetric thresholds and particularly larger thresholds for price decrease versus price increase in the coffee category. Pauwels, Srinivasan and Franses (2007) find evidence for asymmetric thresholds and for different sign and magnitude of elasticity transitions in a large supermarket of Chicago. Price thresholds can be justified by adaptation level theory and saturation effects. In the case of negative price gap, that is equivalent to a consumer gain, even consumers perceive and recognize discounts, they may not react strongly if they are waiting for still better deals (Kalyanaram and Little, 1994 ; adaptation level theory). Moreover, saturation effects for gains (Gupta and Cooper, 1992) in retail market may originate from consumer limits to purchasing, transporting, and stockpiling products. For positive price gap, that is consumer loss, a loss must exceed a consumer's price threshold in order to be perceived (Kalyanaram and Little, 1994 ; adaptation level theory) and core loyal consumer base with a strong need or desire for the focal good (Jacoby and Chestnut, 1978 ; saturation effects).

The approach followed in this paper consists of two steps, where in the first we estimate a demand model allowing for the possibility of asymmetric demand price sensitivities along the above mentioned literature. In doing so, using consumers' actual purchase data and price variation, we assess the asymmetric price response of consumers in their brand choice in the French Coffee Market. Given the estimated demand model, we investigate in a counterfactual framework, whether the estimated asymmetric price demand model would result in firm level simulated asymmetric cost pass-through, and estimate the magnitude of the asymmetry in price cost transmission as a function of demand factors.

This paper uses structural econometric models that allow to account for the structure of this industry, and in particular the horizontal and vertical interactions between manufacturers and retailers. From estimates of consumers' demand on the French Coffee Market, we are able to recover price cost margins and estimated marginal costs from a supply model as in Bonnet and Dubois (2010). We choose the same two part tarif model as in Bonnet and Dubois (2010), Bonnet and Requillart (2012) and Bonnet et al. (2012). Assumptions on relationships between manufacturers and retailers and on vertical restraints may change the magnitude of the retail price transmission as Bonnet et al. (2012) show. However the level of pass through is out of the scope of this paper, we are interesting in the identification of an asymmetric cost pass through. Thanks to simulations of cost shocks, we estimate cost pass-through and by implementing positive and negative cost shock simulations, we will test the asymmetry of cost pass-through.

Section 2 describes the French Coffee market and available data. Section 3 presents the estimation method allowing to estimate asymmetric price response of consumers and asymmetric price threshold in their brand choice behavior. Section 4 develops the method used to estimate cost pass-through by recovering price-cost margins, estimating marginal costs and simulating cost shock. Section 5 describes demand results, asymmetric consumer behavior and asymmetric pass-through. Section 6 concludes.

2 French Coffee Market and Data

We focus our empirical analysis on the French Coffee Market during the period 1998-2006. The French Coffee market is third in the world. In 2006, behind USA and Germany, the French per capita average consumption amounts to 5 kilograms per year and then consumption stagnates in the last decade. During this long period of analysis we take advantage of price variations on raw coffee price and product prices. As Figure 1 shows, in the raw coffee price (composite indicator price of the International Coffee Organization in US cents per lb), we have a global decrease until 2001, then a global increase, and there are a lot of ups and downs. Figure 2, that represents the evolution of raw coffee price and brand prices in a retailer, shows an asymmetric product price

TAB. 1 – **Reduced form analysis of the impact of raw price on coffee retail price.**

Price	Mean (std)	Mean (std)
Raw	0.008 (0.002)	
Raw^{+}		0.011 (0.002)
Raw^{-}		0.007 (0.002)
Product fixed effects	Yes	Yes
Time fixed effects	Yes	Yes
R^2	0.75	0.75

adjustment when raw coffee price decreases or increases and also shows that price variations of coffee products on the French market are product specific. Raw coffee price increases seems to be more transmitted than raw coffee price decreases. Table 1 presents a reduce form analysis of retail price on raw coffee price where we see the impact on retail price being larger when we observe an increased raw price than a decreased one. Indeed, Raw^{+} represents the raw coffee price interacted with a dummy which is equal to one if the raw coffee price at the period t is larger than the raw coffee price at period t-1. Raw^{-} is the raw coffee price in the case of negative change. The coefficient related to Raw^{+} is indeed larger meaning that raw coffee prices impact more retail prices when they increase rather than they decrease. From the reduced form estimates we conclude that the French Coffee market consists of an interesting market to analyze the possible forces behind asymmetric price transmission of a cost shock into retail prices.

The French coffee market is concentrated at both manufacturer and retailer levels. The retailing industry of the French Coffee market represents 90% of the total consumption of coffee and is composed of seven main retailers (70% of the coffee purchases in the data) and four main manufacturers which produce six national brands (71% of the coffee purchases in the seven main retailers in our data). Market shares of the six brands vary from 2.5% to 10%. We take into account private labels of retailers on this market which represent 14% of the market share of our sample. On average, the 49 products considered, which are defined as a brand in a retailer, represent 52% of the total purchases each period, where a period consists of 4 weeks.

The data used in this paper are collected by TNS WordPanel and market shares, prices and promotion rates for all products at each period are computed from household coffee purchases from 1998 to 2006. We also are able to compute from the consumer purchases the characteristics

Tab. 2 – **Descriptive Statistics.**

	Prices in € (std)	Shares in % (std)	Promotion rate in % (std)	Arabica coffee rate in % (std)	Robusta coffee rate in % (std)
Brands					
B1	9.60 (0.73)	9.26 (2.16)	9.77 (9.60)	99.92 (0.62)	0
B2	5.43 (0.81)	7.76 (1.98)	27.20 (17.16)	32.28 (12.53)	0.05 (0.39)
B3	7.41 (1.05)	7.09 (1.27)	22.27 (11.54)	65.63 (1.30)	14.45 (10.49)
B4	7.51 (1.53)	10.20 (2.38)	21.49 (11.19)	66.50 (12.23)	0.05 (0.42)
B5	5.02 (1.29)	2.97 (0.92)	38.69 (24.37)	42.55 (23.67)	5.16 (11.61)
B6	8.30 (1.23)	2.69 (0.43)	16.30 (13.03)	75.19 (14.16)	0.01 (0.20)
B7	5.49 (0.67)	14.30 (2.46)	12.05 (9.06)	58.19 (14.82)	10.41 (14.28)
Retailers					
R1	6.67 (1.91)	6.80 (1.07)	26.48 (17.64)	59.88 (25.38)	4.96 (11.60)
R2	6.86 (2.05)	9.24 (1.50)	22.69 (17.90)	63.16 (25.26)	4.86 (9.61)
R3	7.17 (1.84)	5.37 (1.75)	15.74 (14.11)	62.33 (23.92)	7.15 (14.28)
R4	7.15 (1.93)	10.63 (1.67)	15.87 (12.92)	61.69 (25.26)	4.00 (6.26)
R5	6.67 (1.76)	13.55 (1.76)	23.75 (17.11)	62.50 (24.74)	3.11 (6.96)
R6	7.08 (1.83)	5.19 (1.24)	19.41 (16.83)	65.30 (23.80)	4.12 (9.68)
R7	7.18 (1.98)	3.49 (0.96)	23.61 (19.71)	65.62 (24.77)	1.93 (5.95)
Outside Option		45.69			

of the product such as the rate of arabica coffee and ground coffee. In our data, during the period 1998-2006, we have roughly 50% of price increase. This proportion is the same for all brands and all retailers considered in this paper, except for brand 4 where the proportion of price increases is lightly greater (55%). Descriptive statistics of these data are presented in Table 2 and 3. There exists some heterogeneity of the price and market shares among brands. Prices are between €5.02 and €9.60 and market shares between 2.69% and 14.30%. Brand 1 is the most expensive, which could be explained by the weakest promotion rate (9.77%) and the higher rate of arabica coffee, and brand 5 the cheapest, that could be explained by the highest promotion rate (38.69%). The private label product is sold at €5.49 on average and has the higher market shares. Interestingly there is no heterogeneity in price across retailers despite a large heterogeneity in market shares among them. For arabica, bean and caffeine-free coffee types we remark there exists few heterogeneity among purchases in the different retailers. In terms of of product purchases, 60% originate from arabica coffee in all retailers, 1.7% are bean coffee and the caffeine-free product purchases are around 10%. The only heterogeneity remains in the robusta coffee rate (from 1.93% to 7.15% in average). Finally, descriptive statistics suggest a larger magnitude in coffee characteristics by brands.

TAB. 3 – **Descriptive Statistics (cont.).**

	Bean coffee rate in % (std)	Caffeine-free coffee rate in % (std)
Brands		
B1	2.52 (2.37)	8.40 (4.72)
B2	1.34 (1.90)	16.92 (7.36)
B3	2.69 (3.13)	11.09 (6.65)
B4	1.49 (1.63)	11.25 (5.40)
B5	0.81 (4.75)	3.32 (6.28)
B6	0.24 (1.07)	7.49 (8.11)
B7	2.08 (2.21)	13.75 (6.95)
Retailers		
R1	1.37 (2.25)	10.91 (8.88)
R2	1.56 (2.37)	9.12 (6.42)
R3	2.04 (4.64)	10.01 (7.58)
R4	1.73 (2.47)	10.93 (7.79)
R5	1.67 (1.92)	11.12 (6.47)
R6	1.68 (2.95)	11.30 (8.72)
R7	1.13 (1.93)	8.91 (7.64)

3 Estimation Method of the Asymmetric Consumer Price Response

3.1 Demand Model

To model consumer behavior and asymmetric demand responses to a price change, we use a standard brand choice model such as a random coefficients logit model as in Berry, Levinsohn, Pakes (1995) and Nevo (2001). This model allows flexible substitution patterns with respect to the standard multinomial logit model taking account for consumer heterogeneity. We assume that I consumers can choose among J products during T periods. The utility of a consumer i purchasing the product j at period t can be written as :

$$U_{ijt} = V_{ijt} + \varepsilon_{ijt} = \delta_j + \eta_t - \alpha_i p_{jt} + X_{jt}\beta_x + \xi_{jt} + \varepsilon_{ijt},$$

where δ_j is a product fixed effect capturing unobserved time invariant product characteristics, η_t is a time fixed effect allowing to capture seasonnal variations and trend of coffee consumption, p_{jt} is the price of the product j at period t and α_i represents the consumer price sensitivity, X_{jt} is observed product characteristics like promotion and β_x are corresponding coefficients. The term ξ_{jt} accounts for monthly changes in factors such as shelf space, positioning of the product among others that affect consumer utility, are observed by consumers and firms but are not observed by the researcher. ε_{ijt} is an i.i.d. type I extreme value distributed error term capturing consumer idiosyncratic preferences.

We allow for unobserved household heterogeneity in the price sensitivity throught a random component $\nu_i \sim N(0,1)$ in α_i and for an asymmetric consumer price response through both coefficient α^1 and α^2. The coefficient of price variable is then given by

$$\alpha_i = \left(\alpha^1 + \alpha^2 1_{[p_{jt} - p_{jt-1} > 0]}\right) + \sigma \nu_i.$$

We suppose that the reference price of consumers is only the last price observed. This adjustment implies that consumers make an immediate and complete adjustment in their price expectations after an exposure to a price stimulus.

We introduce an outside good option, denoted good 0, to allow the possibility of consumer i not buying one of the J marketed products and suppose that the utility is given by :

$$U_{i0kt} = \varepsilon_{i0kt}.$$

Let the distribution of ν_i across consumers be denoted by $F(\nu_i)$. The aggregate share S_{jt} of product j at period t across all consumers is obtained by integrating the consumer level probabilities :

$$S_{jt} = \int \frac{\exp(V_{ijt})}{1 + \sum_{k=1}^{J} \exp(V_{ikt})} dF(\nu_i). \tag{1}$$

This demand model allow to obtain own- and cross-price elasticities and we will show if there exists an asymmetric behavior in the price response of consumers.

3.2 Estimation and identification of Demand

To estimate the set of parameters $\theta = (\delta_j, \eta_t, \beta_x, \alpha^0, \alpha^1, \sigma)$, we use the GMM method as in Nevo (2001) and solve the endogeneity problem of prices by using input prices as instrumental variables such as oil, raw coffee price, arabica and robusta coffee price interacted with national brand or private label dummies. Raw coffee prices are a composite indicator prices computed by the International Coffee Organization and average composite prices for arabicas and robustas group. The oil price index is given by the French National Institute for Statistics and Economics Studies (INSEE). The interaction with national brand or private label dummies aims at capturing the fact that the cost of input may differ according to the brand and particularly differ between national brands and private labels.

4 Estimation Method of Cost Pass-Through

In this section, after deducing the price elasticities given demand, we then compute estimated marginal cost. Thanks to simulations comparing equilibrium prices in both cases, with and without a cost shock on the estimated marginal cost, we are able to estimate cost pass-through. We will then estimate the cost pass-through in both cases of positive and negative upstream cost shocks and we will expect significant different price changes.

4.1 Supply Model

Given the market considered, we assume an oligopoly model of two part tarif contracts between manufacturers and retailers to estimate price-cost margins and marginal costs. This model, introduced theoretically by Rey and Vergé (2004) and empirically implemented in Bonnet and Dubois (2010), allows a simple expression for price-cost margins in the case where we assume resale price maintenance with respect to linear pricing contracts, that are usually used. Moreover, these two part tarifs contracts with resale price maintenance are considered in several empirical studies of vertical contracts as a better model than the linear pricing one or two part tariff contracts without resale price maintenance (Bonnet and Dubois, 2008 and 2010 ; Bonnet, Dubois and Villas Boas (2009)).

Manufacturers offer two-part tariffs contracts which consists of wholesale prices w_j and franchise fees F_j paid by the retailer for selling the product j to the manufacturer but also retail prices p_j since manufacturers can use resale price maintenance. Then retailers simultaneously accept or reject the offers that are public information. If one offer is rejected, all contracts are refused. If all offers have been accepted, retailers simultaneously set their retail prices and demand and contracts are satisfied.

Let S_r define the set of products sold by the retailer r and S_f the set of products produced by the manufacturer f.

In the case of these two part tariffs contracts, the profit function of retailer r is

$$\Pi^r = \sum_{j \in S_r} [M(p_j - w_j - c_j)s_j(p) - F_j]$$

where c_j the constant marginal cost of distribution of product j and $s_j(p)$ the market share of the product j. The profit function of firm f is equal to

$$\Pi^f = \sum_{k \in S_f} [M(w_k - \mu_k)s_k(p) + F_k]$$

where μ_k represents the constant marginal cost of production of product j. Manufacturer f chooses the terms of the contracts (p_j, w_j and F_j) in order to maximize profits Π^f subject to the following retailers' participation constraints for all $r = 1, .., R$, $\Pi^r \geq \overline{\Pi}^r$.

If we consider the case where wholesale prices are such that the retailers add only retail costs to the wholesale prices and thus the retailer's price cost margins are zero ($p_k^*(w_k^*) - w_k^* - c_k = 0$), we deduce from this model, an expression for the price-cost margins of the manufacturer f :

$$\sum_{k \in S_f} (p_k - \mu_k - c_k)\frac{\partial s_k(p)}{\partial p_j} + s_j(p) + \sum_{k \in \{J', .., J\}} (p_k - \mu_k - c_k)\frac{\partial s_k(p)}{\partial p_j} = 0 \quad \text{for all } j \in G_f \tag{2}$$

where products in $\{J', .., J\}$ are private labels.[3]

Given the vertical supply model assumptions a price cost margin is obtained $\Gamma_{jt} = p_{jt} - \mu_j - c_j$ for the product j and a corresponding marginal cost $C_{jt} = \mu_j + c_j = p_{jt} - \Gamma_{jt} follows.$

4.2 Cost Shock Simulation

Given these marginal costs $C_t = (C_{1t}, ..., C_{Jt})$ and the other estimated structural parameters, we are able to simulate an upstream cost shock λ and equilibrium prices are deduced from the following minimization program

$$\min_{\{p_{jt}^*\}_{j=1,\dots,J}} \quad \|p_t^* - \Gamma_t\left(p_t^*\right) - \lambda \times C_t\|$$

where $\|.\|$ is a norm of $\mathbb{R}^J$. In practice we will take the euclidean norm in $\mathbb{R}^J$.

The cost pass-through is estimated from the difference between observed prices and new equilibrium prices in the case of a cost shock. We investigate the asymmetry of cost pass-through simulating both a cost increase (for instance, $\lambda = 1.1$) and a cost decrease (for instance, $\lambda = 0.9$) and comparing the magnitude of this both cost pass-through given the structural model.[4]

[3] For expressions for private labels margins see in Bonnet and Dubois (2010).

[4] It has to be noted that equilibrium prices depend only on total marginal cost. Thus, the effect of production or distribution cost shocks that result in the same total marginal cost will always be the same.

TAB. 4 – **Demand Estimates (standard errors are in parenthesis).**

	Model 1 Mean (Std)	**Model 2** Mean (Std)
Price (α^1)	-0.74 (0.02)	-0.73 (0.03)
Price$\times 1_{[p_t - p_{t-1} > 0]}(\alpha^2)$		0.12 (0.06)
Price (σ)	0.16 (0.08)	0.18 (0.09)
Promotion rate	-0.24 (0.07)	0.43 (0.35)
Arabica coffee rate	2.63 (0.25)	1.64 (0.56)
Robusta coffee rate	-0.38 (0.11)	0.15 (0.30)
Bean coffee rate	-1.52 (0.25)	-2.09 (0.40)
Caffeine-free coffee rate	-0.27 (0.16)	-1.08 (0.43)
$\delta_j, \eta_{y(t)}$ and $\eta_{m(t)}$ not shown		
GMM objective (df)	$3.67(\chi^2(7))$	$2.25(\chi^2(7))$

5 Results

In this section, we first present results from the estimation of consumers demand to assess asymmetric consumer price response to an increase or decrease in retail prices. Then, we show how cost pass-through could differ in magnitude according to the sign of the change in cost.

5.1 Consumer Price Response

Table 4 shows the estimated instrumental variable demand parameters given a random coefficient specification under two models. Model 1 does not take into account the different consumer price response when prices increased or decreased whereas the model 2 does so. According to the GMM objective function, the set of instruments used is valid since the test statistic of the Hansen (1982) test, the GMM objective, is lower than the critical value the a Chi Deux of 7 degree of freedom. While both models suggest a negative estimated price coefficient, when consumers are faced with a price increase, their price sensitivity significantly decreases. We note that the promotion rate is negatively correlated with utility when we do not account for asymmetric consumer price responses and the estimated coefficient becomes positive and non significant in model 2. We obtain the same behavior for the robusta coffee rate characteristics. For both models, the coefficient related to the arabica coffee rate is positive and significant, meaning that consumers prefer arabica characteristics relative to the bean and the caffeine-free characteristics.

The random coefficients logit model gives different and significant price elasticities when prices

Tab. 5 – **Own price elasticities from the Random Coefficients logit Model (standar errors are in parenthesis).**

	Model 1		Model 2	
	$\Delta p > 0$	$\Delta p \leq 0$	$\Delta p > 0$	$\Delta p \leq 0$
Brand 1	-5.96 (0.38)	-5.77 (0.33)	-4.40 (0.26)	-5.48 (0.31)
Brand 2	-3.95 (0.43)	-3.58 (0.43)	-3.10 (0.31)	-3.49 (0.40)
Brand 3	-5.08 (0.50)	-4.61 (0.55)	-3.87(0.34)	-4.44 (0.50)
Brand 4	-5.07 (0.73)	-4.66 (0.74)	-3.85 (0.46)	-4.48 (0.68)
Brand 5	-3.83 (0.80)	-3.24 (0.57)	-3.01 (0.57)	-3.17 (0.55)
Brand 6	-5.58 (0.49)	-5.07 (0.62)	-4.18 (0.32)	-4.86 (0.56)
Brand 7	-3.90 (0.39)	-3.66 (0.40)	-3.06 (0.28)	-3.57 (0.38)

increase and decrease. Table 5 represents for each brand the own price elasticities in both cases and for each models. We obtain -4.58 (1.01) and -3.65 (0.65) for own price elasticities when prices increase in models 1 and 2 respectively, and –4.36 (1.00) and -4.20 (0.91) in the opposite case for models 1 and 2 respectively. Whether own price elasticities seem to be close when consumers face to a price decrease, we obtain a significant difference when prices increase. We over estimate consumer price response by 30% in average when they face to price increase if we do not take into account an asymmetric price response in the utility specification. We also see that own price elasticities are different across brands and the over estimation of own price elasticities could vary from 27% to 35% according the brand.

5.2 Cost Pass-Through

From the demand model estimates, we are able to compute estimated margins from the supply model in section 4.1. We obtain in average 35.08% with a standard deviation 7.90. Taking the difference between observed prices and estimated margins, we can estimate marginal cost for each product at each period in our French Coffee data which amounts to €4.61 (1.61 for standard deviation).[5]

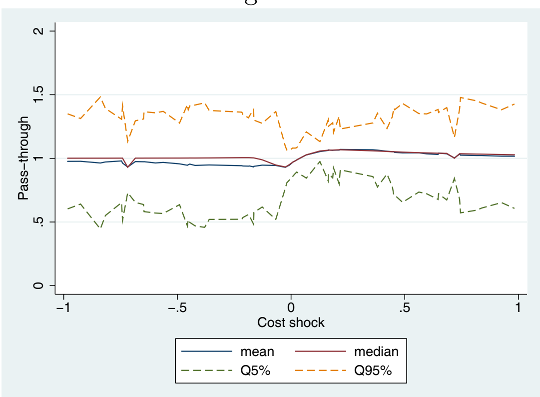
Given the estimated models, we simulate a range of negative and positive shocks (between -100% and 100%) to obtain a distribution of cost pass-through estimates. The first step is to estimate the impact of the cost shock on the total marginal cost of coffee products. We use an OLS

[5] In the model 1 case, that is without considering asymmetric consumer price response, margins are underestimated, 30.21 (7.29) on average, and marginal costs are then overestimated. Indeed we obtain 4.95 (1.73) on average, which consists in an error of estimation by 7% in average.

regression of the marginal cost estimated from the demand and supply models on the raw coffee price and product and time fixed effects (see table 7 in appendix for results in both demand cases). Marginal cost changes correspond to 84% of the simulated raw cost shock, that is when the raw coffee shock increases by 10%, the impact of the total marginal cost is by 8.4%, and that is true for the marginal cost estimated from both demand models.

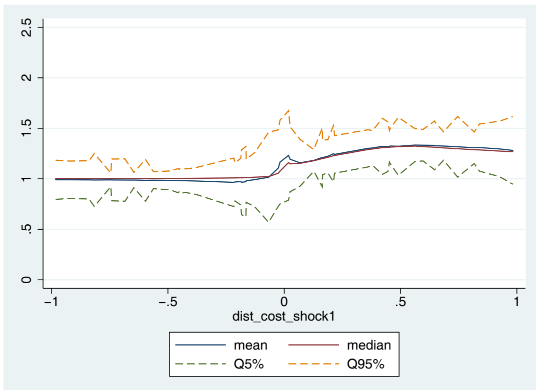
The cost pass-through estimated, which is defined by the ratio of the difference in final retail price and the difference in raw coffee cost shock, is illustrated by the Figures A and B when asymmetric consumer price response are and are not considered. Without considering asymmetric consumer price responses Figure A suggest that few difference exists between the effect of a positive and of a negative cost shock on retail prices. Both imply a pass-through around 1, event if a positive cost shock slightly implies a pass-through above one and a negative cost shock below one. On the contrary, Figure B suggest that a positive raw coffee shock is more passed on than a negative raw coffee shock when considering asymmetric price response. We also obtain that the pass-through tends to decrease after a positive cost shock greater than 50%. Small negative cost shock would slightly transmit more than 1 whereas after a negative 10% cost shock, the pass-through seems to converge to one. We also remark that a low cost shock (under 3% cost shock), whatever the sign of the shock, is more transmitted.

Figure A



Without asymmetric consumer price responce

Figure B



With asymmetric consumer price response

Table 6 shows the results of the regression of estimated pass-through on cost shock variables and on product characteristics when we take into account the asymmetric price response of consumers in the demand model. We try to explain the estimated pass-through by a dummy for each retailer (the retailer 7 is in reference) that could capture the different price transmission behavior of

TAB. 6 – **Regression of Pass-through on cost shock variables and product characteristics.**

	With asymmetric consumer price response
Retailer 1	-0.002 (0.001)
Retailer 2	0.000 (0.001)
Retailer 3	0.002 (0.001)*
Retailer 4	0.006 (0.001)**
Retailer 5	0.001 (0.001)
Retailer 6	0.003 (0.001)**
Manufacturer 1^+	0.163 (0.002)**
Manufacturer 1^-	-0.047 (0.001)**
Manufacturer 2^+	0.081 (0.002)**
Manufacturer 2^-	0.010 (0.002)**
Manufacturer 3^+	0.045 (0.002)**
Manufacturer 3^-	-
Private labels$^+$	0.077 (0.002)**
Private labels$^-$	0.013 (0.002)**
Cost variation$^+$	0.233 (0.003)**
Cost variation$^-$	-0.245 (0.003)**
Cost variation$(> 50\%)^+$	-0.123 (0.003)**
Cost variation$(>50\%)^-$	0.132 (0.003)**
Const	1.073 (0.004)**
Month fixed effects	Yes

retailers, by a dummy for each of the three manufacturers and for private labels as well allowing a different effect on pass-through computed from a negative cost shock and on ones computed from a positive cost shock. We also choose as explanatory variables the value of the cost shock differentiating negative and positive shocks and allow for different effects whether the cost shock is greater than 50%. We control for the time period as well. We find weak differences across retailers. Few coefficients of retailers fixed effects are significant and the value of significant ones is low. Concerning manufacturers dummies, their effect is larger on pass-through than the retailers dummies, meaning the role of manufacturers in the price transmission of cost shock is greater than the role of retailers[6]. We also see that private labels transmit more negative shocks that the three other manufacturers whereas their price transmission of a positive cost shock is lower than manufacturers 1 and 2. We face to some heterogeneity across manufacturers in the price transmission of a cost shock. Results from cost shock variables show that the pass-through from a positive cost shock increases with the level of the shock whereas we find the opposite result

[6] This result coul be seen as a consequence of the supply model assumed. Indeed, we consider that manufacturers have all bargaining power and they impose to retailers the consumer prices. However, Rey and Vergé (2010) show the price equilibrium would be the same whether one assume that retailers have all the bargaining power. Only the sharing of the profit would change. The estimated marginal cost and then the estimated pass-through would be the same. Hence, this result is not an artefact of this assumption.

for negative cost shocks. We also find that large positive cost shocks (greater than 50%) are less transmitted and large negative cost shocks are more transmitted. Taken as a whole, we see that cost shocks are more transmitted to the consumer price than the variation in cost and positive cost shocks are more transmitted than negative ones as we saw in the previous graph as well.

6 Conclusion

In this paper, we present empirical evidence on the role of possible asymmetries in consumers' price responses into explaining asymmetric cost price pass-through. For that, we use a structural econometric model that allows to recover marginal costs from prices, market shares and product characteristics. Given the demand and supply model we estimate marginal cost. From estimated cost we simulate shocks and find the resulting simulated new equilibrium prices. Introducing the possibility of consumers reacting differently to a price increase or decrease, we find that French households are less sensitive to a price increase than to a price decrease on the Coffee Market. This implies different magnitudes of a cost pass-through according to the sign of the cost shock simulated. A positive cost shock is more transmitted than a negative one.

For future research, this work could be extended estimating price thresholds from which the consumer differently reacts to a price variation. To taclke this point we need to use Bayesian method as in Terui and Dahana (2006).

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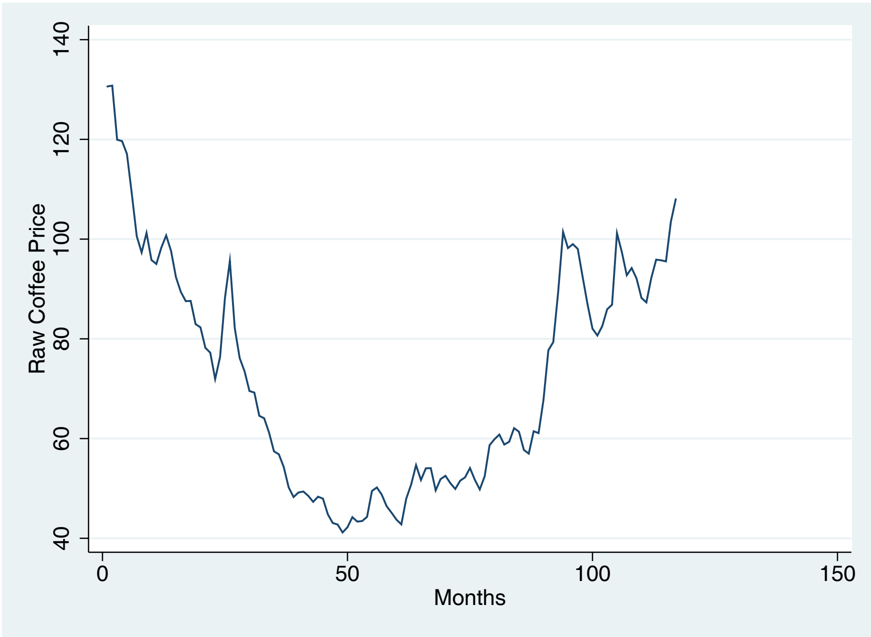

FIG. 1 – Raw Coffee Price from 1998 to 2006

TAB. 7 – **OLS regression of the marginal cost estimated.**

Marginal cost estimated	Model 1 Mean (Std)	Model 2 Mean (Std)
Raw	0.052 (0.001)	0.048 (0.001)
Product fixed effects	Yes	Yes
Time fixed effects	Yes	Yes
R^2	0.96	0.96
Number of observations	5671	5671

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8 Appendices

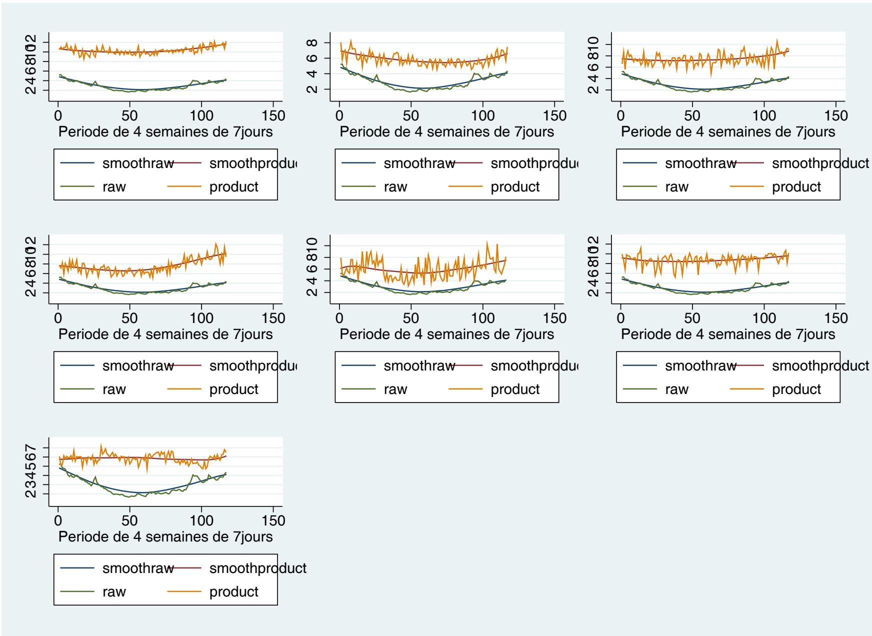

Fig. 2 – Raw coffee price and brand prices in a retailer.

Price Transmission in the Dairy Industry : The Cases of the French Dairy Desserts and Fluid Milk Markets

Céline Bonnet, Tifenn Corre and Vincent Réquillart

June 26, 2013

Preliminary Version

1 Introduction

To be done

Main ideas :

- Since the reform of the CAP in 2006, the volatility of milk price has increased significantly. Percent variations are large.
- It's interesting to analyse the price transmission on markets where milk is widely used : cases of dairy desserts and fluid milk markets

2 Data and descriptive statistics

We study both dairy desserts and fluid milk markets in France, quaterly, from 2006 to 2009. We use consumer panel data collected by Kantar WorldPanel (formerly TNS WorldPanel) which is a French representative survey of 20,000 households over a four-year period (2006-2009). This survey records information on every food products each household in the panel purchased (in particular : quantity, price, retail chain, brand, characteristics of goods). In order to compare purchases from a year to another, we kept only the households who bought at least one product each year, that is to say 7,738 and 7,293 households for the dairy desserts and fluid milk markets, respectively.

We divided those markets into segments. In the case of dairy desserts, we defined three segments : yoghurts (plain, flavoured or fruit yoghurts), cottage cheeses, and others dairy desserts such as cream desserts, creamy rice puddings, mousses or custards for example. Then, we consider that the yoghurts and cottage cheeses can either be light or not according to their fat content, whereas the others dairy desserts are considered to never be light. Thus, five categories are defined. We selected the eighteen primary national brands (NB) as well as five private labels (PL), one for each of the five categories described previously. As regards the fluid milk, we separated the market into three groups : skimmed, semi-skimmed and whole milk. We selected the twelve primary NB as well as three PL, one for each of the three kinds of milk.

We consider purchases in all retailers. Retailers are grocery store chains which differ by both the size of their outlets and the services they provide to consumers. In addition to the top five retailers that operate in the French retail sector (three of them are characterized by large outlets and the two other ones have intermediate size outlets), we define two aggregates : the first one includes the discounters which have small to intermediate size outlets and propose basic services only. The other one comprises the remaining retailers. All those retailers are national chains present throughout France. Consumers from the different regions in France face the same assortment of products when they go in a given retailer[1] From the consumer perspective, a product is the combination of a brand and a retailer. Thus, brand 1 bought at retailer 1 is different from brand 1 purchased at retailer 2. This distinction allow us to analyse vertical contracts between manufacturers and retailers as well as prices strategies.

Taking into account the set of products carried by each retailer, we obtain 161 and 103 differenciated products that compete on the market of dairy desserts and fluid milk respectively. Besides, we define an 'outside option' which aggregates all the other alternatives a consumer might choose rather than the dairy desserts or fluid milk. In the analysis of dairy desserts, the outside option includes fruits, ice creams and pastries whereas in the analysis of fluid milk, the outside option includes goat, soy and other origins milks. Consumers can thus substitute one of the NB or PL dairy dessert or fluid milk brands with an alternative product.

[1]This is true for the NBs we consider which are the main ones. It might be the case that in some small outlets, the assortment is reduced but we do not have the information.

2.1 The market of dairy desserts

In the case of dairy desserts, the database is composed of 4,450,818 purchases, outside option included. The products selected for this analysis represent 53.15% of the entire market.[2] The average part of outside option is 46.85% and it is mainly composed of pastries and ice creams (7% and 5% of the entire market respectively). The remaining part (35%) is composed of the purchases of different fruits with lower market shares. According to our sample, Danone, Yoplait and Nestlé are the three main manufacturers on the market of dairy desserts. they represent 42% of purchases on average over the 16 quarters, while the market share of private labels is around 49%.We decide to create an aggregate "Other manufacturers" that contains all the remaining manufacturers who produce national brands other than Danone, Yoplait and Nestlé. Its market share is around 9% over the 16 periods. We consider the four main brands produced by Danone (Activia, Danette, Taillefine and Gervais), the main brand for Yoplait (Panier) and the main brand for Nestlé (La laitière). We also define define three aggregates, each one gathering brands of Danone, Yoplait and Nestlé other than those described previously.

The average price over all products and all periods is €2.27 per kilogram. The average prices of yoghurts, cottage cheeses and other dairy desserts are €1.94, €2.42 and €2.96 per kilogram respectively. Regular products dominate since they roughly represent 85% of the dairy desserts purchases. On average, diet yoghurts are sold at a higher price than the regular ones whereas we observe the opposite effect for the cottage cheeses (Table 1). This could be explained by the fact that diet cottage cheeses are PLs only. The main difference is between NBs and PLs (Table 17). Due to the fact that NBs prices are much higher than PLs prices (€2.36 and €1.45 per kilogram for yoghurts, €3.05 and €1.93 per kilogram for cottage cheeses, €3.48 and €2.47 per kilogram for other dairy desserts) and because NBs and PL's have almost the same market shares on this market (51% and 49% respectively), we can deduce that consumers have a good perception of PL's products.

All brands are available in every retail chain, except in retailer 7 which mainly sells PLs (Table 16). Retailers 1 to 5 choose prices which are quite similar. The average price within a retailer is mainly explained by the relative shares of NB and PL sold by the retailer. Retailer 6 is a little more expensive than the other ones whereas retailer 7 is a special case since it is an aggregate of discounters which generally offer less products (they sell 16 NBs among the 18) with lower services. Prices for both NBs and PLs are lower in retailer 7 than in the other retailers.

[2]The market share of a product (brand x retailer) is defined as the ratio of the sum of the quantities of the selected brand purchased at the selected retailer during a period of three months and the sum of quantities of all brands purchased at all of the retailers during the same period in the whole market which includes dairy desserts, fruits, ice-creams and pastries in the case of dairy desserts and all kinds of milk in the case of fluid milk

Table 1: **Descriptive Statistics for Prices and Market Shares by Categories (Desserts).**

		Prices (in euros per kilogram) Mean (std)	Market Shares Mean in % (std)
Outside Good			46.85 (6.32)
Dairy desserts		2.27 (0.04)	53.15 (6.32)
	Regular yoghurts	1.90 (0.04)	44.73 (0.51)
	Diet yoghurts	2.10 (0.05)	13.00 (0.74)
	Regular Cottage cheeses	2.51 (0.05)	16.14 (0.32)
	Diet Cottage cheeses	1.68 (0.07)	2.14 (0.26)
	Regular Other dairy desserts	2.96 (0.06)	23.98 (0.87)
	National brands	2.72 (0.08)	50.94 (1.31)
	Private labels	1.81 (0.05)	49.06 (1.31)

2.2 The market of fluid milk

As regards the fluid milk market, the database is composed of 577,334 purchases of cow milk which represent 98.56% of the entire fluid milk market (composed of 596 850 purchases). Thus, the average part of outside option is 1.44%, mainly composed of soy milk and goat milk (1.12% and 0.23% of the entire market respectively). The remaining part (0.09%) is made of the purchases of other origins milk. In our sample, Sodiaal and lactalis are the two main manufacturers on the market of the cow fluid milk. They represent 20% of purchases on average over the 16 quarters, while the market share of privtate labels is around 62%.We also decide to create an aggregate "Other manufacturers" that contains all the remaining manufacturers who produce national brands other than Sodiaal and Lactalis. Its market share is around 18% over the 16 periods. We consider the main brand produced by Sodiaal (Candia) and the two main brands for Lactalis (Lactel and Bridel).

The average price over all products and all periods is 0.67 euros per liter. The average prices of skimmed, semi-skimmed and whole milk are €0.67, €0.66 and €0.84 per liter respectively. Semi skimmed products dominate since they roughly represent 86% of the cow milk purchases. The main difference is between NBs and PLs (Table 20). Due to the fact that NBs prices are much higher than PLs prices (€0.92 and €0.58 per liter for skimmed milk, €0.71 and €0.63 per liter for semi-skimmed milk, €1.07 and €0.73 per liter for whole milk) and because PLs have a greater market share than the NBs on this market (62% and 38% respectively), we can deduce that consumers have a good perception of PLs products.

All brands are available in every retail chain, except in retailers 2 where a product is missing and in retailer 7 which mainly sells PLs (Table 19). On this market, retailers 1 to 5 also choose prices which are quite similar on the average. Despite the fact that PLs have almost the same price in the different retailers, we can notice a bigger difference between NBs prices. In fact, retailers 3 and 6 are selling the NB products at a higher price than the other retailers. The average price within a retailer is mainly explained by the relative shares of NB and PL sold by the retailer. Retailer 7 is still a special case on this market with lower prices for both NBs and PLs than in the other retailers.

Table 2: **Descriptive Statistics for Prices and Market Shares by Categories (Milk).**

		Prices (in euros per liter) Mean (std)	Market Shares Mean in % (std)
Outside Good			1.44 (0.11)
Cow fluid milk			98.56 (0.11)
	Skimmed milk	0.67 (0.05)	8.45 (0.28)
	Semi-skimmed milk	0.66 (0.03)	85.79 (0.30)
	Whole milk	0.84 (0.05)	5.76 (0.28)
	National brands	0.74 (0.02)	38.16 (3.43)
	Private labels	0.63 (0.03)	61.84 (3.43)

3 Models and methods

To analyze strategic pricing in the food chain, we follow a general methodology that was recently developed to analyze vertical relationships between manufacturers and retailers (e.g. Berto Villas-Boas, 2007; Bonnet and Dubois, 2010) . We consider a demand model to obtain the price elasticities of demand for every products. The model needs to be as flexible as possible, so we opt for a random coefficients logit model (Berry et al., 1995; McFadden and Train, 2000) . Strategic pricing in the channel can be modified by the nature of the contracts between the firms in the sector or by the vertical restraints considered. We design alternative models for the vertical relationships between the processors ans the retailers. Based on the first-order conditions ans estimates of demand, we are able to compute the price cost margins for manufacturers ans retailers, from which we deduce the cost estimates. To choose the vertical relationship model that best fits the data, we estimate a cost equation for each vertical relationship model. The endogenous variable of the cost equation is the cost calculated from the considered model of vertical relationship. Then we use a non-nested Rivers and Vuong (2002) test to select the best supply model among all the alternatives. Finally, using the selected model, we simulate the impact of the alternative price policies on consumers' prices and consumption. In the following, we provide a brief summary regarding the main assumptions and methods. More extensive explanations regarding the details of the method can be found in Bonnet and Dubois (2010).

3.1 The demand Model : a random coefficients logit model

We use a random coefficients logit model to estimate the demand model and the related price elasticites. In the case of dairy desserts, the indirect utility function V_{ijt} for consumer i buying product j in period t is given by

$$V_{ijt} = \beta_{b(j)} + \beta_{r(j)} + \alpha_i p_{jt} + \beta_c C_j + \beta_d D_j + \beta_l l_j + \varepsilon_{ijt}$$

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, α_i is the marginal disutility of the price for consumer i, C_j D_j and l_j are dummies related to an observed characteristic (C_j takes the value of 1 if product j is a cottage cheese product and 0 otherwise ; D_j takes the value of 1 if product j is an other dairy dessert and 0 otherwise ; l_j takes the value of 1 if product j is a light product and 0 otherwise) and ε_{ijt} is an unobserved error term.

On the fluid milk market, the indirect utility function is a bit different and is given by

$$V_{ijt} = \beta_{b(j)} + \beta_{r(j)} + \alpha_i p_{jt} + \beta_s S_j + \beta_w W_j + \varepsilon_{ijt}$$

where S_j and W_j are dummies related to an observed characteristic (S_j takes the value of 1 if product j is a skimmed milk product and 0 otherwise ; W_j takes the value of 1 if product j is whole milk product and 0 otherwise).

In both cases of dairy desserts and fluid milk, we assume that α_i varies across consumers. Indeed, consumers can have a different price disutility. We assume that the parameter has the following specification :

$$\alpha_i = \alpha_{NB_j} + \alpha_{PL_j} + \sigma\nu_i$$

where ν_i captures the unobserved consumers characteristics and σ measures the unobserved heterogeneity of consumers. We assume a parametric distribution for ν_i denoted by $P_\nu(.)$ and P_ν is independently and normally distributed with mean $\alpha_{NB} + \alpha_{PL}$ and standard deviation σ.

We can then break down the indirect utility into a mean utility

$$\delta_{jt} = \beta_{b(j)} + \beta_{r(j)} + (\alpha_{NB_j} + \alpha_{PL_j})p_{jt} + \beta_c C_j + \beta_d D_j + \beta_l l_j + \xi_{jt}$$

or

$$\delta_{jt} = \beta_{b(j)} + \beta_{r(j)} + (\alpha_{NB_j} + \alpha_{PL_j})p_{jt} + \beta_s S_j + \beta_w W_j + \xi_{jt}$$

for the dairy desserts and for the fluid milk respectively, where ξ_{jt} captures all unobserved product characteristics and a deviation from this mean utility $\mu_{ijt} = p_{jt}\sigma\nu_i$. The indirect utility is then 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 allows subsitution 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 ε_{ijt} is independently and identically distributed like an extreme value type I distribution, we are able to whrite the market share of product j at period t in the following way (Nevo, 2001) :

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

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

The random coefficients logit model generates a flexible pattern of subsitutions between products, driven by the different consumer price disutilities α_i. Thus, the own and cross-price elasticities of the market share s_{jt} can be written as :

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

3.2 Identification and estimation method

We estimated the demand model using individual data. We randomly chose 100,000 observations among the 4,450,818 we have in the database of dairy desserts and also 100,000 observations among the 596, 850 we have in the database of fluid milk. [3] We used the simulated maximum likelihood method as in Revelt and Train (1998).[4]

This method relies on the assumption that on the dairy desserts market (the fluid milk market, respectively), all product characteristics $X_{jt} = (p_{jt}, C_j, D_j, l_j)$ ($X_{jt} = (p_{jt}, S_j, W_j)$, resp.) are independent of the error term ε_{ijt}. However, assuming that $\varepsilon_{ijt} = \xi_{jt} + e_{ijt}$ where ξ_{jt} is a product-specific error term varying across periods and e_{ijt} is an individual specific error term, the independence assumption cannot be hold if unobserved factors included in ξ_{jt} (and hence in ε_{ijt}) as promotions, displays or advertising are correlated with observed characteristics X_{jt}. For instance, we do not know the amount of advertising account that firms quaterly invest for their brands. This effect is thus included in the error term because advertising might play a role in the choice of desserts by households. As advertising is an appreciable share of products production costs, it is obviously correlated with prices. To solve the problem that omitted product characteristics might be correlated with prices, we use a control function approach as in Petrin and Train (2010). We then regress prices on instrumental variables, that is input prices, as well as exogenous variables of the demand equation. This can be written in the case of dairy desserts as :

[3] Due to constraints on computers, we are not able to estimate the demand model using the whole sample. The sample used is representative of the whole sample over products and periods.

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

$$p_{jt} = W_{jt}\gamma + \kappa_{b(j)} + \kappa_{r(j)} + \tau_c C_j + \tau_d D_j + \tau_l l_j + \eta_{jt}$$

and in the case of fluid milk :

$$p_{jt} = W_{jt}\gamma + \kappa_{b(j)} + \kappa_{r(j)} + \tau_s S_j + \tau_w W_j + \eta_{jt}$$

where W_{jt} is a vector of input price variables, γ the vector of parameters associated and η_{jt} is an error term that captures the remaining unobserved variations in prices. The estimated error term $\hat{\eta}_{jt}$ of the price equation includes some omitted variables as advertising variations, promotions and shelf displays that are not captured by the other exogenous variables of the demand aquation and by the cost shifters. Introducing this term in the mean utility of consumers δ_{jt} allows to capture unobserved product characteristics varying across time. Prices are now uncorrelated with the new error term $\xi_{jt} + \varepsilon_{jht} - \pi\hat{\eta}_{jt}$.

We then write for the dairy desserts

$$\delta_{jt} = \beta_{b(j)} + \beta_{r(j)} + \alpha p_{jt} + \beta_c C_j + \beta_d D_j + \beta_l l_j + \xi_{jt} + \pi\hat{\eta}_{jt}$$

where π is the estimated parameter associated with the estimated error term of the first stage.

As regards the fluid milk, we can write

$$\delta_{jt} = \beta_{b(j)} + \beta_{r(j)} + \alpha p_{jt} + \beta_s S_j + \beta_w W_j + \xi_{jt} + (\pi_{NB_j} + \pi_{PL_j})\hat{\eta}_{jt}$$

In this case, we assume that the error term $\hat{\eta}_{jt}$ can be different depending on whether it's a NB or PL product. For example, an unobserved information can be the way products are displayed in retailers. More often, the PLs are more valorised than NBs.

In practice, we use the price indexes for the main inputs used in the production of desserts or milk, that is raw milk, energy and packaging. About the dairy desserts, cost variables in equation above include the quaterly price of cow milk and the quaterly price indexes of wages, gasoline, aluminium, glass and metal as it is unlikely that input prices are correlated with unobserved determinants of demand for dairy desserts.[5] These variables are interacted with private label/national brand dummies because we expect that manufacturers obtain different prices from suppliers for raw materials according to what they produce. We also expect that some characteristics of the inputs (e.g. quality of glass) depend on the private label / national brand characteristics of products. In the case of fluid milk, cost variables only include the quaterly price of cow milk and the quaterly price indexes of wages, gasoline and cardboard).

3.3 Supply models : vertical relationships between processors and retailers

The economics literature has extensively explored the vertical relationships between manufacturers and retailersIn food retailing, the upstream and downstream industries are highly concentrated and it is well known that linear contracts are not efficient in a chain of oligopolies because the profit of the chain is not maximised. Indeed, this situation provides incentives to agents to design more sophisticated contracts such as non-linear contracts and particularly two-part tariff contracts. in the empirical literature, two-part tariff contracts were only recently integrated into the analysis (Berto Villas-Boas, 2007; Bonnet and Dubois, 2010). In this paper, we consider linear pricing and a set of two-part tariff contracts where the processors have all of the bargaining power. [6]The general framework of the vertical relationships is described by the following game :

- Stage 1 : manufacturers simultaneously propose take-it or leave-it contracts to retailers. In case of linear pricing, the contratc is simply a wholesale price and manufacturers compete à la Bertrand-Nash as they compete on prices. With two-part tariff, the contract includes a wholesale price and a fixed fee. Finally, in case of resale price maintenance (RPM), the contract is composed of a wholesale price, a fixed fee and a consumer price.

- Stage 2 : retailers simultaneously accept or reject the offers which are public information. If a retailer rejects one offer, he obtains his outside option. We consider two possibilities. In the first one, the outside option is exogenously set to a positive fixed value. In the second case, the outside option is determined endogenously and its amount is equal to the profit a retailer gets from selling its own private labels

- Stage 3 : retailers set consumer prices and thus compete à la Bertrand-Nash.

[5]These indexes are from the French National Institute for Statistics and Economic Studies.

[6]The assumption on who has the bargaining power primarily affects how profits are shared (through the fixed fees) rather than the choices of prices that we are studying here. According to Rey and Vergé (2010), equilibrium prices would be the same if retailers have all of the bargaining power conditioning on the fact that retailers have an outside option.

Depending on the assumptions on contracts and on the outside option of retailers, we specify seven different cases : linear pricing and six cases of non-linear contracts. The six cases of non-linear pricing are the combination of three types of contracts proposed by manufacturers with the two possibilities for the outside option of retailers. The three non-linear contracts correspond to two-part tariff without resale price maintenance and two possibilities of two-part tariff with resale price maitnenance. With resale price maintenance, we consider the two polar cases for price cost margins : zero wholesale margins for national brands ($w_j - \mu_j = 0$) or, alternatively, zero retail margins for national brands ($p_j - w_j - c_j = 0$).

We now present the general methodology. The profit $\Pi^r$of retailer r is given by :

$$\Pi^r = \sum_{j \in S_r} \left[M \left(p_j - w_j - c_j \right) s_j \left(p \right) - F_j \right]$$

where M is the size of the market, S_r is the set of products that retailer r sells, w_j and p_j are the wholesale ans retail prices of product j, $s_j \left(p \right)$ is the market share of product j and c_j is the constant marginal cost to distribute product j. In the specific case of private labels, we assume that they aresold to retailers at the marginal cost by the producing firms.[7]

Assuming price competition among retailers and assuming the existence of the equilibrium, the first-order conditions are given by :

$$s_k + \sum_{j \in S_r} \left[\left(p_j - w_j - c_j \right) \right] \frac{\partial s_j}{\partial p_k} = 0 \qquad \forall k \in S_r, \qquad for\ r = 1, ..., R \tag{3}$$

These are standard conditions that define the Bertrand-Nash equilibrium at the third stage of the game. [8] These conditions are valid regardless of whether manufacturers propose linear prices or two-part tariffs. However, with RPM, the conditions do not hold. Thus, RPM is a practice whereby a manufacturer imposes the selling price of its products to a retailer. A retailer no longer chooses the consumer price of the national brands and thus the above conditions do not hold.

[7]A retailer defines the characteristics of its own private label. It then delegates the production of this product to a manufacturer. In this process the retailer organizes competition among producers for a given product. This competition is interpreted to be a price competition with a homogenous product that leads to a selling price that is equal to the marginal costs. For additional information on private labels, refer to Bergès-Sennou et al. (2004).

[8]We do not consider the case of collusion between retailers as two recent studies on the French market concluded in the absence of collusion (Turolla, 2012; Heller, 2012).

We now focus on two-part tariff contracts, as the linear case (double marginalization) is well known Sudhir2001,BertoVillas-Boas2007,Bonnet2010. Besides, we develop the endogenous outside option case which adds to the literature. Let us define μ_j the constant marginal cost to prodice product j and G_f the set of products sold by manufacturer f. The manufacturer maximizes its profit

$$\Pi^f = \sum_{j \in G_f} \left[M \left(w_j - \mu_j \right) s_j \left(p \right) + F_j \right]$$

subject to the participation constraint of each retailer, *i.e.* for all $r = 1$, ..., R,

$$\Pi^r \geq \sum_{j \in \tilde{S}_r} M \left(\tilde{p}_j^r - w_j - c_j \right) s_j \left(\tilde{p}^r \right)$$

where $\tilde{S}_r$ is the set of private labels belonging to retailer r and $\tilde{p}^r = (p_1^r, ..., p_J^r)$ is the vector of prices when retailer r sells only its private labels. By convention, we have $\tilde{p}_j^r = +\infty$ for all national brands sold by retailer r. The vector of the market share $s\left(\tilde{p}^r\right)$ thus corresponds to the market shares when retailer r sells only its private labels.

Manufacturers can adjust franchises fees such that all constraints are binding. The use of the participation constraint of retailer r allows us to re-write the profit of manufacturer f as :

$$\Pi^f = \sum_{j \in G_f} M \left(w_j - \mu_j \right) s_j \left(p \right) + \sum_{j=1}^{J} M \left(p_j - w_j - c_j \right) s_j \left(p \right) - \sum_{r=1}^{R} \sum_{j \in \tilde{S}_r} M \left(\tilde{p}_j^r - w_j - c_j \right) s_j \left(\tilde{p}^r \right) - \sum_{j \notin G_f} F_j$$

Thus, the profit of a manufacturer is no longer a function of the fixed fees attached to its products.Rather, the profit depends on the fixed fees set by the other manufacturers. thus, the maximization problem becomes simple to solve and everything occurs as if the manufacturer only chooses prices. It chooses wholesale prices when there is no RPM, or chooses consumer prices when there is RPM. RPM is prohibited by the competition authorities. However, in France, specific laws (such as the Galland Act which prohibits below-cost pricing) for the retail industry have led to a situation where it is, in pratice, possible to implement RPM (Biscourp et al., 2008) justifying to consider that possibility in our analisys.

We first consider the case where the manufacturers can use RPM in their contracts with the retailers. In this case, the manufacturers propose the franchise fees F as well as the retail prices p to the retailers. Note that the wholesale prices have no direct effect on the profits [9]. Therefore, the program of manufacturer f is given by

$$\max_{\{p_k\}_{k\in G_f}} \sum_{j\in G_f} M\left(w_j-\mu_j\right)s_j\left(p\right)+\sum_{j=1}^{J} M\left(p_j-w_j-c_j\right)s_j\left(p\right)-\sum_{r=1}^{R}\sum_{j\in \tilde{S}_r} M\left(\tilde{p}_j^r-w_j-c_j\right)s_j\left(\tilde{p}^r\right)$$

We deduce the first order conditions for this manufacturer's program as

$$\sum_{j\in G_f}\left(w_j-\mu_j\right)\frac{\partial s_j\left(p\right)}{\partial p_k}+s_k\left(p\right)+\sum_{j=1}^{J}\left(p_j-w_j-c_j\right)\frac{\partial s_j\left(p\right)}{\partial p_k}-\sum_{r=1}^{R}\sum_{j\in \tilde{S}_r}\left(\tilde{p}_j^r-w_j-c_j\right)\frac{\partial s_j\left(\tilde{p}^r\right)}{\partial p_k}=0 \quad (4)$$

$\forall k\in G_f, \qquad for\ f=1,...,N_f$

The above conditions only apply for NBs. For PLs, the retailers maximize their profit with respect to the retail prices of PLs :

$$\max_{\{p_k\}_{k\in \tilde{S}_r}} \sum_{j\in \tilde{S}_r}\left(p_j-\mu_j-c_j\right)s_j\left(p\right)+\sum_{j\in S_r\backslash \tilde{S}_r}\left(p_j^*-w_j-c_j\right)s_j\left(p^*\right)$$

where p_j^* represents the equilibrium price of NBs chosen by the manufacturers. Thus, for PLs, additional equations are obtained from the first_order conditions of the profit maximization of retailers :

$$\sum_{j\in \tilde{S}_r}\left(p_j-\mu_j-c_j\right)\frac{\partial s_j\left(p\right)}{\partial p_k}+s_k\left(p\right)+\sum_{j\in S_r\backslash \tilde{S}_r}\left(p_j^*-w_j-c_j\right)\frac{\partial s_j\left(p^*\right)}{\partial p_k}=0 \quad (5)$$

$\forall k\in \tilde{S}_r, \qquad for\ r=1,...,R$

[9] The wholesale prices of the manufacturer f have no direct effect on profits but they have a strategic role in the retail price choices because they affect the profits of the other manufacturers.

The system of the equations (4) and (5) characterizes the equilibrium, which depends on the structure of the industry at the manufacturer ans retailer levels and also on the shape of the demand curve. It should be noted that, because wholesale and retail margins cannot be identified in this system, it is necessary to include additional assumptions about the margins. As in Bonnet and Dubois (2010), we assume zero wholesale margins for national brands ($p_j - w_j - c_j = 0$).

When resale price maintenance is not allowed, manufacturer f maximizes its profit with respect to wholesale prices :

$$\max_{\{w_k\}_{k\in G_f}} M\left(w_j - \mu_j\right) s_j\left(p\right) + \sum_{j=1}^{J} M\left(p_j - w_j - c_j\right) s_j\left(p\right) - \sum_{r=1}^{R}\sum_{j\in\tilde{S}_r} M\left(\tilde{p}_j^r - w_j - c_j\right) s_j\left(\tilde{p}^r\right)$$

from which we deduce the following first-order conditions :

$$\sum_{j\in G_f}\left(w_j - \mu_j\right)\frac{\partial s_j\left(p\right)}{\partial w_k} + \sum_{j=1}^{J}\frac{\partial p_j}{\partial w_k} s_j\left(p\right) + \sum_{j=1}^{J}\left(p_j - w_j - c_j\right)\frac{\partial s_j\left(p\right)}{\partial w_k} - \sum_{r=1}^{R}\sum_{j\in\tilde{S}_r} M\left(\tilde{p}_j^r - w_j - c_j\right)\frac{\partial s_k\left(\tilde{p}^r\right)}{\partial w_k} = 0 \tag{6}$$

$\forall k \in G_{f},\qquad for\ f = 1, ..., N_f$

The equilibrium is then characterized by the system of equations (6) where the retail price response amtrix to the wholesale prices that contains the first derivatives of the retail prices with respect to the wholesale prices is obtained by totally differentiating (3), and the retail margins are deduced from (3).

3.4 Cost specification, testing between the alternative models and simulations

After the demand model is estimated and given the assumptions regarding the structure of the industry and the vertical interactions between the manufacturers and the retailers, price-cost margins are estimated. We thus obtain estimated marginal costs $C_{jt}^h = p_{jt} - \Gamma_{jt}^h - \gamma_{jt}^h$ for each product j in period t for any supply model h, where $\Gamma_{jt}^h = w_{jt}^h - \mu_{jt}^h$ is the manufacturer's margin for product j and $\gamma_{jt}^h = p_{jt}^h - w_{jt}^h - c_{jt}^h$ is the retailer's margin for product j.

We specify the following model for the estimated marginal costs in the case of dairy desserts :

$$C_{jt}^{h}=\sum_{k=1}^{K}\lambda_{k}^{h}W_{jt}^{k}+w_{b(j)}^{h}+w_{r(j)}^{h}+\eta_{jt}^{h}$$

and in the case of fluid milk :

$$C_{jt}^{h}=\sum_{k=1}^{K}\lambda_{k}^{h}W_{jt}^{k}+w_{r(j)}^{h}+\eta_{jt}^{h}$$

where W_{jt} is a vector of inputs, $w_{b(j)}^{h}$ represents the product fixed effects for model h, $w_{r(j)}^{h}$ is the retailer fixed effect for model h. We suppose that $E(\eta_{jt}^{h}|W_{jt}', w_{j}^{h}, w_{jy(t)}^{h}, \tau_{t}^{h})=0$ to consistently identify and estimate $\lambda_{k}^{h}, w_{b(j)}^{h}$ and $w_{r(j)}^{h}$. To be consistent with the economic theory, as in Gasmi et al. (1992), we impose the positivity of parameters λ_{k}^{h} and use a non-linear least square method to estimate them. We use this cost function specification to test any pair of supply models C_{jt}^{h} and $C_{jt}^{h'}$ and we infer which model is statistically the best using a non nested Rivers and Vuong (2002) test.[10]

Using the estimated marginal costs from the preferred model of contracts in the vertical chain as well as the other estimated structural parameters from the demand estimation, we can simulate some policy experiments. We analyze both a decrease and an increase in cow milk price as well as a change in both cow milk price and energy, wage and plastic price indexes. We denote $C_t=(C_{1t},..,C_{jt},..,C_{Jt})$ the vector of marginal costs for all products present in period t. To model the impact of a change in the cow milk price, we have to solve the following program:

$$\min_{\{p_{jt}^{*}\}_{j=1,..,J}}\left\|p_{t}^{*}-\Gamma_{t}\left(p_{t}^{*}\right)-\gamma_{t}\left(p_{t}^{*}\right)-\widetilde{C}_{t}\right\|$$

where $\|.\|$ is the Euclidean norm in $\mathbb{R}^{J}$, γ_t and Γ_t correspond respectively to the retail and wholesale margins for the best supply model and $\widetilde{C}_t$ is the vector of marginal cost estimated using the new cow milk price.

4 Results on demand and vertical relationships

[10]In the following, we refer this model as the preferred model of contracts.

4.1 Demand results

4.1.1 The market of dairy desserts

We estimated two models (Table 3). Model 1 is the demand model without controlling for the endogeneity problem of prices whereas model 2 controls for it. 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 justify the need to control for endogeneity problem (we provide in Table 23 in the appendix results for the price equation). The instrumental variables used are not weak and significantly affect prices. Moreover, correlation between instruments is not high.

In order to get a better demand model, we introduced some product heterogeneity in the price sensitivity. Heterogeneity that is taken into account is related to the choice of NB or PL product. We do not extensively report the results here as they are not useful for our purpose. On average, the price has a significant and negative impact on utility. Consumers are more sensitive to the price variations of PLs than to NBs even if the two values are close. This is consistent with the idea that consumers might have more loyalty with respect to NBs than to PLs. Results suggest that households prefer other dairy desserts than yoghurts or cottage cheeses and regular products than diet products, since the mean coefficient is negative and the standard deviation quite low. We also introduced brands and retailers fixed effects. The reference brands are a PL regular other dairy dessert, a PL diet cottage cheese and a PL regular cottage cheese. The reference retailer is the aggregate of discounters. Four fixed effect coefficients are positive meaning that consumers prefer these retail chains which offer more services than the discounters do. But the discounters are still prefered to two other retail chains wich fixed effect coefficients are negative.

Using the structural demand estimates, we are able to compute own and cross-price elasticities for each differentiated products (see Table 21 in appendix). The own-price elasticities of demand for a brand vary between -8.27 and -2.97 with an average value of -4.77. Demand for regular products is more elastic than demand for diet products. Indeed, the average own-price elasticity of demand for regular brands is -5.07 while it is -3.92 for diet brands. If we compare the demand for yoghurts, cottage cheeses and other dairy desserts, we observe that the demand for dairy desserts is more elastic than demand for cottage cheeses and both demands are more elastic than demand for yoghurts with an average own-price elasticity of demand of -6.33, -4.90 and -4.04 respectively.

Table 3: **Results of the random coefficients logit model (Desserts).**

	Model 1		Model 2	
	Mean	StD	Mean	StD
Price (p_{jt})		0.0013 (0.000)		0.028 (0.000)
$\times$ PL	-0.956 (0.000)		-2.058 (0.000)	
$\times$ NB	-0.182 (0.000)		-1.792 (0.000)	
Yoghurt (Y_j)	-		-	
Cottage cheese (C_j)	-2.258 (0.000)		-0.473 (0.000)	
Dairy desserts (D_j)	-1.061 (0.000)		1.380 (0.001)	
Diet (l_j)	-1.803 (0.000)		-2.095 (0.000)	
Brand fixed effects				
B1	-4.105 (0.000)		-0.648 (0.001)	
B2	-5.453 (0.000)		-2.371 (0.001)	
B3	-3.726 (0.000)		-0.543 (0.001)	
B4	-2.520 (0.000)		1.688 (0.001)	
B5	-2.904 (0.000)		1.699 (0.001)	
B6	-3.029 (0.000)		-1.510 (0.000)	
B7	-2.683 (0.000)		0.351 (0.000)	
B8	-4.201 (0.000)		-0.928 (0.001)	
B9	-2.281 (0.000)		0.825 (0.000)	
B10	-5.401 (0.000)		-2.859 (0.000)	
B11	-2.601 (0.000)		-0.213 (0.000)	
B12	-5.413 (0.000)		-1.623 (0.001)	
B13	-3.957 (0.000)		-0.538 (0.001)	
B14	-3.997 (0.000)		-1.528 (0.000)	
B15	-4.358 (0.000)		0.044 (0.001)	
B16	-4.009 (0.000)		0.028 (0.001)	
B17	-3.160 (0.000)		-0.312 (0.000)	
B18	-2.821 (0.000)		1.136 (0.001)	
B19	-2.204 (0.000)		-0.978 (0.000)	
B20	-2.046 (0.000)		-0.475 (0.000)	
B21	-		-	
B22	-		-	
B23	-		-	
Retailers fixed effects				
R1	0.057 (0.000)		0.336 (0.000)	
R2	-0.228 (0.000)		0.236 (0.000)	
R3	-0.371 (0.000)		-0.102 (0.000)	
R4	0.352 (0.000)		0.917 (0.000)	
R5	-0.655 (0.000)		-0.293 (0.000)	
R6	-0.114 (0.000)		0.690 (0.000)	
R7	-		-	
Error term ($\widehat{\eta}_{jt}$)			1.608 (0.000)	
Log Likelihood	-320,547		-320,960	
Number of observations	100,000		100,000	

4.1.2 The market of fluid milk

We also estimated two models (Table 4). Model 1 is the demand model without controlling for the endogeneity problem of prices whereas model 2 controls for it. First, the coefficients of the error term are positive and significant. It means that the unobserved part explaining prices is positively correlated with the choice of the alternative and justify the need to control for endogeneity problem (we provide in Table 24 in the appendix results for the price equation). The instrumental variables used are not weak and significantly affect prices. Moreover, correlation between instruments is not high.

In order to get a better demand model, we introduced some product heterogeneity in the price sensitivity. Heterogeneity that is taken into account is related to the choice of NB or PL product. On average, the price has a significant and negative impact on utility. Consumers are much more sensitive to the price variations of PLs than to NBs. On this market, consumers may have more loyalty with respect to NBs than to PLs too. Results suggest that households have a preference for the semi-skimmed milk since the mean coefficients of both skimmed and whole milk are negative and the standard deviations are low. We also introduced brands and retailers fixed effects. The brand fixed effects reveal that the private label 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 or at least a not too much differentiated product.The reference retailer is the aggregate of discounters. From the retailer fixed effect estimation results, the effects of purchasing in one of the seven major retailers on consumer utility are heterogeneous. For four of the six retailers, the average consumer values more the retailer channel than the hard discount stores. This may be due to the characteristics of major retailers that generally offer a wider range of products not only for the product at stake but also for the entire range of products sold in their stores. However, hard discounters seem to be more valued by consumers compared to retailers 3 and 5.

From the structural demand estimates, we compute own and cross-price elasticities for each differentiated products (see Table 22 in the appendices results). The own-price elasticities of demand for a brand vary between -6.56 and -1.79 with an average value of -3.01. If we compare the demand for skimmed milk, semi-skimmed milk and whole milk, we observe that the demand for whole milk is more elastic than demand for skimmed milk and both demands are more elastic than demand for semi-skimmed milk with an average own-price elasticity of demand of -3.36, -3.12 and -2.80 respectively.

Table 4: **Results of the random coefficients logit model. (Milk)**

	Model 1		Model 2	
	Mean	StD	Mean	StD
Price (p_{jt})		0.703 (0.000)		1.388 (0.000)
× PL	-6.916 (0.000)		-8.607 (0.000)	
× NB	-0.999 (000)		-2.945 (0.000)	
Skimmed (S_j)	-2.230 (0.000)		-2.009 (0.000)	
Whole (W_j)	-1.688 (0.000)		-1.271 (0.000)	
Brand fixed effects				
B1	2.114 (0.000)		3.904 (0.000)	
B2	1.876 (0.000)		3.726 (0.000)	
B3	-0.005 (0.000)		1.826 (0.000)	
B4	2.252 (0.000)		3.533 (0.000)	
PL	7.397 (0.000)		8.449 (0.000)	
Retailers fixed effects				
R1	-0.012 (0.000)		0.067 (0.000)	
R2	-0.049 (0.000)		0.286 (0.000)	
R3	-0.359 (0.000)		-0.141 (0.000)	
R4	0.480 (0.000)		0.611 (0.000)	
R5	-0.504 (0.000)		-0.126 (0.000)	
R6	-0.016 (0.000)		0.264 (0.000)	
R7	-		-	
Error term ($\widehat{\eta}_{jt}$)				
× PL			2.557 (0.000)	
× NB			0.852 (0.000)	
Log Likelihood	-365,125		-364,884	
Number of observations	100,000		100,000	

4.2 Preferred model, price-cost margins and cost estimates

4.2.1 The market of dairy desserts

Using the demand estimates, we compute marginal costs and price cost margins for each supply model. On the basis of the Rivers and Vuong tests (see the results in Table 29 in the appendix) the best supply model is model '3' where the manufacturers and the retailers use two-part tariff contracts with resale price maintenance, the distribution margin is equal to zero (meaning that the consumer selling price is equal to the sum of the wholesale price and marginal costs), and where the private labels have no strategic role in the manufacturer-retailer relationships.[11] . The existence of such a contract is important for the analysis of how a cost change or an excise tax are passed-through to consumer prices. Thus, Delipalla and Keen (1992) showed that under imperfect competition the cost pass-through of an excise tax could be less than or greater than 100% depending on the curvature, i.e. the elasticity of the elasticity, of the demand.

Marginal costs, which include processing and retailing costs, are brand specific. On average, they amount to €1.92 per kilogram. The average marginal cost of the PLs(€1.34 per kilogram) is lower than that of the NBs (€2.08 per kilogram). Among retailers, marginal costs at retailer 7 are the lowest ones. This is consistent with the strategy of retailer 7 which offers only few services to consumers. Heterogeneity of marginal costs among retailers is larger for NBs than PLs. The price cost margins are 28.5% of the consumer price, on average. Heterogeneity of percent margins across NBs is greater than that across PLs(see Table 25 in the appendix). The average price-cost margins for the PLs (28.8%) are slightly greater than those for the NBs (28.4%).

4.2.2 The market of fluid milk

In this case, the best supply model is model '6' (see the results in Table 30 in the appendix) where the manufacturers and the retailers use two-part tariff contracts with resale price maintenance, the distribution margin is equal to zero and where the private labels have some strategic role in the manufacturer-retailer relationships.[12] .

[11]Consider row 3: all test statistics of the Rivers and Vuong test are higher than 1.96 which means that model 3 is better than models 4, 5, 6 or 7. In addition, the test statistics in column 3 is lower than -1.96 which means that models 1 and 2 are not preferred to model 3. As a consequence model 3 is the preferred model.

[12]Consider row 6: the test statistic of the Rivers and Vuong test is higher than 1.96 which means that model 6 is better than model 7. In addition, the test statistics in column 6 are lower than -1.96 (except for model 1) which means that models 2, 3, 4 and 5 are not preferred to model 6. As regards the model 1, we consider that model 6 is prefered at a 10% threshold (the test statistic is lower than 1.64). As a consequence model 6 is the preferred model.

Marginal costs, which include processing and retailing costs, are brand specific. On average, they amount to €0.45 per liter. The average marginal cost of the PLs(€0.56 per liter) is higher than that of the NBs (€0.42 per liter). Marginal costs at retailer 7 are also the lowest ones on this market with an averge cost of €0.25 per liter. The price cost margins are 44.5% of the consumer price, on average. Heterogeneity of percent margins across NBs is greater than that across PLs(see Table 26 in the appendix). The average price-cost margins for the PLs (19.0%) are much lower than those for the NBs (51.8%).

5 Simulations

We define two policy scenarios. Scenario 1 simulates the impact of a 10% decrease in the milk price . [13] Scenarios 2 simulates the impact a 10% decrease in the milk price when two firms merge.

5.1 Scenario 1 : The impact of a 10% decrease in milk price on prices and market shares

Using the estimated marginal cost specification (see Tables 27 and 28 in the appendix), we compute the change in marginal cost for each product.

5.1.1 Results in the case of dairy desserts

On average, the 10% decrease in milk price causes a €2.60 cents per kilogram decrease (approximately 1.6%) in the total marginal cost of desserts in general. It causes a €2.60 cents per kilogram (1.91%), €3.66 cents per kilogram (1.99%) and €1.35 cent per kilogram (0.55%) decrease in the total marginal cost of yoghurts, cottage cheese and other dairy desserts respectively. If we compare the regular and light products, the 10% decrease in milk price leads to a €2.86 cents per kilogram (1.69%) and €1.90 cent per kilogram (1.47%) decrease in the total marginal cost of regular and light products, respectively.

[13] We actually defined other scenarios : a 2%, 10%, 20%, 36% and 50% increases and decreases in the milk price. Since the results were roughly the same, we decide to show only one of those.

Table 5: **Impact of a 10% decrease in the milk price (Desserts)**

			Change in cost in % Mean (std)	Change in price in % Mean (std)	Pass-through $\triangle p/\triangle c$ Mean (std)	Change in MS in % Mean (std)
Brand 1	NB	Y-R	-2.09 (0.26)	-1.13 (0.12)	0.82 (0.00)	2.53 (0.37)
Brand 2	NB	Y-R	-2.34 (0.33)	-1.34 (0.17)	0.86 (0.01)	2.82 (0.40)
Brand 3	NB	Y-D	-1.23 (0.23)	-0.58 (0.09)	0.73 (0.01)	-0.19 (0.09)
Brand 4	NB	Y-D	-0.88 (0.17)	-0.39 (0.06)	0.63 (0.00)	-0.47 (0.07)
Brand 5	NB	D-R	-0.35 (0.05)	-0.21 (0.03)	0.72 (0.02)	-0.59 (0.09)
Brand 6	NB	D-R	-0.73 (0.13)	-0.28 (0.04)	0.55 (0.01)	-0.99 (0.09)
Brand 7	NB	C-R	-1.58 (0.21)	-0.99 (0.12)	0.84 (0.00)	3.39 (0.48)
Brand 8	NB	Y-R	-2.27 (0.43)	-1.19 (0.18)	0.82 (0.00)	2.53 (0.37)
Brand 9	NB	C-R	-1.55 (0.20)	-0.98 (0.12)	0.84 (0.00)	3.39 (0.47)
Brand 10	NB	Y-R	-3.07 (0.46)	-1.59 (0.20)	0.86 (0.01)	2.82 (0.40)
Brand 11	NB	C-R	-1.82 (0.23)	-1.19 (0.15)	0.88 (0.01)	3.68 (0.51)
Brand 12	NB	Y-R	-1.80(0.31)	-1.14 (0.16)	0.88 (0.01)	2.94 (0.41)
Brand 13	NB	Y-D	-1.16 (0.33)	-0.58 (0.11)	0.77 (0.02)	-0.07 (0.09)
Brand 14	NB	D-R	-0.55 (0.11)	-0.30 (0.05)	0.72 (0.02)	-0.59 (0.09)
Brand 15	NB	Y-R	-1.86 (1.37)	-1.05 (0.45)	0.87 (0.01)	2.83 (0.40)
Brand 16	NB	Y-D	-1.17 (0.86)	-0.52 (0.20)	0.73 (0.02)	-0.18 (0.09)
Brand 17	NB	C-R	-1.75 (0.55)	-1.14 (0.26)	0.88 (0.01)	3.70 (0.51)
Brand 18	NB	D-R	-0.45 (0.23)	-0.23 (0.09)	0.67 (0.02)	-0.70 (0.09)
Brand 19	PL	Y-R	-3.48 (0.46)	-2.23 (0.27)	0.98 (0.01)	4.46 (0.60)
Brand 20	PL	Y-D	-1.70 (0.25)	-1.08 (0.14)	0.97 (0.01)	0.95 (0.18)
Brand 21	PL	C-R	-2.51 (0.30)	-1.85 (0.21)	0.99 (0.01)	5.47 (0.73)
Brand 22	PL	C-D	-2.66 (0.49)	-1.83 (0.28)	0.98 (0.01)	4.11 (0.56)
Brand 23	PL	D-R	-0.67 (0.11)	-0.52 (0.08)	0.96 (0.01)	0.35 (0.12)
OG						-2.30 (0.23)

NB/PL stand for National Brands/Private Labels; Y/C/D stands for Yoghurt/Cottage cheese/Dairy dessert Labels; R/D stands for Regular/Diet

On average, in response to the price cut, consumer prices decrease by 1.1%, 1.3%, 0.3%, 1.0% and 0.8% for yoghurts, cottage cheese, other dairy desserts, regular products and light products respectively. Note that the percent price decrease for the PLs is larger than that for the NBs because the PLs are cheaper than the NBs. For yoghurts, the pass-through, which is measured by the ratio of the difference in retail prices to the difference in marginal costs, has an average value of 0.83. Therefore, if the marginal cost decreases by €1 cent/kilogram the retail price decreases by an average of €0.83 cent/kilogram. The industry thus undershifts the cost decrease.

The pass-through is brand specific and varies from 0.55 to 0.99. For the NBs, it seems not to be related neither to the firm nor the kind of product even if the pass-through of other dairy desserts are the lowest ones.The pass-through for PLs is greater than that of NBs meaning that retailers choose larger pass-through rate than manufacturers. Note also that the pass-through for PLs is close to 1. Manufacturers choose a pricing policy for the entire set of products, thereby internalizing the substitution among their own set of products. As a result of these strategic price reactions, the aggregate market share of the PL products increases and the market share of the outside option decreases by 2.3%.[14]

5.1.2 Results in the case of fluid milk

On average, the 10% decrease in milk price causes a €1.77 cents per liter decrease (approximately 4.1%) in the total marginal cost of fluid milk in general. It causes a €1.31 cent per liter (3.62%), €1.31 cent per liter (3.74%) and €2.65 cents per liter (4.95%) decrease in the total marginal cost of skimmed, semi-skimmed and whole milk, respectively. In response to the price cut, consumer prices decrease on average by 1.81%, 1.92% and 3.36% for skimmed, semi-skimmed and whole milk, respectively. Note that the percent price decrease for the PLs is quite the same than that for the NBs even if PLs are cheaper than NBs. For skimmed milk, the pass-through has an average value of 1.07. Therefore, if the marginal cost decreases by €1 cent/kilogram the retail price decreases by an average of €1.07 cent/kilogram. The industry thus overshifts the cost decrease.

The pass-through varies from 0.97 to 1.33. Among the NBs, the greatest ones are obtained for the whole milk. The pass-through for PLs is smaller than that of NBs and also close to 1 on this marlet, meaning that retailers choose lower pass-through rate than manufacturers. As a result of these strategic price reactions, the aggregate market share of the PL products increases and the market share of the outside option decreases by 10.4%.

[14] Note that the price of the outside option is assumed to be unchanged, which is a limit in the analysis.

Table 6: **Impact of a 10% decrease in the milk price (Milk).**

			Change in cost in % Mean (std)	Change in price in % Mean (std)	Pass-through $\triangle p/\triangle c$ Mean (std)	Change in MS in % Mean (std)
Brand 1	NB	S	-2.88 (2.92)	-1.45 (0.41)	1.12 (0.23)	-4.63 (0.62)
Brand 2	NB	SS	-3.18 (0.64)	-1.69 (0.25)	1.09 (0.02)	-4.72 (0.50)
Brand 3	NB	W	-4.48 (0.77)	-3.14 (0.42)	1.30 (0.04)	-0.27 (0.33)
Brand 4	NB	S	-2.27 (0.52)	-1.28 (0.25)	1.04 (0.04)	-4.77 (0.52)
Brand 5	NB	SS	-3.00 (0.75)	-1.58 (0.28)	1.05 (0.03)	-4.82 (0.52)
Brand 6	NB	W	-4.05 (0.79)	-2.95 (0.40)	1.33 (0.08)	-0.40 (0.30)
Brand 7	NB	S	-2.55 (0.51)	-1.44 (0.24)	1.06 (0.02)	-4.77 (0.54)
Brand 8	NB	SS	-2.58 (0.43)	-1.44 (0.21)	1.06 (0.02)	-4.81 (0.51)
Brand 9	NB	W	-5.04 (1.57)	-3.33 (0.59)	1.25 (0.03)	-0.29 (0.37)
Brand 10	NB	S	-7.84 (2.81)	-2.71 (0.61)	1.22 (0.08)	-4.29 (0.57)
Brand 11	NB	SS	-7.02 (1.30)	-2.71 (0.37)	1.22 (0.05)	-4.29 (0.56)
Brand 12	NB	W	-6.79 (2.89)	-3.83 (0.72)	1.28 (0.05	0.18 (0.48)
Brand 13	PL	S	-2.62 (0.44)	-2.02 (0.26)	0.97 (0.01)	1.83 (0.50)
Brand 14	PL	SS	-2.57 (0.35)	-1.99 (0.24)	0.97 (0.01)	1.83 (0.49)
Brand 15	PL	W	-4.13 (0.78)	-3.41 (0.52)	1.00 (0.01)	14.44 (2.03)
OG						-10.41 (1.10)

NB/PL stand for National Brands/Private Labels; S/SS/W stands for Skimmed/Semi-skimmed/Whole milk

5.2 Scenario 2 : Impact of a merger on prices and market shares

5.2.1 In the case of dairy desserts

We first decide to merge both firms 1 and 2 and then both firms 2 and 3 in order to analyse the effects of such a change in the market structure on the market shares and prices. If we compare prices before and after a merge when a change in milk price is not taken into account (7 and 8), we notice that they all increase on average. The change in prices is bigger for products made by the merged manufacturers, especially for the products which were the cheapest before the merge, that's to say brands 2, 3, 10 and 11. In the same way, their market shares are those which decrease the most among the decreasing market shares. On the other hand, manufacturers who dont merge see their market shares improve.

If we then look at a change in milk price while two firms merged (9 and 10), we can notice that the pass-through remains the same for the products made by the firms that did not merge (for example, the PLs). About the merged manufacturers, their pass-through decrease, especially for products that used to be made by the firm with the lower market share (for example products 2 and 3 when firms 1 and 2 merge or products 5 and 14 when firms 2 and 3 merge).

Table 7: **Impact of a merge between firms 1 and 2 on prices and market shares (Desserts)**

Firm				Change in price in % Mean (std)	Change in MS in % Mean (std)
Brand 1	1	NB	Y-R	1.22 (0.17)	-3.57 (0.15)
Brand 2	2	NB	Y-R	5.33 (0.80)	-17.06 (1.61)
Brand 3	2	NB	Y-D	5.49 (0.80)	-17.06 (1.61)
Brand 4	1	NB	Y-D	1.08 (0.16)	-3.57 (0.15)
Brand 5	3	NB	D-R	0.05 (0.01)	1.11 (0.23)
Brand 6	1	NB	D-R	1.09 (0.18)	-3.57 (0.15)
Brand 7	1	NB	C-R	0.91 (0.15)	-3.57 (0.15)
Brand 8	1	NB	Y-R	1.28 (0.24)	-3.57 (0.15)
Brand 9	1	NB	C-R	0.90 (0.13)	-3.57 (0.15)
Brand 10	2	NB	Y-R	6.34 (0.98)	-17.06 (1.62)
Brand 11	2	NB	C-R	4.08 (0.56)	-17.07 (1.61)
Brand 12	3	NB	Y-R	0.09 (0.02)	1.11 (0.23)
Brand 13	3	NB	Y-D	0.11 (0.03)	1.11 (0.23)
Brand 14	3	NB	D-R	0.08 (0.02)	1.08 (0.22)
Brand 15	4	NB	Y-R	0.09 (0.04)	1.08 (0.22)
Brand 16	4	NB	Y-D	0.11 (0.04)	1.08 (0.22)
Brand 17	4	NB	C-R	0.09 (0.02)	1.08 (0.22)
Brand 18	4	NB	D-R	0.07 (0.03)	1.08 (0.22)
Brand 19	5	PL	Y-R	0.02 (0.01)	1.48 (0.29)
Brand 20	5	PL	Y-D	0.02 (0.01)	1.48 (0.29)
Brand 21	5	PL	C-R	0.01 (0.00)	1.48 (0.29)
Brand 22	5	PL	C-D	0.02 (0.01)	1.48 (0.29)
Brand 23	5	PL	D-R	0.01 (0.00)	1.48 (0.29)

NB/PL stand for National Brands/Private Labels; R/D stands for Regular/Diet labels

Y/C/D stands for Yoghurt/Cottage cheese/Dairy dessert Labels

Table 8: **Impact of a merge between firms 2 and 3 on prices and market shares**

Firm				Change in price in % Mean (std)	Change in MS in % Mean (std)
Brand 1	1	NB	Y-R	0.05 (0.01)	0.32 (0.06)
Brand 2	2	NB	Y-R	1.66 (0.23)	-5.62 (0.50)
Brand 3	2	NB	Y-D	1.71 (0.24)	-5.62 (0.50)
Brand 4	1	NB	Y-D	0.05 (0.01)	0.32 (0.01)
Brand 5	3	NB	D-R	0.62 (0.09)	-4.43 (0.29)
Brand 6	1	NB	D-R	0.05 (0.01)	0.32 (0.01)
Brand 7	1	NB	C-R	0.04 (0.01)	0.32 (0.01)
Brand 8	1	NB	Y-R	0.05 (0.02)	0.32 (0.01)
Brand 9	1	NB	C-R	0.04 (0.01)	0.32 (0.01)
Brand 10	2	NB	Y-R	1.98 (0.28)	-5.62 (0.50)
Brand 11	2	NB	C-R	1.27 (0.16)	-5.63 (0.50)
Brand 12	3	NB	Y-R	1.11 (0.16)	-4.43 (0.29)
Brand 13	3	NB	Y-D	1.31 (0.23)	-4.43 (0.29)
Brand 14	3	NB	D-R	0.89 (0.15)	-4.43 (0.29)
Brand 15	4	NB	Y-R	0.03 (0.01)	0.38 (0.08)
Brand 16	4	NB	Y-D	0.04 (0.02)	0.38 (0.08)
Brand 17	4	NB	C-R	0.03 (0.01)	0.38 (0.08)
Brand 18	4	NB	D-R	0.02 (0.01)	0.38 (0.08)
Brand 19	5	PL	Y-R	0.01 (0.00)	0.52 (0.10)
Brand 20	5	PL	Y-D	0.01 (0.00)	0.52 (0.10)
Brand 21	5	PL	C-R	0.00 (0.00)	0.52 (0.10)
Brand 22	5	PL	C-D	0.01 (0.00)	0.52 (0.10)
Brand 23	5	PL	D-R	0.00 (0.00)	0.52 (0.10)

NB/PL stand for National Brands/Private Labels; R/D stands for Regular/Diet labels

Y/C/D stands for Yoghurt/Cottage cheese/Dairy dessert Labels

Table 9: **Impact of a 10% decrease in the milk price after firms 1 and 2 merged (Desserts)**

Firm				Change in cost in % Mean (std)	Change in price in % Mean (std)	Pass-through $\triangle p/\triangle c$ Mean (std)	Change in MS in % Mean (std)
Brand 1	1	NB	Y-R	-2.09 (0.26)	-1.08 (0.12)	0.79 (0.00)	2.43 (0.36)
Brand 2	2	NB	Y-R	-2.34 (0.33)	-1.16 (0.15)	0.79 (0.00)	2.43 (0.36)
Brand 3	2	NB	Y-D	-1.23 (0.23)	-0.43 (0.07)	0.57 (0.00)	-0.57 (0.07)
Brand 4	1	NB	Y-D	-0.88 (0.17)	-0.35 (0.05)	0.57 (0.00)	-0.57 (0.07)
Brand 5	3	NB	D-R	-0.35 (0.05)	-0.21 (0.03)	0.71 (0.02)	-0.55 (0.09)
Brand 6	1	NB	D-R	-0.73 (0.13)	-0.24 (0.04)	0.48 (0.01)	-1.09 (0.10)
Brand 7	1	NB	C-R	-1.58 (0.21)	-0.95 (0.11)	0.81 (0.00)	3.29 (0.46)
Brand 8	1	NB	Y-R	-2.27 (0.43)	-1.13 (0.17)	0.79 (0.00)	2.43 (0.36)
Brand 9	1	NB	C-R	-1.55 (0.20)	-0.94 (0.11)	0.81 (0.00)	3.29 (0.47)
Brand 10	2	NB	Y-R	-3.07 (0.46)	-1.36 (0.18)	0.79 (0.21)	2.43 (0.36)
Brand 11	2	NB	C-R	-1.82 (0.23)	-1.06 (0.13)	0.81 (0.00)	3.29 (0.47)
Brand 12	3	NB	Y-R	-1.80 (0.31)	-1.13 (0.16)	0.88 (0.01)	2.99 (0.42)
Brand 13	3	NB	Y-D	-1.56 (0.33)	-0.57 (0.11)	0.76 (0.02)	-0.03 (0.10)
Brand 14	3	NB	D-R	-0.55 (0.11)	-0.30 (0.05)	0.71 (0.02)	-0.55 (0.09)
Brand 15	4	NB	Y-R	-1.86 (1.37)	-1.04 (0.44)	0.86 (0.01)	2.87 (0.40)
Brand 16	4	NB	Y-D	-1.17 (0.86)	-0.51 (0.20)	0.72 (0.01)	-0.14 (0.09)
Brand 17	4	NB	C-R	-1.75 (0.55)	-1.13 (0.26)	0.88 (0.01)	3.74 (0.51)
Brand 18	4	NB	D-R	-0.45 (0.23)	-0.23 (0.08)	0.66 (0.02)	-0.66 (0.09)
Brand 19	5	PL	Y-R	-3.48 (0.46)	-2.23 (0.27)	0.98 (0.01)	4.53 (0.61)
Brand 20	5	PL	Y-D	-1.70 (0.25)	-1.08 (0.14)	0.97 (0.01)	1.02 (0.19)
Brand 21	5	PL	C-R	-2.51 (0.30)	-1.85 (0.21)	0.99 (0.00)	5.54 (0.73)
Brand 22	5	PL	C-D	-2.66 (0.49)	-1.82 (0.28)	0.98 (0.01)	4.19 (0.57)
Brand 23	5	PL	D-R	-0.67 (0.11)	-0.51 (0.08)	0.96 (0.01)	0.42 (0.12)
OG							-2.23 (0.22)

NB/PL stand for National Brands/Private Labels; Y/C/D stands for Yoghurt/Cottage cheese/Dairy dessert Labels; R/D stands for Regular/Diet

Table 10: **Impact of a 10% decrease in the milk price after firms 2 and 3 merged (Desserts)**

Firm				Change in cost in % Mean (std)	Change in price in % Mean (std)	Pass-through $\triangle p/\triangle c$ Mean (std)	Change in MS in % Mean (std)
Brand 1	1	NB	Y-R	-2.09 (0.26)	-1.13 (0.12)	0.81 (0.00)	2.53 (0.37)
Brand 2	2	NB	Y-R	-2.34 (0.33)	-1.31 (0.16)	0.86 (0.01)	2.80 (0.40)
Brand 3	2	NB	Y-D	-1.23 (0.23)	-0.56 (0.08)	0.71 (0.01)	-0.21 (0.08)
Brand 4	1	NB	Y-D	-0.88 (0.17)	-0.39 (0.06)	0.63 (0.00)	-0.47 (0.07)
Brand 5	3	NB	D-R	-0.35 (0.05)	-0.19 (0.03)	0.65 (0.02)	-0.74 (0.09)
Brand 6	1	NB	D-R	-0.73 (0.13)	-0.28 (0.04)	0.55 (0.01)	-0.98 (0.09)
Brand 7	1	NB	C-R	-1.58 (0.21)	-0.99 (0.12)	0.84 (0.00)	3.40 (0.48)
Brand 8	1	NB	Y-R	-2.27 (0.43)	-1.19 (0.18)	0.81 (0.00)	2.53 (0.37)
Brand 9	1	NB	C-R	-1.55 (0.20)	-0.98 (0.12)	0.84 (0.00)	3.40 (0.48)
Brand 10	2	NB	Y-R	-3.07 (0.46)	-1.55 (0.20)	0.86 (0.01)	2.80 (0.40)
Brand 11	2	NB	C-R	-1.82 (0.23)	-1.17 (0.15)	0.87 (0.01)	3.66 (0.50)
Brand 12	3	NB	Y-R	-1.80 (0.31)	-1.09 (0.15)	0.86 (0.01)	2.79 (0.40)
Brand 13	3	NB	Y-D	-1.16 (0.33)	-0.53 (0.10)	0.71 (0.01)	-0.21 (0.08)
Brand 14	3	NB	D-R	-0.55 (0.11)	-0.27 (0.05)	0.65 (0.02)	-0.73 (0.09)
Brand 15	4	NB	Y-R	-1.86 (1.37)	-1.05 (0.45)	0.87 (0.01)	2.84 (0.40)
Brand 16	4	NB	Y-D	-1.17 (0.86)	-0.52 (0.20)	0.73 (0.02)	-0.17 (0.09)
Brand 17	4	NB	C-R	-1.75 (0.55)	-1.14 (0.26)	0.88 (0.01)	3.71 (0.51)
Brand 18	4	NB	D-R	-0.45 (0.23)	-0.23 (0.09)	0.67 (0.02)	-0.69 (0.09)
Brand 19	5	PL	Y-R	-3.48 (0.46)	-2.23 (0.27)	0.98 (0.01)	4.48 (0.60)
Brand 20	5	PL	Y-D	-1.70 (0.25)	-1.08 (0.14)	0.97 (0.01)	0.97 (0.18)
Brand 21	5	PL	C-R	-2.51 (0.30)	-1.85 (0.21)	0.99 (0.46)	5.49 (0.73)
Brand 22	5	PL	C-D	-2.66 (0.49)	-1.83 (0.28)	0.98 (0.01)	4.13 (0.56)
Brand 23	5	PL	D-R	-0.67 (0.11)	-0.52 (0.08)	0.96 (0.01)	0.37 (0.12)
OG							-2.29 (0.22)

NB/PL stand for National Brands/Private Labels; Y/C/D stands for Yoghurt/Cottage cheese/Dairy dessert Labels; R/D stands for Regular/Diet

5.2.2 In the case of fluid milk

We first merge both firms 1 and 3 and then both firms 2 and 3. If we compare prices before and after a merge when a change in milk price is not taken into account (11 and 12), we notice that only the prices of products made by those firms strongly increase. In fact, prices of PLs barely increase and prices of other products may slightly increase or even decrease on average. If we look at the market shares, the merged firms are those which lose market shares whereas the other firm and PLs gain some.

If we apply a 10% decrease in the milk price, we observe that the pass-through increases for merged firms (13 and 14) whereas it remains roughly the same for the other ones. Thus, when a merger occurs, the concerned manufacturers overshift more the cost decrease.

Table 11: **Impact of a merge between firms 1 and 3 on prices and market shares (Milk)**

Firm				Change in price in % Mean (std)	Change in MS in % Mean (std)
Brand 1	1	NB	S	9.42 (3.89)	-16.38 (2.44)
Brand 2	1	NB	SS	11.13 (2.43)	-17.75 (3.43)
Brand 3	1	NB	W	9.46 (1.74)	-16.66 (2.98)
Brand 4	2	NB	S	-0.29 (0.22)	5.11 (1.37)
Brand 5	2	NB	SS	-0.09 (0.15)	5.16 (1.42)
Brand 6	2	NB	W	-0.40 (0.21)	5.09 (1.36)
Brand 7	2	NB	S	-0.19 (0.10)	5.14 (1.39)
Brand 8	2	NB	SS	-0.18 (0.12)	5.14 (1.40)
Brand 9	2	NB	W	-0.20 (0.13)	5.12 (1.39)
Brand 10	3	NB	S	8.13 (1.47)	-8.79 (0.82)
Brand 11	3	NB	SS	8.17 (0.72)	-8.92 (0.83)
Brand 12	3	NB	W	6.82 (0.63)	-9.85 (0.66)
Brand 13	4	PL	S	0.06 (0.08)	5.12 (1.38)
Brand 14	4	PL	SS	0.07 (0.10)	5.04 (1.27)
Brand 15	4	PL	W	0.04 (0.07)	4.83 (1.30)

NB/PL stand for National Brands/Private Labels; S/SS/W stands for Skimmed/Semi-skimmed/Whole milk

Table 12: **Impact of a merge between firms 2 and 3 on prices and market shares (Milk)**

Firm				Change in price in % Mean (std)	Change in MS in % Mean (std)
Brand 1	1	NB	S	0.01 (0.73)	3.91 (0.97)
Brand 2	1	NB	SS	0.03 (0.11)	4.15 (1.20)
Brand 3	1	NB	W	-0.17 (0.12)	4.11 (1.17)
Brand 4	2	NB	S	9.77 (1.70)	-17.47 (2.96)
Brand 5	2	NB	SS	11.01 (2.40)	-18.35 (3.45)
Brand 6	2	NB	W	9.47 (1.58)	-17.19 (2.92)
Brand 7	2	NB	S	10.53 (1.90)	-17.87 (3.28)
Brand 8	2	NB	SS	10.12 (1.72)	-17.76 (3.07)
Brand 9	2	NB	W	9.98 (2.12)	-17.72 (3.22)
Brand 10	3	NB	S	6.73 (1.25)	-7.25 (0.51)
Brand 11	3	NB	SS	6.70 (0.65)	-7.28 (0.60)
Brand 12	3	NB	W	5.73 (0.62)	-8.32 (0.56)
Brand 13	4	PL	S	0.05 (0.06)	4.25 (1.20)
Brand 14	4	PL	SS	0.05 (0.06)	4.26 (1.22)
Brand 15	4	PL	W	0.04 (0.05)	4.03 (1.14)

NB/PL stand for National Brands/Private Labels; S/SS/W stands for Skimmed/Semi-skimmed/Whole milk

Table 13: **Impact of a 10% decrease in the milk price after firms 1 and 3 merged (Milk)**

Firm				Change in cost in % Mean (std)	Change in price in % Mean (std)	Pass-through $\triangle p/\triangle c$ Mean (std)	Change in MS in % Mean (std)
Brand 1	1	NB	S	-2.88 (2.92)	-1.72 (1.35)	1.44 (2.38)	-3.89 (2.48)
Brand 2	1	NB	SS	-3.18 (0.64)	-1.94 (0.42)	1.39 (0.26)	-4.06 (0.95)
Brand 3	1	NB	W	-4.48 (0.77)	-3.29 (0.48)	1.49 (0.11)	0.27 (0.59)
Brand 4	2	NB	S	-2.27 (0.52)	-1.27 (0.30)	1.03 (0.14)	-5.09 (0.77)
Brand 5	2	NB	SS	-3.00 (0.75)	-1.58 (0.28)	1.05 (0.04)	-5.15 (0.69)
Brand 6	2	NB	W	-4.05 (0.79)	-2.92 (0.41)	1.31 (0.07)	-0.74 (0.52)
Brand 7	2	NB	S	-2.55 (0.51)	-1.43 (0.25)	1.05 (0.03)	-5.10 (0.74)
Brand 8	2	NB	SS	-2.58 (0.43)	-1.44 (0.22)	1.05 (0.04)	-5.12 (0.70)
Brand 9	2	NB	W	-5.04 (1.57)	-3.30 (0.61)	1.24 (0.05)	-0.64 (0.56)
Brand 10	3	NB	S	-7.84 (2.81)	-2.80 (0.67)	1.37 (0.14)	-4.09 (0.75)
Brand 11	3	NB	SS	-7.02 (1.30)	-2.84 (0.54)	1.38 (0.19)	-4.04 (0.88)
Brand 12	3	NB	W	-6.79 (2.89)	-3.96 (0.70)	1.42 (0.11)	0.61 (0.87)
Brand 13	4	PL	S	-2.62 (0.44)	-2.02 (0.27)	0.97 (0.04)	1.45 (0.76)
Brand 14	4	PL	SS	-2.57 (0.35)	-1.98 (0.37)	0.96 (0.14)	1.39 (1.50)
Brand 15	4	PL	W	-4.13 (0.78)	-3.41 (0.53)	1.00 (0.01)	14.07 (2.00)
OG							-10.86 (1.27)

NB/PL stand for National Brands/Private Labels; S/SS/W stands for Skimmed/Semi-skimmed/Whole milk

Table 14: **Impact of a 10% decrease in the milk price after firms 2 and 3 merged (Milk)**

Firm				Change in cost in % Mean (std)	Change in price in % Mean (std)	Pass-through $\triangle p/\triangle c$ Mean (std)	Change in MS in % Mean (std)
Brand 1	1	NB	S	-2.88 (2.92)	-1.46 (0.41)	1.14 (0.28)	-4.90 (0.68)
Brand 2	1	NB	SS	-3.18 (0.64)	-1.70 (0.25)	1.10 (0.02)	-5.00 (0.51)
Brand 3	1	NB	W	-4.48 (0.77)	-3.13 (0.42)	1.29 (0.04)	-0.56 (0.27)
Brand 4	2	NB	S	-2.27 (0.52)	-1.55 (0.26)	1.40 (0.08)	-4.07 (0.51)
Brand 5	2	NB	SS	-3.00 (0.75)	-1.86 (0.29)	1.38 (0.07)	-4.10 (0.51)
Brand 6	2	NB	W	-4.05 (0.79)	-3.20 (0.38)	1.59 (0.15)	0.33 (0.43)
Brand 7	2	NB	S	-2.55 (0.51)	-1.72 (0.27)	1.40 (0.07)	-4.04 (0.52)
Brand 8	2	NB	SS	-2.58 (0.43)	-1.71 (0.23)	1.39 (0.07)	-4.10 (0.49)
Brand 9	2	NB	W	-5.04 (1.57)	-3.50 (0.56)	1.45 (0.06)	0.36 (0.47)
Brand 10	3	NB	S	-7.84 (2.81)	-2.81 (0.60)	1.36 (0.07)	-4.12 (0.52)
Brand 11	3	NB	SS	-7.02 (1.30)	-2.82 (0.36)	1.35 (0.06)	-4.12 (0.52)
Brand 12	3	NB	W	-6.79 (2.89)	-3.94 (0.69)	1.40 (0.07)	0.51 (0.47)
Brand 13	4	PL	S	-2.62 (0.44)	-2.02 (0.27)	0.97 (0.01)	1.48 (0.41)
Brand 14	4	PL	SS	-2.57 (0.35)	-1.99 (0.24)	0.97 (0.01)	1.49 (0.40)
Brand 15	4	PL	W	-4.13 (0.78)	-3.41 (0.52)	1.00 (0.01)	14.09 (1.95)
OG							-10.82 (1.16)

NB/PL stand for National Brands/Private Labels; S/SS/W stands for Skimmed/Semi-skimmed/Whole milk

6 Conclusion

To be done

Main ideas :

- Global impact of a 10% decrease in milk price on both dairy desserts and fluid milk market
- The pass-through for PLs is close to 1 on both markets
- The pass-through for NBs is different from 1
  - <1 on the dairy desserts market
  - >1 on the fluid milk market

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7 Appendices

Table 15: **Descriptive Statistics for Prices and Market Shares by Brands (Desserts).**

	Type	Number of Retailers	Prices (in euros per kilogram) Mean (std)	Market Shares Mean in % (std)
National Brands		7	2.72 (0.08)	50.94 (1.31)
Brand 1	Y-R	7	2.42 (0.11)	6.83 (0.64)
Brand 2	Y-R	7	2.10 (0.07)	2.15 (0.19)
Brand 3	Y-D	7	2.07 (0.08)	1.74 (0.24)
Brand 4	Y-D	7	2.75 (0.11)	4.27 (0.27)
Brand 5	D-R	7	4.57 (0.19)	2.27 (0.44)
Brand 6	D-R	7	2.70 (0.21)	4.64 (0.41)
Brand 7	C-R	7	3.25 (0.19)	1.75 (0.18)
Brand 8	Y-R	7	2.25 (0.17)	7.03 (0.64)
Brand 9	C-R	6	3.25 (0.12)	2.21 (0.29)
Brand 10	Y-R	6	1.81 (0.06)	2.18 (0.31)
Brand 11	C-R	7	2.78 (0.08)	2.64 (0.21)
Brand 12	Y-R	7	2.61 (0.13)	1.59 (0.23)
Brand 13	Y-D	7	2.22 (0.09)	1.20 (0.31)
Brand 14	D-R	7	3.10 (0.15)	1.50 (0.13)
Brand 15	Y-R	7	2.74 (0.07)	3.23 (0.23)
Brand 16	Y-D	7	2.28 (0.19)	1.15 (0.29)
Brand 17	C-R	7	2.99 (0.07)	1.30 (0.16)
Brand 18	D-R	7	4.03 (0.21)	3.26 (0.19)
Private Labels		7	1.81 (0.05)	49.06 (1.31)
Brand 19	Y-R	7	1.45 (0.03)	21.73 (0.57)
Brand 20	Y-D	7	1.46 (0.02)	4.64 (0.36)
Brand 21	C-R	7	2.00 (0.05)	8.23 (0.37)
Brand 22	C-D	7	1.68 (0.07)	2.14 (0.26)
Brand 23	D-R	7	2.47 (0.08)	12.32 (0.39)

Y stands for Yoghurt, C for cottage cheese, D for other dairy desserts, R for Regular and D for Diet.

Table 16: **Descriptive Statistics for Prices and Market Shares by Retailers; Prices in euros/kilogram (Desserts).**

	Number of brands NB	Number of brands PL	Share of PL %	Price of NB Mean	Price of PL Mean	Price Mean (std)	Market Shares Mean in % (std)
Retailer 1	18	5	46.95 (2.27)	2.64 (0.09)	1.74 (0.05)	2.22 (0.04)	17.45 (0.49)
Retailer 2	18	5	53.48 (2.29)	2.76 (0.11)	1.85 (0.07)	2.27 (0.04)	13.60 (0.20)
Retailer 3	18	5	34.53 (2.23)	2.71 (0.09)	1.77 (0.06)	2.39 (0.05)	10.52 (0.24)
Retailer 4	18	5	37.69 (2.13)	2.81 (0.09)	1.84 (0.05)	2.44 (0.05)	20.94 (0.55)
Retailer 5	18	5	42.52 (1.32)	2.69 (0.10)	1.83 (0.05)	2.32 (0.06)	7.87 (0.27)
Retailer 6	18	5	38.22 (2.02)	3.02 (0.10)	2.03 (0.09)	2.64 (0.05)	12.41 (0.39)
Retailer 7	16	5	81.34 (3.33)	1.90 (0.09)	1.73 (0.05)	1.77 (0.05)	17.20 (0.75)

Table 17: **Descriptive Statistics for Prices and Market Shares by Categories and Retailers (Desserts).**

	Share of PL %	Price of NB Mean	Price of PL Mean	Price Mean (std)
Yoghurt	45.66 (1.43)	2.36 (0.08)	1.45 (0.03)	1.94 (0.04)
Retailer 1	44.10 (2.86)	2.29 (0.09)	1.40 (0.02)	1.89 (0.05)
Retailer 2	50.19 (2.36)	2.38 (0.11)	1.50 (0.04)	1.94 (0.05)
Retailer 3	33.79 (2.51)	2.36 (0.09)	1.44 (0.05)	2.05 (0.05)
Retailer 4	35.25 (2.63)	2.42 (0.09)	1.45 (0.03)	2.08 (0.05)
Retailer 5	39.74 (1.51)	2.34 (0.09)	1.45 (0.04)	1.99 (0.04)
Retailer 6	34.85 (2.39)	2.65 (0.08)	1.59 (0.06)	2.28 (0.04)
Retailer 7	78.51 (5.18)	1.61 (0.11)	1.40 (0.03)	1.45 (0.04)
Cottage cheese	56.70 (2.05)	3.05 (0.09)	1.93 (0.06)	2.42 (0.05)
Retailer 1	51.50 (3.28)	2.96 (0.10)	1.91 (0.08)	2.42 (0.04)
Retailer 2	57.56 (3.30)	3.02 (0.13)	2.09 (0.10)	2.49 (0.06)
Retailer 3	43.35 (3.39)	2.97 (0.13)	1.84 (0.07)	2.49 (0.09)
Retailer 4	44.45 (3.06)	3.16 (0.09)	1.89 (0.04)	2.60 (0.07)
Retailer 5	49.34 (3.23)	3.00 (0.11)	1.97 (0.07)	2.49 (0.08)
Retailer 6	47.59 (2.77)	3.30 (0.11)	2.06 (0.10)	2.71 (0.06)
Retailer 7	89.46 (1.83)	2.36 (0.10)	1.85 (0.06)	1.91 (0.06)
Dairy desserts	51.42 (1.45)	3.48 (0.11)	2.47 (0.08)	2.96 (0.06)
Retailer 1	50.66 (2.38)	3.40 (0.17)	2.32 (0.12)	2.85 (0.07)
Retailer 2	58.51 (2.69)	3.68 (0.14)	2.39 (0.12)	2.93 (0.07)
Retailer 3	29.95 (1.80)	3.37 (0.13)	2.58 (0.10)	3.13 (0.09)
Retailer 4	38.89 (1.75)	3.68 (0.13)	2.77 (0.17)	3.32 (0.08)
Retailer 5	44.08 (1.33)	3.39 (0.17)	2.54 (0.10)	3.01 (0.11)
Retailer 6	39.35 (1.45)	3.92 (0.15)	3.04 (0.16)	3.57 (0.10)
Retailer 7	80.58 (1.88)	2.32 (0.20)	2.24 (0.06)	2.26 (0.07)

Table 18: **Descriptive Statistics for Prices and Market Shares by Brands (Milk).**

	Type	Number of Retailers	Prices (in euros per liter) Mean (std)	Market Shares Mean in % (std)
National Brands		7	0.74 (0.02)	38.16 (3.43)
Brand 1	S	7	0.95 (0.17)	0.88 (0.14)
Brand 2	SS	7	0.83 (0.05)	8.94 (1.31)
Brand 3	W	7	1.13 (0.08)	0.72 (0.10)
Brand 4	S	7	1.07 (0.09)	0.82 (0.10)
Brand 5	SS	7	0.86 (0.05)	7.44 (1.25)
Brand 6	W	7	1.16 (0.10)	0.62 (0.07)
Brand 7	S	5	0.98 (0.07)	0.02 (0.02)
Brand 8	SS	7	0.94 (0.07)	0.41 (0.07)
Brand 9	W	7	1.01 (0.07)	0.17 (0.03)
Brand 10	S	7	0.54 (0.03)	0.35 (0.12)
Brand 11	SS	7	0.57 (0.01)	17.34 (1.97)
Brand 12	W	7	0.89 (0.06)	0.45 (0.06)
Private Labels		7	0.63 (0.03)	61.84 (3.43)
Brand 13	S	7	0.58 (0.04)	6.38 (0.30)
Brand 14	SS	7	0.63 (0.03)	51.66 (3.47)
Brand 15	W	7	0.73 (0.04)	3.80 (0.28)

S stands for skimmed, SS for semi-skimmed, W for whole milk

Table 19: **Descriptive Statistics for Prices and Market Shares by Retailers; Prices in euros/liter (Milk).**

	Number of brands		Share of PL	Price of NB	Price of PL	Price	Market Shares
	NB	PL	%	Mean	Mean	Mean (std)	Mean in % (std)
Retailer 1	12	3	47.44 (0.08)	0.69 (0.02)	0.63 (0.04)	0.66 (0.03)	16.41 (0.59)
Retailer 2	11	3	72.03 (0.04)	0.71 (0.02)	0.66 (0.05)	0.68 (0.04)	12.83 (0.34)
Retailer 3	12	3	60.78 (0.03)	0.79 (0.06)	0.65 (0.03)	0.71 (0.04)	9.91 (0.43)
Retailer 4	12	3	41.81 (0.07)	0.75 (0.03)	0.70 (0.06)	0.72 (0.04)	18.81 (0.62)
Retailer 5	12	3	41.02 (0.03)	0.68 (0.02)	0.66 (0.04)	0.67 (0.03)	8.14 (0.32)
Retailer 6	12	3	58.47 (0.03)	0.91 (0.05)	0.66 (0.05)	0.76 (0.05)	10.43 (0.37)
Retailer 7	11	3	91.74 (0.01)	0.59 (0.02)	0.57 (0.02)	0.57 (0.02)	23.47 (0.92)

Table 20: **Descriptive Statistics for Prices and Market Shares by Categories and Retailers (Milk).**

	Share of PL %	Price of NB Mean	Price of PL Mean	Price Mean (std)
Skimmed milk	75.53 (1.94)	0.92 (0.10)	0.58 (0.04)	0.67 (0.05)
Retailer 1	61.34 (3.25)	0.90 (0.11)	0.64 (0.04)	0.74 (0.07)
Retailer 2	86.19 (4.46)	1.23 (0.23)	0.68 (0.06)	0.76 (0.10)
Retailer 3	65.82 (6.02)	0.97 (0.19)	0.65 (0.07)	0.76 (0.10)
Retailer 4	40.80 (4.32)	0.95 (0.10)	0.66 (0.06)	0.83 (0.07)
Retailer 5	78.06 (4.50)	1.20 (0.15)	0.63 (0.05)	0.76 (0.06)
Retailer 6	60.50 (3.64)	1.01 (0.17)	0.66 (0.06)	0.80 (0.10)
Retailer 7	93.80 (3.01)	0.52 (0.03)	0.52 (0.04)	0.52 (0.04)
Semi-skimmed milk	60.21 (3.96)	0.71 (0.02)	0.63 (0.03)	0.66 (0.03)
Retailer 1	45.69 (8.70)	0.67 (0.02)	0.62 (0.04)	0.65 (0.03)
Retailer 2	70.02 (4.63)	0.69 (0.02)	0.65 (0.04)	0.66 (0.03)
Retailer 3	60.81 (3.93)	0.77 (0.05)	0.64 (0.03)	0.69 (0.04)
Retailer 4	42.32 (8.09)	0.71 (0.02)	0.70 (0.07)	0.70 (0.04)
Retailer 5	36.41 (3.34)	0.65 (0.02)	0.65 (0.03)	0.65 (0.02)
Retailer 6	61.20 (4.31)	0.86 (0.04)	0.66 (0.05)	0.74 (0.04)
Retailer 7	90.85 (1.34)	0.59 (0.03)	0.58 (0.02)	0.58 (0.02)
Whole milk	65.92 (2.04)	1.07 (0.07)	0.73 (0.04)	0.84 (0.05)
Retailer 1	61.08 (5.78)	0.98 (0.06)	0.75 (0.04)	0.84 (0.04)
Retailer 2	91.15 (2.13)	1.07 (0.08)	0.84 (0.06)	0.86 (0.06)
Retailer 3	54.20 (5.95)	1.08 (0.10)	0.85 (0.09)	0.95 (0.08)
Retailer 4	33.85 (3.56)	1.07 (0.07)	0.84 (0.02)	0.99 (0.04)
Retailer 5	67.75 (4.94)	1.13 (0.06)	0.80 (0.05)	0.91 (0.05)
Retailer 6	25.90 (6.76)	1.14 (0.09)	0.81 (0.04)	1.05 (0.07)
Retailer 7	96.87 (0.86)	0.64 (0.09)	0.61 (0.03)	0.61 (0.03)

Table 21: **Own Price Elasticities between products (Desserts)**

Brands	Characteristic	Own Price Elasticities
B1	Y-R	-4.25 (0.31)
B2	Y-R	-3.82 (0.29)
B3	Y-D	-3.72 (0.32)
B4	Y-D	-4.81 (0.44)
B5	D-R	-8.27 (0.84)
B6	D-R	-4.82 (0.53)
B7	C-R	-5.73 (0.54)
B8	Y-R	-4.10 (0.56)
B9	C-R	-5.79 (0.44)
B10	Y-R	-3.22 (0.26)
B11	C-R	-4.98 (0.23)
B12	Y-R	-4.63 (0.50)
B13	Y-D	-3.95 (0.52)
B14	D-R	-5.83 (0.86)
B15	Y-R	-5.37 (1.33)
B16	Y-D	-4.50 (1.06)
B17	C-R	-5.40 (0.87)
B18	D-R	-7.53 (1.75)
B19	Y-R	-2.97 (0.16)
B20	Y-D	-3.03 (0.17)
B21	C-R	-4.11 (0.22)
B22	C-D	-3.53 (0.47)
B23	D-R	-5.19 (0.59)

NB/PL stand for National Brands/Private Labels; R/D stands for Regular/Diet

Y/C/D stands for Yoghurt/Cottage cheese/Dairy dessert Labels

Table 22: **Own Price Elasticities between products (Milk)**

Brands	Characteristic	Own Price Elasticities
B1	S	-2.25 (0.29)
B2	SS	-2.21 (0.14)
B3	W	-2.43 (0.09)
B4	S	-2.41 (0.13)
B5	SS	-2.24 (0.15)
B6	W	-2.45 (0.10)
B7	S	-2.37 (0.12)
B8	SS	-2.35 (0.12)
B9	W	-2.38 (0.13)
B10	S	-1.81 (0.23)
B11	SS	-1.79 (0.09)
B12	W	-2.27 (0.20)
B13	S	-5.47 (0.58)
B14	SS	-5.16 (0.50)
B15	W	-6.56 (0.71)

NB/PL stand for National Brands/Private Labels; S/SS/W stands for Skimmed/Semi-skimmed/Whole milk

Table 23: **Results on price equation (Desserts).**

	Coefficient (Standard Error)
Cow milk	0.730*** (0.361)
Cow milk x PL	-0.172 (0.775)
Wage	-0.067*** (0.016)
Wage x PL	0.085*** (0.033)
Aluminium	0.001 (0.001)
Aluminium x PL	-0.000 (0.003)
Gazole	-0.002*** (0.001)
Gazole x PL	0.002 (0.003)
Glass	0.015*** (0.005)
Glass x PL	-0.005 (0.010)
Metal	-0.025*** (0.009)
Metal x PL	0.017 (0.019)
Cottage Cheese	-0.262 (2.694)
Other dairy desserts	0.282 (2.694)
Diet	-0.294*** (0.047)
Product fixed effects	167.68*** (0.000)
Retailers fixed effects	87.37*** (0.000)
R-squared	0.984
Number of observations	2574

*** significant at 5%

Table 24: **Results on price equation (Milk).**

	Coefficient (Standard Error)
Cow milk	0.751*** (0.248)
Cow milk x PL	-0.227 (0.528)
Wage	-0.080*** (0.008)
Wage x M2	-0.040*** (0.010)
Wage x M3	-0.081*** (0.011)
Wage x M4	-0.054*** (0.012)
Gazole	-0.001*** (0.000)
Gazole x PL	-0.000 (0.001)
Cardboard	-0.005*** (0.002)
Cardboard x PL	0.005 (0.005)
Skimmed milk	0.104*** (0.012)
Whole milk	0.214*** (0.012)
Brand fixed effects (p-value)	20.51*** (0.000)
Retailers fixed effects (p-value)	28.99***(0.000)
R-squared	0.960
Number of observations	1514

*** significant at 5%; M2,M3 and M4 stand for Manfucaturer 2, 3 and 4

Table 25: **Margins for the preferred model (Desserts).**

Brands	Total margins in %	Total marginal costs in euros	Retailers	Total margins in %	Total marginal costs in euros
B1	33.48 (2.62)	1.59 (0.18)	R1	29.16 (6.66)	1.83 (0.73)
B2	33.38 (2.57)	1.43 (0.16)	R2	27.55 (6.59)	1.97 (0.76)
B3	34.43 (3.20)	1.37 (0.18)	R3	28.84 (6.45)	1.84 (0.72)
B4	29.74 (3.07)	1.90 (0.24)	R4	27.50 (6.92)	2.03 (0.88)
B5	15.61 (1.46)	3.92 (0.46)	R5	28.27 (6.45)	1.90 (0.74)
B6	29.72 (3.08)	1.91 (0.29)	R6	25.47 (6.05)	2.20 (0.87)
B7	24.99 (2.52)	2.41 (0.30)	R7	32.77 (10.14)	1.63 (0.90)
B8	35.13 (4.35)	1.50 (0.32)			
B9	24.64 (2.11)	2.45 (0.25)			
B10	39.65 (3.00)	1.09 (0.14)			
B11	25.53 (1.10)	2.07 (0.12)			
B12	28.03 (3.16)	1.87 (0.28)			
B13	33.11 (4.94)	1.49 (0.29)			
B14	22.38 (2.72)	2.54 (0.48)			
B15	26.82 (11.01)	2.28 (0.75)			
B16	31.45 (11.16)	1.79 (0.59)			
B17	24.91 (5.03)	2.29 (0.49)			
B18	18.77 (6.76)	3.49 (0.98)			
B19	34.63 (1.91)	0.95 (0.08)			
B20	34.20 (2.13)	0.97 (0.08)			
B21	25.13 (1.43)	1.51 (0.11)			
B22	29.81 (3.64)	1.21 (0.23)			
B23	19.96 (2.18)	2.05 (0.29)			

Table 26: **Margins for the preferred model (Milk).**

Brands	Total margins in %	Total marginal costs in euros	Retailers	Total margins in %	Total marginal costs in euros
B1	50.65 (9.97)	0.45 (0.26)	R1	45.76 (15.79)	0.43 (0.17)
B2	50.69 (3.62)	0.43 (0.09)	R2	43.65 (17.16)	0.48 (0.22)
B3	45.77 (1.89)	0.54 (0.19)	R3	43.75 (15.64)	0.47 (0.21)
B4	45.62 (2.83)	0.53 (0.22)	R4	44.96 (15.54)	0.46 (0.17)
B5	49.12 (4.05)	0.45 (0.11)	R5	42.85 (15.07)	0.53 (0.19)
B6	44.56 (1.93)	0.58 (0.26)	R6	43.20 (14.52)	0.52 (0.16)
B7	46.45 (2.36)	0.30 (0.27)	R7	49.39 (19.97)	0.25 (0.21)
B8	46.82 (2.44)	0.51 (0.11)			
B9	46.26 (3.18)	0.46 (0.22)			
B10	69.28 (8.27)	0.19 (0.14)			
B11	67.72 (3.90)	0.19 (0.03)			
B12	52.95 (6.62)	0.44 (0.13)			
B13	20.23 (2.91)	0.51 (0.07)			
B14	19.90 (2.12)	0.52 (0.06)			
B15	16.87 (2.63)	0.66 (0.10)			

Table 27: **Estimation of the marginal cost function (preferred model) (Desserts).**

Coefficients (Std. error)	$\mathbf{C}_{jt}$
Wages	0.0057 (0.0004)
Plastic	0.0004 (0.0000)
Energy	0.0055 (0.0006)
Milk x D	0.4776 (0.0325)
Milk x C x R	1.3294 (0.1258)
Milk x C x L	1.1082 (0.3491)
Milk x Y x R	1.1644 (0.1733)
Milk x Y x L	0.5801 (0.0605)
Coefficients $w^h_{b(j)}$,and $w^h_{r(j)}$ not shown	
F test for $w^h_{b(j)}$ (p value)	564.10 (0.00)
F test for $w^h_{r(j)}$ (p value)	98.62 (0.00)

Table 28: **Estimation of the marginal cost function (preferred model) (Milk).**

Coefficients (Std. error)	$\mathbf{C}_{jt}$
Wages	0.0015 (0.0001)
Cardboard	0.0004 (0.0000)
Energy	0.0008 (0.0001)
Milk x Whole	0.9352 (0.0485)
Milk x No Whole	0.4621 (0.0555)
Coefficients $w^h_{r(j)}$ not shown	
F test for $w^h_{r(j)}$ (p value)	47.22 (0.00)

Table 29: **Non-nested Rivers and Vuong tests (Desserts).**

Rivers and Vuong Test Statistic T_n						
$H_1 \backslash H_2$	2	**3**	4	5	6	7
1	0.65	**-2.59**	-1.17	0.56	0.07	-1.76
2		**-3.76**	-4.86	-0.58	-0.65	-2.26
3			**2.04**	**4.44**	**4.18**	**1.97**
4				3.61	1.46	0.35
5					-0.48	-2.47
6						-1.33

Model 1 is linear pricing

Model 2 is two part tariff with RPM and $w = \mu$

Model 3 is two part tariff with RPM and $p - w - c = 0$

Model 4 is two part tariff without RPM

Model 5 is two part tariff with RPM, $w = \mu$ and private labels buyer power

Model 6 is two part tariff with RPM, $p - w - c = 0$ and private labels buyer power

Model 7 is two part tariff without RPM and private labels buyer power

Table 30: **Non-nested Rivers and Vuong tests (Milk).**

Rivers and Vuong Test Statistic T_n						
$H_1 \backslash H_2$	2	3	4	5	**6**	7
1	-1.88	-1.88	-1.12	-1.88	**-1.88**	-1.61
2		-16.57	2.88	-26.17	**-18.78**	2.82
3			2.88	2.53	**-20.90**	2.82
4				-2.88	**-2.88**	-2.92
5					**-10.79**	2.82
6						**2.82**

Model 1 is linear pricing

Model 2 is two part tariff with RPM and $w = \mu$

Model 3 is two part tariff with RPM and $p - w - c = 0$

Model 4 is two part tariff without RPM

Model 5 is two part tariff with RPM, $w = \mu$ and private labels buyer power

Model 6 is two part tariff with RPM, $p - w - c = 0$ and private labels buyer power

Model 7 is two part tariff without RPM and private labels buyer power

COST PASS THROUGH IN DIFFERENTIATED PRODUCT MARKETS:

A DISAGGREGATED STUDY FOR MILK AND BUTTER

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Abstract

Asymmetric cost pass through is often interpreted as an indication of market power. Since 2007 milk markets worldwide have been in turmoil. The price adjustments along the value chain in the following were closely monitored by the public and by antitrust agencies in the European Union, in particular to prove that food retailers use asymmetric cost pass through to increase average margins and profits. In this paper variations in cost pass through are analyzed between wholesale (costs) and retail prices for differentiated milk and butter products (brands) at different (individual) retail outlets in the German market from 2005 to 2008 on a weekly basis. The results indicate statistically significant asymmetric cost-price responses; however, the starting hypothesis, that asymmetric cost pass through is used more excessively by stronger brands, has to be reconsidered. Also the economic impact on average margins and profits appears to be limited.

***JEL*:** C32, D21, L11, L81

Keywords: Cost Pass Through, Threshold Error Correction Model, Dairy Products, Brands, Retail Market, Germany

COST PASS THROUGH IN DIFFERENTIATED PRODUCT MARKETS: A DISAGGREGATED STUDY FOR MILK AND BUTTER

1 Introduction

At first glance milk and butter – respectively – appear to be fairly homogenous goods considering their almost normed physical and chemical characteristics; however, these products show significant price differences at the retail level between national brands and/or private labels or between different retail outlets such as supermarkets, consumer markets or discounters. This holds even for prices in the same week at the same store or at stores close by each other. Looking at average prices over the observation period from 2005 to 2008 we find that national brands range from 53 (80) to 106 (239) Eurocents per liter (per 250 g) for milk (butter). Average private label prices range from 56 (80) to 100 (106) Eurocents per liter (per 250 g) for milk (butter).

Product branding of food processors – mainly dairies – and outlet specific pricing strategies – namely HiLo (High Low) and EDLP (EveryDay Low Price) – may serve as arguments to explain the observed price differentials. Dominant brands as well as certain retail chains have some potential to divert from the competitive single market price equilibrium e.g. due to consumer preferences or costs of store switching. Strong brands can generate loyal consumers who do not switch to competing brands before certain price differentials are exceeded. Retail outlets offer a bundle of products to consumers who face store switching costs and therefore often exercise one-stop-shopping. This allows manufacturers and retail outlets to use single product prices strategically.

This potential to manipulate prices might not only result in deviations of average prices but might also lead to differences in the dynamic price adjustments between brands and retail outlets. At the aggregated level many studies for dairy products and other agricultural goods have shown significant asymmetric cost pass through (amongst others PELTZMAN 2000; GOODWIN AND PIGGOTT 2001; BAUMGARTNER ET AL. 2009). The direction (sign) of price changes or marketing margins therefore leads to different dynamic price reactions with respect to the speed of adjustment and/or the magnitude of the long-run price equilibrium. To what extent and why the dynamic pricing behavior differs between brand and/or retail outlets is the main subject of this study. We analyze the variations in cost pass through, namely the vertical price adjustment between retail and whole sale prices for the differentiated milk and butter products (brands) and for different (individual) retail outlets in the German market.

The underlying hypothesis is that an increasing potential to manipulate retail prices (market power) goes along with a (positive) dynamic asymmetric cost pass through. Such a behavior is more likely to be observed for strong (national) brands and outlets that serve a wider assortment of goods and more complex or higher quality services such as consumer markets, supermarkets or hypermarkets compared to discounters.

Our study contributes to the literature by adding to the following aspects: First, we present cost pass through estimates at the most disaggregated level using specific product prices (EAN-code based) at individual retail outlets to obtain brand (product) specific and store specific cost-price adjustments using an extensive retail scanner data set over a four years period from 2005 to 2008. Second, retail prices often show a high level of rigidity which prevents an efficient estimation of dynamic price adjustment processes; in the sample under study the food crisis in 2007 has caused significant price variation at the wholesale and the retail level. In addition, retail prices are set on a weekly basis which is the frequency of the data under study; the majority of former studies employ data at a monthly frequency. Third, we use wholesale prices instead of farm prices.[2] Wholesale milk prices might better reflect short-run cost changes in the retail market than farm prices. Fourth, a two stage estimation approach is employed to analyze the differences in the price response functions. In the first stage after testing the time series properties, we apply a three regime threshold error correction model (TECM) to a wide range of time series (2643) including 71 (90) different brands for milk (butter) and 327 (447) retail stores.[3] In the second stage the estimates of the individual dynamic cost-price adjustment enter an estimated dependent variable regression which uses dummy variables as explanatory variables to measure and test brand, store type and product specific effects. The estimated dependent variable regression has to our knowledge not been used in this context before, at least for dairy market data.

The paper is organized as follows. In section two we summarize the empirical literature on vertical dairy product cost-price transmission. In the following section the methodological background of estimating asymmetric cost-price transmission is explained. Section four gives

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[2] Most studies use farm prices as cost indicators.

[3] Testing non-linearity and the number of regimes for the threshold model is often ignored in empirical applications. We explicitly consider these issues following the procedure by STRIKHOLM AND TERÄSVIRTA (2006).

an overview of German dairy product markets at the wholesale and the retail levels. Descriptive statistics and time series properties of the processes under study are described in section five. In section six the estimation results for the threshold error correction model in the first step and the estimated dependent variable regression for different parameters of the dynamic price adjustment in the second step are presented and discussed. In the final section we present our conclusion.

2 Literature Review

A great number of studies on asymmetric cost pass through or vertical price adjustments and its implications on the performance of agricultural and food markets have been presented over the past decades; several of these studies have specifically investigated dairy product prices starting with the seminal paper by KINNUCAN AND FORKER (1987) (see Table 1).[4] In particular the recent price volatility in the period between 2007 and 2008 has revived the debate on asymmetric cost-price transmission, e.g. in the US where the "debate over this matter grew more intense when retail prices appeared to change relatively little as farm prices dropped in late 2008" (STEWART AND BLAYNEY 2011).

While according the American Farm Bureau Federation increases of farm prices of milk are quickly passed on to consumers by marketers, farm prices decreases are adjusted more slowly to retail prices in order to increase profits mostly in retailing (STEWART AND BLAYNEY 2011). According to MEYER AND CRAMON-TAUBADEL (2004) such a price response is defined as positive asymmetry. The European Commission comes to a similar conclusion: "Since 2007, consumer prices – and to a lesser extent food producer prices – have failed to decrease in line with the decrease in agricultural commodity prices, exhibiting a 'rockets and feathers' evolution pattern in which prices are fast to raise and slow to decrease. The decline in agricultural commodity prices has been passed on up to one year later to the consumers" (EUROPEAN COMMISSION 2009). The German Antitrust Commission has looked at the dynamics of vertical price relationships on domestic dairy markets concluding that the pricing process appears to be efficient; following, they see no need for antitrust policy actions (BUNDESKARTELLAMT 2009). The analysis is based on disaggregated data for national brands and private labels which might explain the differences in the results compared e.g. with other European countries; also, Germany seems to be a special case with a highly competitive retail

[4] The terms cost pass through, cost-price transmission and (vertical) price transmission are used interchangeably in this paper.

sector. However, no formal testing is applied; the conclusions are based on graphical analyzes of only a few case studies.

Table 1: Empirical studies of asymmetric cost pass through or vertical price transmission for dairy products

Author(s)	**Kinnucan, Forker**	**Serra, Goodwin**	**Chavas, Mehta**	**Jensen, Møller**	**Baumgartner et al.**	**European Commission**	**Stewart, Blayney**
Year	1987	2003	2004	2007	2009	2009	2011
Journal[a]	AJAE	AE	AJAE	WP	WP	RP	ARE
Relationship[b]	Pf ↔Pr	Pf ↔Pr	Pw ↔Pr	Pf ↔ Pw ↔Pr	Pf ↔Pr	Pf ↔Pr	Pf ↔Pr
Product	Milk, Butter, Cheese, Ice Cream	Milk, Cheese, Cream Caramel	Butter	Milk[e]	Milk, Butter, Cheese	Milk, Butter, Cheese and other	Milk, Cheese
Country	USA	Spain	USA	Denmark	Austria	EU-27	USA
Frequency	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly
Result (Asymmetry)	Yes	Yes[d]	Yes	Yes	Yes	Yes	Yes
Form of Asymmetry	Positive	Positive	Positive	Positive[f]	Positive[g]	Positive	Positive[h]
Model[c]	DLM	TECM	ECM	ECM	TVECM	DLM	ECM/TECM/STECM
# Regimes	2	3	2	2	3	2	1/2/3

Legend: a) AJAE: American Journal of Agricultural Economics; AE: Applied Economics; ARE: Agricultural and Resource Economics; WP: Working Paper; RP: Report;
b) Farm gate Price (Pf); wholesale Price (Pw); retail-Price (Pr);
c) Distributed Lag Model (DLM); Threshold (Vector) Error Correction Model (T(V)ECM); Smooth Transition Error Correction Model (STECM);
d) Not in case of milk and cream caramel;
e) Additional investigation of non-dairy products; f) significant asymmetries only found in price transmission between wholesale and retail prices;
g) Negative asymmetries are estimated for cheese and are related to growing international competition;
h) Adjustment to the long run a twofold and show negative asymmetries in case of milk;

Source: Own.

KINNUCAN AND FORKER (1987) investigate price transmission between retail and farm prices for milk, butter, cheese and ice cream. They find significant positive asymmetries in the price transmission process using the Wolffram-Houck approach. KINNUCAN AND FORKER (1987) argue that governmental price support and industry concentration cause the asymmetric price response; they also discuss the static marketing margin model of GARDNER (1975) and show that farm-retail price transmission elasticities are smaller when price changes are predominantly triggered by cost shifts. However, cost shifters are identified to play only a minor role in explaining the asymmetric price adjustment.SERRA AND GOODWIN (2003) (milk, cheese, cream caramel), CHAVAS AND MEHTA (2004) (butter), JENSEN AND SKADKÆR MØLLER (2007) (price indexes of different milk products), BAUMGARTNER ET AL. (2009) (milk, butter, cheese, dairy products) and STEWART AND BLAYNEY (2011) (milk, cheese) use (threshold) error correction models. SERRA AND GOODWIN (2003) find positive asymmetries for the Spanish dairy market. The authors relate the asymmetric pricing behavior in the Spanish dairy sector mainly to menu costs, inventory management, search costs and public market intervention. CHAVAS AND MEHTA (2004) find that retail prices respond more strongly to wholesale price increases than to wholesale price decreases; their explanations are consumer search costs, retailers' menu costs and also imperfect competition at the retail level. JENSEN AND SKADKÆR MØLLER (2007) detect weak price transmission especially for milk. In their view asymmetric price adjustment is caused by public intervention and product differences. More value added products show a higher degree of asymmetry. The EUROPEAN COMMISSION (2009) analyzes a range of different milk products (milk, butter, cheese, skim milk etc.) for a variety of EU Member States. Instead of an error correction approach a model in first differences is used to detect asymmetric price responses. In particular for Slovenia, the United Kingdom, Denmark and Lithuania significant asymmetries are found. The Commission relates the positive asymmetries to "the limited share of agricultural commodities into final food prices, inefficiencies in the market structure of the chain (either linked to imbalances in bargaining power and/or anti-competitive practices), and some adjustments constraints and costs (e.g. costs of changing prices for both producers and retailers, the slow price transmission due to long-term contracts between economic actors)" (EUROPEAN COMMISSION 2009).

BAUMGARTNER ET AL. (2009) detect positive asymmetries for milk and butter. STEWART AND BLAYNEY (2011) study price transmission over the food crisis from 2007 to 2009 in the US. They analyze the nature of price transmission for whole milk and cheddar cheese, comparing results of different model specifications. Independent of underlying specification they find positive asymmetries. Additionally, STEWART AND BLAYNEY (2011) state for the lower processed product (whole milk) that the price pass-through is larger and that the process of error correction is active in the whole spectrum of observed disequilibria. In contrast the higher processed product (cheddar cheese) shows a band of sluggish or zero error correction.[5]

In conclusion, the empirical evidence for statistically significant positive price asymmetries in the dairy sector is overwhelming. However, a few issues need to be resolved before concluding what the main drivers for these phenomena are. First, most studies use farm prices at the upstream level. Dairy farms have contracts with dairies. In case of cooperative companies farmers hold company's shares. Therefore, contract prices might not follow simple market integration rules; for instance, dairies try to use higher prices in the winter season to allocate more milk in that period or some dairies might stabilize prices over the season.[6] In addition, when studying highly processed products such as butter or cheese compared to fresh milk, price transmission might be affected by the importance of processing costs and/or the prices of complements that are not considered. Analyzes of price transmission have to take into account these issues when using farm level instead of respective wholesale prices.[7] Second, all studies discussed here use relatively highly aggregated monthly data. Thus, it might be questioned whether the estimated results indicate an average behavior in the industry. CRAMON-TAUBADEL ET AL. (2006) have shown "that estimation with aggregated data can generate misleading conclusions about price transmission behavior at the level of the individual units (i.e. retail stores) that underlie these aggregates." We also lose the information about variations in individual price responses and about what subsectors are driving the average behavior. Third, many studies focus on statistical significance.[8] It would, however, be important to calculate the economic importance not only in theory by relating coefficients to the scale of respective variables simulating artificial shocks but also to simulate the impact of asymmetry with real data shocks. All these issues are considered in the present study.

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[5] STEWART AND BLAYNEY (2011) mention some more studies for the US market (LASS AND ADANU 2001; LASS 2005; CAPPS AND SHERWELL 2007; AWOKUSE AND WANG 2009). They conclude: "However, all studies find evidence of some type of asymmetry."

[6] Therefore, imperfect or asymmetric price transmission between farm and retail prices might not indicate imperfect competition and/or inefficient exchange processes. Wholesale prices used here are not directly affected by vertical integration (contracts); for those retailers using contracts wholesale prices still reflect opportunity costs.

[7] At the farm level there is only one price, namely the price of raw milk. The relationship between the farm price of milk and the retail price of butter is likely affected by the price of skim milk powder as it is the complementary product. In this study we use wholesale prices of butter to avoid these problems of model misspecification.

[8] CRAMON-TAUBADEL (1998) presents a simulation to evaluate the economic significance of asymmetric price adjustment. We follow his approach and adopt it for the estimated threshold model.

3 *Methodology*

A technique to estimate asymmetric price transmission has first been proposed by WOLFFRAM (1971) and later modified by, inter alia, HOUCK (1977). Since then many methodological enhancements have been introduced and a great number of empirical studies e.g. for aggregated data have been presented. A consistent theoretical explanation is still at large (see PELTZMAN 2000). Main arguments for asymmetric price transmission are market or bargaining power, menu costs, inventory management and internalization of price variations. A detailed overview on methodological developments, theoretical justifications and empirical results in this field can be found in FREY AND MANERA (2007) and MEYER AND CRAMON-TAUBADEL (2004).

A major step in developing a methodology to efficiently estimate asymmetric price transmissions is the work by ENGLE AND GRANGER (1987) on cointegration. Most price series indicate non-stationary behavior similar to random walks. Cointegration tests and the error correction representation of cointegrated processes solve the problem of spurious regressions and offer a simple as well as meaningful economic interpretation. GRANGER AND LEE (1989) adopted the concept of asymmetric adjustments to the error correction representation. The basic idea is that the speed of returning back to the equilibrium differs with respect to the sign of the deviation from the long-run equilibrium. Compared to earlier approaches which are based on the signs of price changes, the specification proposed by GRANGER AND LEE (1989) separates positive and negative deviations from the long-run equilibrium. Thereby GRANGER AND LEE (1989) do not only present a statistically consistent specification but also a consistent economic interpretation. This concept can be applied in all fields that rely on an equilibrium concept. While originally developed to analyze the relationship between production, sales and inventories, the specification can also be applied to cost pass through or price integration studies. The following specification illustrates the model. Let p_{1t} be a retail price and p_{2t} be a wholesale price, μ_{t-1} is the deviation from the long-run price relationship.[9] I_{t_1} is an indicator variable. I_{t_1} is 1 if $\mu_{t-1} < 0$ and zero otherwise.

$$\Delta p_{1t} = \alpha_0 + \delta^- I_{t_1} \mu_{t-1} + \delta^+ (1 - I_{t_1}) \mu_{t-1} + \varphi \Delta p_{2t} + \sum_{j=1}^{k} \beta_{1j} \Delta p_{1,t-j} + \sum_{j=1}^{k} \beta_{2j} \Delta p_{2,t-j} + \varepsilon_t \qquad (1)$$

[9] The deviations from the long-run price equilibrium are estimated in a first step as by the Engle-Granger-Two-Step-Procedure.

Asymmetric error correction models have been applied in different forms, restricted and unrestricted models, with different asymmetric and lag specifications (see CRAMON-TAUBADEL AND LOY 1999, 1996; GRANGER AND LEE 1989).

The two main characteristics of the (asymmetric) price transmission process are the speed of adjustment back to the (linear) long-run equilibrium and its parameters indicating the average margin. For asymmetric processes the speed of price adjustment varies with respect to the sign of the deviation from the long-run equilibrium. Asymmetries are classified into positive and negative. A positive asymmetry implies adjusting retail prices faster when wholesale prices rise compared to when they fall. Negative asymmetries describe the opposite. Traditionally asymmetric models have one threshold (two regimes) which is *a priori* set at zero. In more recent papers the threshold is determined endogenously in a separate procedure. For vertical price transmission models two thresholds (three regimes) are often used to represent the theoretical idea of menu costs that prevent or limit adjustments of small deviations from the equilibrium in the inner regime (BALKE AND FOMBY 1997). In the two threshold model the error correction term is split into three regimes as shown in Equation 2 and 3.

$$\mu_t = \begin{cases} \delta^1 \mu_{t-1} + \varepsilon_{1t} & if \quad \mu_{t-1} > \theta_1 \\ \delta^2 \mu_{t-1} + \varepsilon_{2t} & if \quad \theta_2 \leq \mu_{t-1} \leq \theta_1 \\ \delta^3 \mu_{t-1} + \varepsilon_{3t} & if \quad \mu_{t-1} < \theta_2 \end{cases} \tag{2}$$

$$\Delta\mu_t = ([\delta^1 - 1)I]_{t_1}\mu_{t-1} + [(\delta]^2 - 1)(1 - I_{t_1} - I_{t_2})\mu_{t-1} + [(\delta]^3 - 1)I_{t_2}\mu_{t-1} + \varepsilon_t \qquad (3)^{10}$$

The thresholds are estimated following a procedure by CHAN (1993) who proposes an iterative (grid) search using all potential values for the transition variable and selecting thresholds based on minimizing the residual sum of squares of all potential TAR models. The search is limited to guaranty a minimum number of observations in each regime (HANSEN 1999;

[10] The transformation of (2) into first differences is due to testing convenience similar to the first differencing in linear case applying the ADF-procedure.
The indicator variables are defined according to the regimes separated by the thresholds; for instance, if $\mu_{t-1} < \theta_1$, then $I_{t_1} = 1$ else $I_{t_1} = 0$. If $\mu_{t-1} > \theta_2$, then $I_{t_2} = 1$ else $I_{t_2} = 0$.

HANSEN AND SEO 2002). Threshold values estimated based on CHAN (1993) are super-consistent.[11]

For every regime a separate autoregressive structure is assumed. Thus, conditions to ensure stationarity of the error term $\mathrm{I}(\mu_t)$, which is a requisite for (threshold) cointegration, are more complex than in the linear case. For multiple regimes there might be a very large number of sufficient conditions to ensure stationarity. Additionally, the number of regimes (thresholds) needs to be confirmed empirically. The threshold parameters are not known a priori and have to be estimated. Standard procedures to test for linearity against non-linearity cannot be applied (HANSEN 1996). For correct inference on threshold cointegration, testing for linearity and the number of regimes need to account for the problem of nuisance parameters under the H_1–hypothesis (ANDREWS AND PLOBERGER 1994; HANSEN 1996).[12] TJØSTHEIM (1990) proves that if the characteristic roots of the autoregressive lag processes in the outer regimes are smaller than one, then the process is stationary; namely, if the outer regimes are stationary, the whole process is stationary. CHAN ET AL. (1985) show sufficient conditions for the three regime model. If $\delta^1 < 1, \delta^3 < 1$ and $\delta^1\delta^3 < 1$, then μ_t is a stationary process.[13]

Following ENGLE AND GRANGER (1987), stationarity of the error term $\mathrm{I}(\mu_t)$ indicates that processes (prices) are threshold cointegrated. Assuming a symmetric lag structure of order k for all prices, threshold cointegration implies the existence of a threshold error correction representation of the following form:

$$\Delta p_{t} =$$

$$+ \sum_{j=1}^{k} \beta_{1,j} \Delta p_{1,t-j} + \sum_{j=1}^{k} \beta_{2,j} \Delta p_{2,t-j} + v_t \qquad (4)$$

The indicator functions are defined as above. The error correction representation in equation 4 allows for different adjustments of deviations from the long-run equilibrium depending on the size of the deviation. If the inner regime shows no responses (δ_i =0), then the lag polynomial

[11] A more detailed description on the estimation of thresholds by grid search can be found in CHAN (1993) and STIGLER (2010); ENDERS AND SIKLOS (2001), ABDULAI (2002) and BAUMGARTNER ET AL. (2009) present applications of the procedure.
[12] The problem vanishes if the underlying economic relationship is known a priori.
[13] See BALKE AND FOMBY (1997) for more details on the issue of stationarity, e.g. when the outer regimes indicate non-stationary behavior.

of the error process has a unit root and the process is non-stationary. As long as the outer regimes are stationary, such behavior can be compatible with threshold cointegration.

PIPPENGER AND GOERING (1993, 2000), BALKE AND FOMBY (1997), ENDERS AND GRANGER (1998), ENDERS AND SIKLOS (2001) and LO AND ZIVOT (2001) show that traditional tests do not fail to detect cointegration but they can lose power in presence of threshold (non-linear) effects. Regardless what test is used, e.g. ENGLE-GRANGER Approach (1987)[14] or JOHANSEN trace test (1988), the test power decreases for absolute larger thresholds. Testing directly the null of no cointegration against the alternative of threshold cointegration is a superior alternative. ENDERS AND SIKLOS (2001) propose a non-standard test based on Monte-Carlo-Experiments. They develop two test statistics (t-max- and φ-statistic) and simulate critical values.[15] The statistics are then applied to test the null hypothesis of no cointegration against the alternative of threshold cointegration. The hypotheses $\delta^1 < 1, \delta^3 < 1$ are tested with the t-max statistic and in addition $\delta^1 = \delta^3 = 1$ is tested by applying the φ-statistic. Whenever the test statistics exceed their critical values, the null is rejected.[16]

For testing the number of regimes (thresholds) several approaches are available. A graphical approach is proposed by TSAY (1989) using scatterplots of various statistics versus the specified threshold variables. A formal inference is provided by HANSEN (1996, 1999). HANSEN (1999) proposes a sequential likelihood ratio type test setting the model with the higher number of regimes as the alternative hypothesis. Bootstrapped asymptotic distributions are used to result critical values. The sequential procedure tests the linear model against the one threshold autoregressive model alternative (two regimes) in the first step; then, secondly, a one threshold model is tested against the two threshold alternative and so forth. The procedure stops when the null hypothesis is rejected for the first time. GONZALO AND PITARAKIS (2002) suggest also a sequential test, but based on information criteria. Hansen's test is computational burdensome due to the bootstrapped null distributions. Both sequential methods require the estimation of the model with the higher number of regimes, even if the

[14] Different tests to detect stationarity in the equilibrium error, such as Augmented-Dickey-Fuller test (ADF), Philips-Peron test (PP) or Kwiatkowski et al. test (KPSS), are considered in the mentioned studies and lead to same loss of test power.

[15] ENDERS AND SIKLOS (2001) simulated their test statistic for a one threshold model; we reexamined their Monte-Carlo-Experiment for a two threshold model. Details on the simulation can be obtained from the authors upon request.

[16] These conditions are sufficient if processes converge, implying that autoregressive coefficients have to be positive. Then these conditions fulfill the first case in BALKE AND FOMBY (1997) mentioned above. Though there might be other conditions to ensure stationarity, rejecting these hypotheses identifies stationary processes. Not rejecting might not necessarily imply non-stationarity.

parsimonious model is the favorable specification. This multiplies again the necessary computational time.[17]

STRIKHOLM AND TERÄSVIRTA (2006) propose another sequential procedure which has two advantages. Firstly, standard inferential methods can be applied and secondly, the higher order threshold alternative needs not to be estimated. The test uses a smooth transition generalization of the TAR model (STAR model) in Equation 3 in order to sequentially determine the right number of regimes. In Equation 5 a three regime STAR model is shown:

$$\Delta\mu_t = \partial^1\mu_{t-1} + \partial^2\mu_{t-1}G_{t_1}(\mu_{t-1},\theta_1,\gamma_1) + \partial^3\mu_{t-1}G_{t_2}(\mu_{t-1},\theta_2,\gamma_2) + \varepsilon_t \quad (5)$$

G_{t_i} is a transition function that uses μ_{t-1} as a transition variable, θ_i are threshold parameters which indicate the point of transition. γ_i are slope coefficients which reflect the speeds of the transition between the regimes (1, 2 and 3). If the slope coefficients γ_i tend to infinity, the STAR model in Equation 5 equals the threshold model in Equation 3.[18] If all γ_i are zero, the STAR model equals a simple linear model (TERÄSVIRTA 2006).

The sequential test for non-linearity starts in the first step with comparing the linear representation against a two-regime-STAR-model. The transition function G_{t_1} is replaced by a first order Taylor approximation. Both specifications are linear models. The hypothesis is equivalent to testing $\gamma_1 = 0$ (DIJK ET AL., 2000; STRIKHOLM AND TERÄSVIRTA 2006). For the decision which model is preferred, a simple F-test approximation is used. If the null hypothesis is rejected, one threshold needs to be estimated. According to Chan (1993) the sequential estimation of thresholds results super-consistent estimators; thus for the second step of testing a two- against a three-regime model, the second threshold is again modeled by a Taylor approximation.[19] This procedure is continued until the null hypothesis is rejected for the first time.

[17] Computational costs of estimating TAR models rise exponentially with increasing number of thresholds.

[18] Transition function $G_{t_i}(\mu_{t-1},\theta_i,\gamma_i)$ is bound between zero and one. It converges to indicator function as in (3) when γ_i becomes large. For details on the transition function see DIJK ET AL. (2000) or STRIKHOLM AND TERÄSVIRTA (2006).

[19] Estimating the thresholds does not depend on the number of thresholds, meaning if we estimate one threshold for a process that has two, then the estimated threshold equals the one or the other (GONZALO AND PITARAKIS 2002). This is an important requisite for the validity of the sequential testing procedure.

4 *Milk Processing and Retailing*

German dairies process about 20 percent of the milk produced in the EU-27 (AMI 2010). In 2006 57 of the 198 German dairy companies are cooperatives and 141 are other non-cooperatives (private enterprises). Cooperatives are on average bigger than non-cooperatives and their total share of processed milk is about 50 percent (AMI 2010; BMELV 2008). The market share of the six biggest dairy companies is almost 50 percent, of which four are cooperatives (FRIEDRICH 2010). Cooperatives mostly focus on cost leadership by utilizing economies of scale producing standard products such as milk powder and butter. In comparison, non-cooperatives use more marketing activities and focus on national brands with higher value added (EVERWAND ET AL. 2007; BUNDESKARTELLAMT 2009). 63 percent of the raw milk produced in Germany is processed to cheese (32 %) and butter (31 %). Another 34 percent of the raw produce goes into the production of milk (13 %), cream (12 %) and curdled milk/milk drinks (9 %) (AMI 2010).[20]

Dairy companies directly deal with food retailers. The food retailing sector is even more concentrated than processing. In 2010 the top 6 grocery retailers make more than 75 percent of the sector's turn over. Additionally, food retailers manage most of the dairy product exports (FRIEDRICH 2010; HELLBERG-BAHR ET AL. 2010). The big retailers such as ALDI, LIDL/SCHWARZ, METRO, REWE or EDEKA dominate the negotiations with the processors and can likely exercise market power (BUNDESKARTELLAMT 2009; HELLBERG-BAHR ET AL. 2010). However, this advantageous position might not result in higher margins due to intense competition between retailers and highly price sensitive consumers (HELLBERG-BAHR ET AL. 2010; TWARDAWA 2006; BACHL ET AL. 2010). The retail business in Germany can be differentiated by five formats with respect to store size and store product assortment (NIELSEN 2006; CLEEREN ET AL. 2010; GIJSBRECHTS ET AL. 2008). Supermarkets sell almost exclusively food items and have a store size smaller than 799 m², small (large) consumer markets sell predominantly food items and have a size above 800 m² and below 1499 m² (> 1500 and < 5000 m²). Hypermarkets sell food and other items such as clothing and have a size bigger than 5000 m² (NIELSEN 2006). Discounters offer a small assortment of

[20] 44 percent of milk processed by dairies is sold to the retail sector; the remaining products are delivered to large consumers (canteens, restaurants etc.) or the food processing industry (FRIEDRICH 2010).

goods (stock keeping units) with a high degree of private labels[21], operate at low costs and low buying-in-prices by realizing huge demand quantities (AGGARWAL 2003; CLEEREN ET AL. 2010; MORSCHETT ET AL. 2006). They use their low cost profile to offer everyday low prices to consumers, using only a small number of price promotions (AGGARWAL 2003; HOCH ET AL. 1994). The other store formats use a larger assortment of goods with a higher share of national brands and more fresh and specialty products (GIJSBRECHTS ET AL. 2008). They offer more services and employ a (high-low) promotional pricing strategy (RONDAN-CATALUÑA ET AL. 2005). The concept of private labels has been adopted also by these formats in order to be competitive at a low price level (BRUHN 2006; SCHMALEN AND SCHACHTER 1999). Recently the concept of premium private labels has been developed to compete with (high quality) national brands (BRUHN 2006). Private labels are owned by the retailer who controls all marketing and pricing activities (COLLINS-DODD 2003).

Dairy retail prices are important elements of the marketing policy. Consumers in Germany are highly price sensitive and main dairy products are key items for the consumers' store choice. Thus, dairy products are often used as loss leaders to lure consumers into the store (BACHL ET AL. 2010; RONDAN-CATALUÑA ET AL. 2005).[22] Almost 75 percent of the milk and more than 50 percent of the butter consumed in Germany are private labels (FRIEDRICH 2010). The market share of discounters has significantly increased over the last decades (FRIEDRICH 2010; TITZE 2008). In 2009 discounters hold 56 percent of milk and 50 percent of butter retail sales in Germany. Hypermarkets make 21 percent of milk and 23 percent of butter retail sales (BMELV different volumes).

5 Descriptive Statistics

For this study we use German milk and butter prices at the retail and the wholesale level. Both products are well defined. All butter prices apply to a fat content of more than 82 percent and a package size of 250 g (paper packed). For milk all prices apply to a fat content of 3.5 percent and a package size of 1 liter (cartons). Retail prices cover private labels and national brands. For national brands we can differentiate between cooperative brands and non-cooperative brands. Butter is packed with a standard label or with some extra information

[21] Discounters can be distinguished into two types. (a) Hard discounters (Aldi and Lidl) offering almost exclusively private labels and (b) soft discounters (Penny, Netto) which offer a limited set of national brands (AGGARWAL 2003, RONDÁN-CATALUÑA ET AL. 2005).

[22] BACHL ET AL. (2010) rank six dairy products into the group of the most price sensitive 'halo' products. Consumers are most price sensitive in buying coffee, chocolate and butter. 'Halo'-Products are characterized by a high frequency of purchase and good price knowledge. The 'halo'-effect indicates that the store price image is perceived by single product prices.

(additionally labeled), e.g. showing regional attributes. While butter is the same quality for all brands in the sample, milk is either fresh or ultra-high temperature milk.

The data set includes 919 (1724) individual store retail price series covering 71 (90) brands for milk (butter) in 327 (447) stores belonging to the 5 different store formats. The data are collected weekly starting in the first week of 2005 to the last week in 2008 (n =208) by SYMPHONYIRI GROUP GMBH (SIG, 2011). Table 2 shows the distribution of prices by calculating means, standard deviations (of means), minima (of means), and maxima (of means) for respective sub-groups. Promotional sales are a special feature of retail prices and are used with different weights by store formats. Hypermarkets heavily use this instrument while discounters mainly go without it. This might affect the measurement of price transmission (cost-pass-through) and comparability between store formats. Promotional sales are significant temporary price reductions which are unrelated to cost changes (HOSKEN AND REIFFEN, 2001). According to this definition, price promotions are not part of the cost pass-through or the price transmission between wholesale and retail prices. We therefore exclude all price promotions from the time series. These observations are replaced by the respective last regular price before the price promotion.[23] Price promotions might not lead to biased estimates of the price transmission process, but they likely decrease the efficiency of estimations by adding unexplained price variation.

[23] As there is no unique definition of promotional sales, we follow HOSKEN AND REIFFEN (2001) and define sales as significant temporary price reductions that are unrelated to cost changes. More specifically, a product is considered to be on sale if its price is cut by at least five percent for no more than four consecutive weeks. The regular or reference price is defined as the last non-sale price that persisted for more than four consecutive weeks. Sale prices are substituted by the preceding regular price to obtain a regular price series.

Table 2: Descriptive statistics for weekly German milk (A) and butter (B) prices over the period from 2005 to 2008

A	Milk (in €/liter)					
			Prices			
	Brands (Price Series)	Market Share	Mean	St.Dev.	Min.	Max
Wholesale Price			0.49	0.05	0.44	0.6
Retail Price Series	**(919)**		0.77	0.14	0.53	1.06
Brands	**71 (919)**					
National Brands	50 (633)	41.6%	0.84	0.08	0.53	1.06
Cooperative Dairies	35 (297)	22.3%	0.78	0.08	0.53	0.93
Non-cooperative Dairies	15 (335)	19.3%	0.89	0.07	0.58	1.06
Private Labels	21 (286)	58.4%	0.6	0.03	0.56	1
Type of Milk						
Fresh Milk	35 (320)	23.4%	0.79	0.11	0.53	1.02
UHT Milk	36 (599)	76.6%	0.75	0.14	0.58	1.06
	Stores (Price Series)					
Stores	**327 (919)**					
Supermarket	72 (168)	6.8%	0.76	0.15	0.59	1.06
Small Consumer Market	60 (175)	9.3%	0.77	0.14	0.59	0.96
Large Consumer Market	71 (233)	25.7%	0.78	0.13	0.56	0.97
Hypermarket	83 (276)	50.6%	0.78	0.122	0.53	0.93
Discounter	39 (67)	7.6%	0.65	0.11	0.56	0.9

B	Butter (in €/250 g)					
			Prices			
	Brands (Price Series)	Market Share	Mean	St.Dev.	Min.	Max
Wholesale Price			0.75	0.13	0.64	1.13
Retail Price Series	**(1724)**		1.25	0.2	0.8	2.39
Brands	**90 (1724)**					
National Brands	81 (1581)	68.8%	1.29	0.17	0.8	2.39
Cooperative Dairies	55 (1130)	24.7%	1.32	0.16	0.8	1.72
Non-cooperative Dairies	26 (451)	44.1%	1.23	0.17	0.94	2.39
Private Labels	9 (143)	31.2%	0.83	0.05	0.8	1.06
Type of Butter						
Standard Butter	52 (512)	31.3%	1.21	0.19	0.81	2.39
Additionally Labelled Butter	29 (1069)	68.7%	1.27	0.21	0.8	1.73
	Stores (Price Series)					
Stores	**447 (1724)**					
Supermarket	76 (205)	3.6%	1.32	0.17	0.82	1.73
Small Consumer Market	66 (253)	5.0%	1.34	0.2	0.82	2.39
Large Consumer Market	77 (458)	19.1%	1.3	0.18	0.81	2.05
Hypermarket	83 (570)	53.6%	1.23	0.2	0.8	1.73
Discounter	145 (238)	18.7%	1.09	0.21	0.81	1.48

Legend: Average prices for observations from 2005 to 2008 are calculated for each individual time series. Mean: Average for the respective group. St.Dev.: Standard deviation of average prices. Min.: Minimum average price in the respective group. Max.: Maximum average price in the respective group.

Source: Own calculations based on SIG (2011) with STATACORP. (2011).

Of the 71 (90) different brands for milk (butter) 50 (81) are national brands. For milk (butter) 35 (55) national brands belong to cooperatives, 15 (26) national brands belong to non-cooperatives, 21 (9) brands are private labels. Most retailers offer one private label and more than one national brand. Private labels are generally the low price option. Though we only have a few time series for private labels, the market volume of private labels is significant. 60 percent of the milk and 30 percent of the butter sold carry private labels. More than 50 percent of the milk (butter) is sold in hypermarkets.[24]

The average margin for milk (butter) is 28 (50) Eurocents per liter (250 g). In relative terms the margin is 57 (67) percent for milk (butter). The lowest margins are found for private labels, namely 10 percent for butter and 22 percent for milk. On average private labels are 24 (46) Eurocents per liter (250 g) cheaper than national brands. Discounters and hypermarkets set lower prices than consumer and supermarkets. The size of consumer markets seems to have a small negative effect on average prices. Fresh milk is about 14 cent per liter more expensive than UHT milk. Standard label butter is on average 6 cent per 250 g cheaper than butter carrying additional labels. For cooperative versus non-cooperatives we do find mixed results; while national cooperative brands for milk are cheaper than their private counterparts, national cooperative brands for butter are more expensive. Private labels show less variation of average prices compared to national brands. The variation of average prices in the different store formats appears to be very similar.

In Table A1 in the Appendix we further disaggregate mean prices to analyze potential cross effects. While the general conclusions hold, some deviations catch the eye. Private label milk is cheaper than other brands; however, average prices of private labels are almost the same in all distribution channels. Private label butter is also cheaper than other brands, but the price differences between store formats are smaller than for cooperative and non-cooperative national brands. Also the price wedge between private labels and other brands is less pronounced in discounters than in other store formats.

In 2007/08 milk prices started to increase considerably due to developments on the world markets. After reducing intervention prices for butter and skim milk powder in 2004 to 2007, EU markets are more closely connected to the world markets. Most of these drastic price changes on the world markets in 2007/08 are transmitted to domestic markets in the EU.

[24] Because the data do not cover sales by hard discounters (e.g. Aldi and Lidl), these numbers do not represent the actual market shares on the German food retail market.

Thus, the price changes in this period are not originated by changes at EU farm level. This development leads us to focus on the wholesale-retail price relationship instead of looking at the farm-gate-retail price relationship.[25] Though buying-in prices might differ between retailers and brands, wholesale prices might still reflect the cost changes over time. We work with this assumption and use the same wholesale price for estimating the price transmission for each retailer and each brand.[26] We collect prices for milk from the statistical report of the German Federal Ministry of Food, Agriculture and Consumer Protection (BMELV different volumes) which is based on an extensive survey of the German dairy industry. The prices reflect an average price per liter of pasteurized milk with 3.5 percent of fat in single packaging. The sales price of butter for German dairies is quoted by the butter and cheese exchange (SBKB) located in Kempten, Germany. A commission of processors, traders and retailers quote weekly butter prices (SBKB 2010). These quotations reflect average prices for all distribution channels. We have extensively surveyed market experts on the interpretation of the wholesale prices for milk and butter we use. All experts agree that these prices reflect the minimum price for butter and milk a dairy can receive on the market. These reflect the costs of production for these two standard products. Thus, it can be interpreted as a minimum opportunity cost. Consequently, if a dairy builds up a brand it might receive a higher price from retailers and the retailer might demand a higher retail price for that brand. The final margin between the retail price and the opportunity costs (our wholesale price) still reflects the total margin the dairy and the retailer share. Even though we cannot tell how the margin is divided, we can still derive the total margin. And in the end we test whether those margins are different for private labels, national brands, etc. which – we think - is an important information to evaluate the potential to discriminate prices or to the application of market power. The same as for the average margin holds for the dynamic price adjustment. We cannot differentiate whether there is a lag in the adjustment between the price that the dairy receives and the opportunity costs or between the retail price and the respective wholesale price; but we can still determine whether the whole process indicates a sluggish or a quick adjustment with respect to the cost of production. We can identify potential problems and differences in the price adjustment though we cannot identify whether the food processor (dairies) or the retailer causes the problem, but it has to be either one.

[25] In particular for butter the use of farm gate milk prices as cost indicators would ignore the effects of joint production on price transmission.

[26] We interviewed a dozen market experts (CEOs of major dairy companies in the German market). The experts confirm that the whole prices indicate productions costs for milk and butter respectively. The variations in production costs between dairies are small in percentage terms. Though there may be concessions for individual retail chains or for certain brands, the dynamic behavior of these prices still correctly reflects cost changes for all chains and brands.

For all price time series we determine the appropriate lag-length by Akaike Information Criteria (AIC) and log likelihood-ratio tests (LR). For more than half of the series the optimal lag length is two. 75 percent of the series indicates up to five lags. To test for stationarity we use procedures by ADF-test and KPSS-test. The null hypothesis of non-stationarity (ADF-test) is only rejected in five percent of all cases. The null hypothesis of stationarity (KPSS-test) is rejected in nearly 95 percent of all price series. We consider the failure of the test in 5 percent of all cases as the expected type one error. The results for the first differences indicate stationarity for all price series. From this we conclude that the prices under study indicate a unit root and are integrated of order one. For the wholesale price series we arrive at the same conclusion.

Bivariate cointegration between wholesale and respective individual retail prices for milk (919 time series) and butter (1724 time series) is tested by the ENGLE AND GRANGER (1987) Two-Step-Procedure and the JOHANSEN-test (JOHANSEN 1988, 1995). In the case of butter both tests indicate (linear) cointegration for one third of all cases. For milk (butter) the Two-Step-Procedure (Johansen-test) indicates cointegration for 67 (15) percent of all cases. For a considerable part of the time series of milk and butter retail prices we find significant evidence against linear cointegration. Therefore, we additionally test for threshold cointegration based on the approach by ENDERS AND SIKLOS (2001). Focusing on the three regime threshold model, the test results indicate significant evidence for (non-linear) threshold cointegration between retail and wholesale prices. Based on φ-statistic 96 (82) percent of the time series for milk (butter) indicate a significant threshold error correction mechanism between retail and wholesale prices.[27]

Though a three regime threshold model is used to testing non-linear cointegration, we additionally check this assumption by testing the number of thresholds using the procedure developed by STRIKHOLM AND TERÄSVIRTA (2006). The test results are presented in Table A2. For 90 (94) percent of all retail price series for milk (butter) we receive at least one threshold. And the majority of these processes indicate two thresholds. Thus, the relationships indicate either none or two thresholds. As the two threshold model is the most flexible form, we

[27] The derived test statistics for unknown thresholds with 208 observations and four lags is 4.84; 5.84 and 8.15 at the 90, 95 and 99 percent significance level for the φ-statistic and is -1.37, -1.58 and -2.06 at the 90, 95 and 99 percent significance level for the t-max-statistic (one sided test). We have additionally tested threshold cointegration based on the approach by ENDERS AND SIKLOS (2001) with one threshold. The t-max statistic leads to similar results, while the φ-statistic leads to slightly less rejections. Based on joint examination with t-max-statistic, the test leads to similar results. 87 (70) percent of the price series indicate a threshold cointegration relationship with respect to the wholesale price.

choose this specification at the cost of losing estimation efficiency in some cases to directly compare and test the estimates for the cost pass through process.

6 Estimation Results

The analysis of the cost pass through is based on a three regime threshold error correction model (see Equation 4). The model allows for different decay rates of deviations from the long-run price equilibrium (margins) between wholesale and retail prices. For brands with market power and menu costs we expect positive price asymmetries and a close to zero reduction for inner regimes. Margins above the long-run price equilibrium are reduced more sluggishly than margins below the long-run equilibrium; margin deviations within the range of the two thresholds are reduced more slowly or not at all. The wholesale prices are set to be exogenous (p_2). Granger-Causality-tests support this assumption. In more than 90 percent of all cases the wholesale price is found to (Granger) cause the retail prices. The reverse can be rejected for at least half of the cases.[28]

The estimation of the threshold error correction model starts with estimating the long-run price equilibrium similar to the first step of the Engle-Granger-Two-Step procedure. For the obtained error terms (deviations from the long-run equilibrium) the thresholds θ_1 and θ_2 are determined by a grid search procedure developed by CHAN (1993). The grid search operates over a limited range of the estimated error terms (85 percent of the observations), guarantying a minimum amount of observations of 5 percent in each regime. For 99 percent of the estimated pairs of thresholds the steady state equilibrium (zero) lies between θ_1 and θ_2; thus, in these cases θ_1 is negative and θ_2 is positive. On average the inner regime contains 150 of the 208 observation (75 percent). The estimated thresholds are not affected by the minimum amount of observations in each regime. The inner regime is on average bounded by the lower (upper) threshold at -0.03 (0.05) in the case of milk and -0.10 (0.12) in the case of butter. Thus, in the case of milk (butter) the inner regime ranges from -3 (-10) to 5 (12) Eurocents per liter (250g). The inner regimes include zero and are mostly significantly asymmetric; a higher tolerance towards inclusion of positive deviations is indicated.

The adjustment coefficient estimates (δ^0) for the inner regime ($\theta_1 \leq \mu_{t-1} \leq \theta_2$) are mostly small. In the case of milk (butter) the average parameter is -0.04 (-0.01). 92 percent (80

[28] The threshold error correction model is estimated using a symmetric lag structure with four lags. For this specification we can ensure no autocorrelation in more than 90 percent of all estimated error terms based on an alternative Durbin using the Huber/White robust estimator for the variance-covariance matrix. R-squares for the individual threshold error correction models lie on average at 20 percent for milk and at 40 percent for butter. More details are provided by the authors upon request.

percent) of the parameter estimates (δ^0) are statistically not significant for the milk (butter) price series. The adjustment coefficients ($\delta^-; \delta^+$) for the outer regime are in most cases absolutely bigger than the respective coefficients for the inner regime. And the coefficients for the lower regimes ($\mu_{t-1} < \theta_1$) are bigger in absolute terms than the estimated coefficients for the upper regime ($\mu_{t-1} > \theta_2$). In the case of milk (butter) the average rate of decay for a negative equilibrium error (δ^-) is -0.32 (-0.36) compared to -0.12 (-0.17) for δ^+ in case of positive disequilibria. The estimates of adjustments in the lower regime are statistically significant in 93 percent of all cases for both products. In the upper regime statistical significance is lower; the null hypothesis is rejected in 62 (77) percent of all cases for milk (butter). The adjustment parameters in the lower regime compared to the ones for the upper regime are (statistically) significantly higher in absolute terms for 76 (61) percent of all price series for milk (butter). Considering the fact that we find quite a number of processes that indicate symmetric price adjustment (one regime, see Table A2), the remaining processes clearly indicate positive asymmetries. Ignoring statistical significance, 90 percent of all estimated processes show a higher speed of adjustment in the lower regime (positive asymmetry). Though we have weekly data, we find considerable contemporaneous price adjustments. For milk the average estimated coefficient is 0.1, for butter it is 0.15.

To fully analyze the determinants of the price adjustment processes, we run a dependent variable regression for various coefficients of the adjustment process, namely the estimated average margin (ϕ), the two thresholds (θ_1, θ_2), the adjustment coefficients of deviations from the long-run equilibrium for the three regimes (δ^-, δ^0, δ^+) and the coefficient for the contemporaneous adjustment (φ). As exogenous variables we use dummies for cooperative brands, non-cooperative brands, private labels, additionally labeled butter, fresh milk and dummies for the individual store formats. We run the estimations for milk and butter separately. We use Ordinary Least Squares (OLS) with robust standard errors and Weighted Least Squares (WLS) procedures. OLS is supposed to result unbiased but potentially inefficient estimates. WLS returns possibly biased but efficient estimates (LEWIS AND LINZER 2005).[29] The estimations indicate some small differences but the interpretation and conclusions drawn from it are consistent. The results presented in Table 3 are based on the WLS procedure.

[29] Following LEWIS AND LINZER (2005) presenting OLS with robust standard errors and WLS is „good practice“ in estimated dependent variable regressions. In particular when results of both procedures are very close and all parameter estimates are significantly different from zero, alternative methods such as the feasible general least square estimator do not promise any further improvements.

Table 3: Dependent variable estimation for average margins, thresholds, adjustment coefficients and contemporaneous adjustment (n = milk and butter)

Milk	η	θ-	θ+	δ-	δ0	δ+	η
UHT Milk of a Cooperative Dairy at a Discount Store	0.284 ***	-0.028 ***	0.066 ***	-0.144 ***	-0.016 *	-0.047 ***	0.081 ***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.08)	(0.00)	(0.00)
Brands compared to Reference Group							
Non-cooperative Dairy	0.104 ***	-0.016 ***	-0.004	-0.018 ***	-0.017 ***	-0.026 ***	-0.023 ***
	(0.00)	(0.00)	(0.19)	(0.00)	(0.00)	(0.00)	(0.00)
Private Label	-0.191 ***	0.002 **	-0.019 ***	-0.328 ***	-0.041 ***	-0.158 ***	0.050 ***
	(0.00)	(0.03)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Fresh Milk compared to Reference Group							
Fresh Milk	-0.006	0.004 ***	0.001	0.002	0.001	-0 .003	-0.029 ***
	(0.50)	(0.00)	(0.51)	(0.52)	(0.75)	(0.29)	(0.00)
Types of Grocery Store compared to Reference Group							
Supermarket	0.040 ***	0.000	-0.008 **	0.001	0.023 **	0.016 ***	-0.011
	(0.01)	(0.99)	(0.01)	(0.92)	(0.02)	(0.01)	(0.31)
Small Consumer Market	0.036 **	0.000	0.002	- 0.005	0.19 **	0.019 ***	-0.002
	(0.03)	(0.99)	(0.47)	(0.52)	(0.05)	(0.00)	(0.87)
Large Consumer Market	0.019	0.000	0.000	-0.029 ***	0.010	0.018 ***	0.022 **
	(0.23)	(0.77)	(0.91)	(0.00)	(0.28)	(0.00)	(0.38)
Hypermarket	0.005 ***	-0.001	-0.002	0.020	-0.005	0.017 ***	0.021 **
	(0.75)	(0.27)	(0.48)	(0.80)	(0.61)	(0.00)	(0.04)
R-squared[a]	0.81	0.12	0.07	0.55	0.02	0.49	0.08

Butter	η	θ-	θ+	δ-	δ0	δ+	η
Standard Butter of a Cooperative Dairy at a Discount Store	0.413 ***	-0.094 ***	0.091 ***	-0.266 ***	-0.008 **	-0.125 ***	0.101 ***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.06)	(0.00)	(0.00)
Brands compared to reference group							
Non-cooperative Dairy	-0.061 ***	0.017 ***	0.011 ***	-0.032 ***	0.003	0.023 ***	0.000
	(0.00)	(0.00)	0.00)	(0.00)	(0.18)	(0.00)	(0.97)
Private Label	-0.360 ***	0.076 ***	-0.064***	-0.144 ***	0.014	-0.108 ***	0.786 ***
	(0.00	(0.00)	(0.00)	(0.00)	(0.18)	(0.00)	(0.00)
Additionally Labelled Butter compared to Reference Group							
Additionally Labelled Butter	0.101 ***	0.018 ***	0.038 ***	0.035 ***	0.003	-0.016 ***	-0.133 ***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.29)	(0.00)	(0.00)
Types of Grocery Store compared to Reference Group							
Supermarket	0.092 ***	-0.038 ***	0.010 ***	-0.009	-0.010 **	0.024 ***	0.080 ***
	(0.00)	(0.00)	(0.00)	(0.12)	(0.03)	(0.00)	(0.00)
Small Consumer Market	0.115 ***	-0.007 ***	0.030 ***	0.010	- 0.007 *	0.017 ***	0.080 ***
	(0.00)	(0.00)	(0.00)	(0.09)	(0.09)	(0.00)	(0.00)
Large Consumer Market	0.089 ***	-0.041 ***	0.021 ***	-0.002	-0.009 **	0.038 ***	0.077 ***
	(0.00)	(0.00)	(0.00)	(0.58)	(0.03)	(0.00)	(0.00)
Hypermarket	0.038 ***	-0.043 ***	0.011 ***	-0.040 ***	-0.014 ***	0.026 ***	0.066 ***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
R-squared[a]	0.60	0.16	0.15	0.17	0.01	0.04	0.47

Legend: */** denote 5 percent/1 percent significance. ϕ: average marging, Θ-: lower threshhold, Θ+: upper threshhold, δ-: lower regime, δ0: middle regime, δ+: upper regime, φ:contemp. adjustment.
[a]) The R-squared is based on OLS estimation.

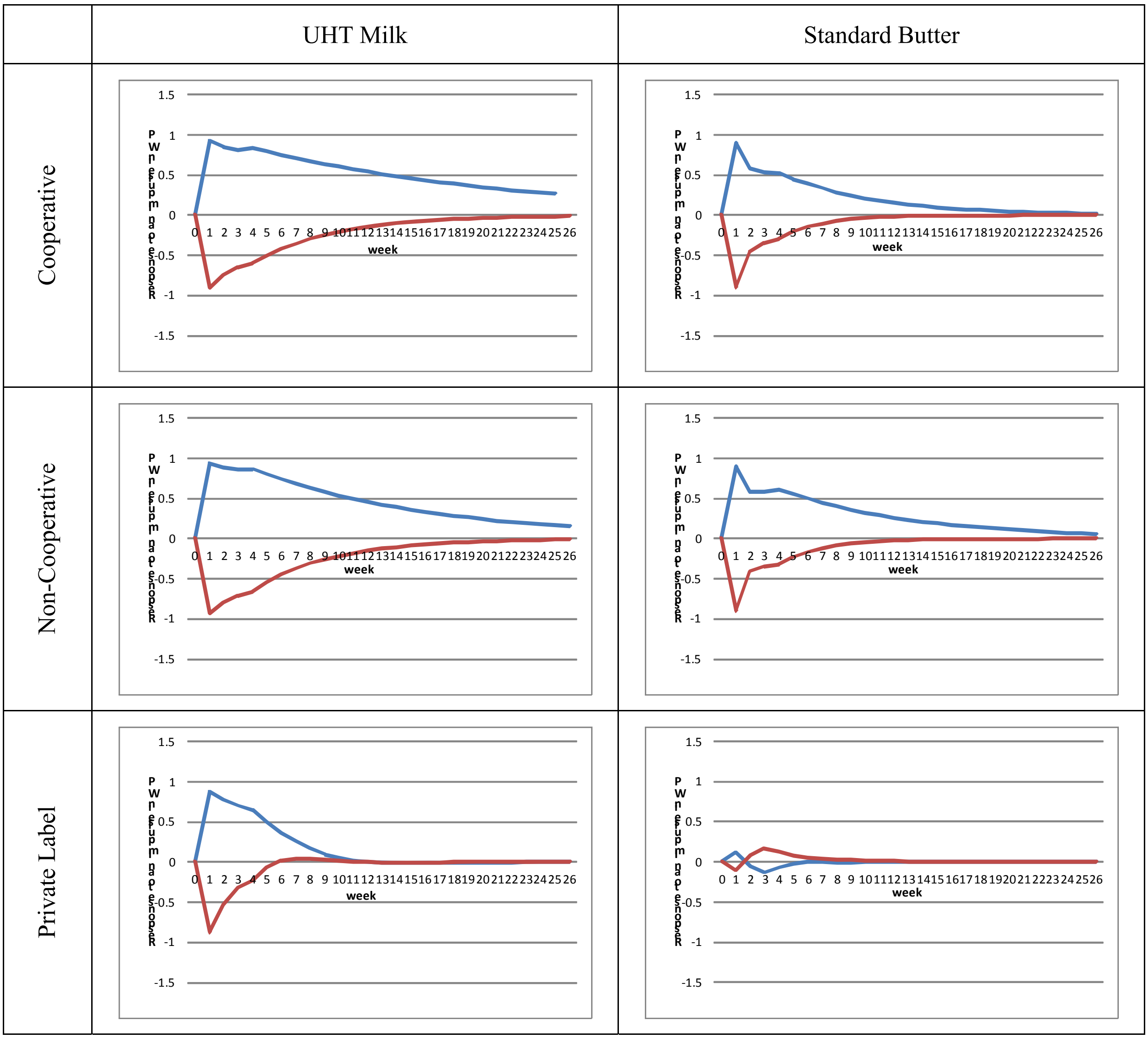
Source: Own calculation based on SIG (2011) with STATACORP. (2011).

The reference groups are ultra-high temperature milk and standard butter of cooperative brands sold in all discounters available. For milk we find an average margin of 28.4 Eurocents per liter, the lower threshold is -0.028, the upper threshold is 0.066 in the reference group. Thus deviations in the range of -10 to +23 percent of the average margin fall into the inner regime in which deviations are reduced at a rate of only 1.6 percent on average. Low margins (below average) are expanded at a rate of 14.4 percent per period; high margins (above average) are reduced at a rate of 4.7 percent back to equilibrium. The contemporaneous adjustment is rather low at 0.08. For butter we find an average margin of 41.3 Eurocents per 250 g, the lower threshold is -0.094, the upper threshold is 0.091 in the reference group. Thus deviations in the range of -20 to +20 percent of the average margin fall into the inner regime in which deviations are reduced at a rate less than 1 percent on average. Lower margins are expanded at a rate of 26.6 percent per period and higher margins are reduced at a rate of 12.5 percent. The contemporaneous adjustment is rather low at 0.10.[30]

To illustrate the differences in dynamic pricing process, Figure 1 shows the adjustment path following a change in the wholesale price by one unit for various groups. As the reaction in the inner regime is close to zero for all groups, we only present the adjustment of significant positive and negative shocks (errors terms that fall in the lower or upper regime). If no contemporaneous adjustment would occur, then the Figures would start at zero (in the pre-shock period) and move up to 1 (in shock period) indicating a disequilibrium of one unit. If a contemporaneous adjustment occurs, the shock is immediately at least partially offset. For instance, a coefficient of 0.2 would correct the shock by 20 percent in the same week. Thus, we would find a move from zero to 0.8 for retail prices from period 0 to 1. Besides the reference groups we look at non-cooperative brands and private labels for the same quality at the same distribution channels (standard butter, UHT milk sold in discounters).

[30] Dependent variable estimation R-squares' are listed in Table 3. In particular for the margins and the adjustments in the lower regime we obtain a very good fit.

Figure 1: Response functions of retail prices to a wholesale price change by one unit



Legend: Week zero is period prior to the wholesale price change.
Source: Own calculations based on estimations results in Table 3 with STATACORP. (2011).

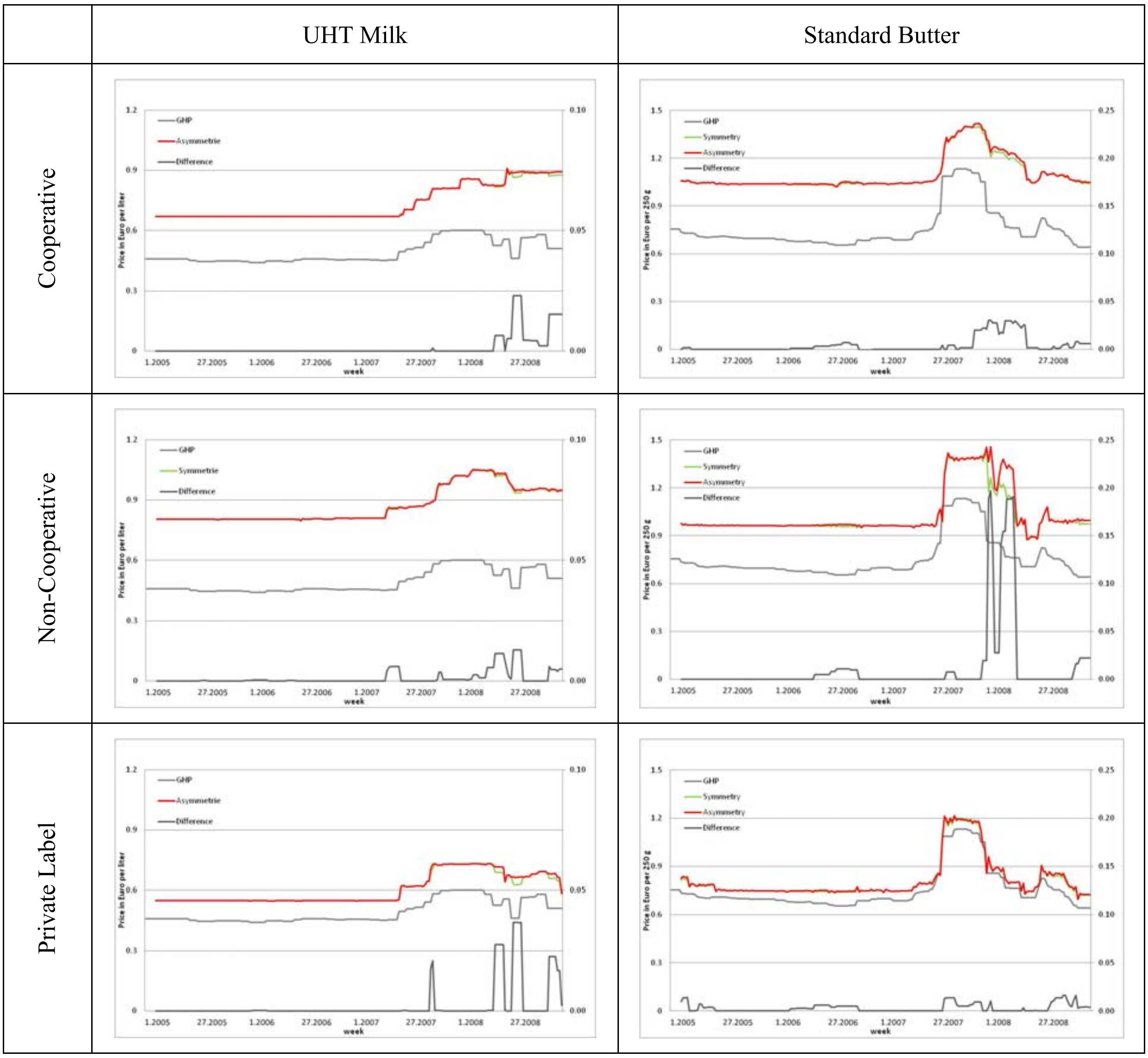
In all cases except for private labels of butter, the contemporaneous adjustment is found to be comparably low. Private label butter retail prices are adjusted almost instantaneously to correct a wholesale price shock and return to the long-run equilibrium margin. Private label milk shows small contemporaneous price adjustments, but lagged responses appear to be quick, however, asymmetric. For milk and butter private labels are offered at very low average margins. Price adjustment processes in the case of milk are slower and indicate more severe asymmetries compared with butter. All asymmetries are of positive nature.

Additionally labeled butter is marketed at a higher average margin and the inner regime of the process is even more biased towards positive values (see Table 3). Dynamic adjustments do not significantly change compared with the reference group, but the contemporaneous adjustment for additionally labeled butter slows down considerably. All other retail store types charge a higher margin than discounters. Hypermarkets are closest to discounters. This holds for milk and butter. In most cases for butter the range for the inner (non-responsive) regime increases for retailers other than discounters. For milk no significant changes in the inner regime can be observed for the different retail outlet formats. There is almost no difference between fresh milk and ultra-high temperature milk.

Finally we simulate the impact of asymmetric price adjustment using real prices by taking a symmetric adjustment as a reference. Following CRAMON-TAUBADEL (1998) we use the minimum of the adjustment coefficients from the lower and upper regime in the reference scenario. In addition we use a symmetric inner regime around zero that is bounded by the minimum of the absolute value of the two estimated thresholds. This procedure assumes that a more competitive price adjustment would indicate the same rate of decay for deviations from the long-run relationship irrespective of the sign. As menu costs might also appear under perfect competition, we keep the inner regime; by forcing symmetry, however, we correct in particular for the tendency that above average margins are if only very slowly reduced.[31] The simulation of the symmetric process is compared to the forecast of the two threshold model.

[31] Thereby we account for the impact of an asymmetric inner regime which also can indicate a form of positive asymmetric price adjustment when in particular positive deviations are adjusted more slowly compared to their symmetric counterparts in the lower regime.

Figure 2: Simulation of retail prices under symmetric and asymmetric price adjustment



Legend: Simulations are based on the individual estimates from threshold error correction representations. After simulating the dynamic processes for each individual time series processes are aggregated for the respective groups shown in the Figure.

Source: Own calculations with STATACORP. (2011)

Results for the simulated processes and their differences over the period of observation are presented in Figure 2 for the same groups as in Figure 1. For all groups asymmetric price adjustment has an impact only after the price crisis starting in 2007. Before 2007 price changes and deviations of margins are rather small and lie within the inner regime which uses the same coefficient of price adjustment in both simulations. As we identified mainly positive asymmetries, the effects only occur in times of strong price reductions, for instance in spring 2008. In that period the effects are significant only for non-cooperative brands in the case of butter. The differences between symmetric and asymmetric price adjustments account for up to 22 Eurocents per 250 g. The average margin for that group is about 40 Eurocents. Thus, asymmetry can cause a significant increase in profits at least for some periods. For cooperative brands the effects are smaller with 3 Eurocents per 250 g at maximum. For milk we find an effect of about 3 Eurocents per liter at a maximum for private labels and cooperative brands, for non-cooperative brands the impact is negligible. There appears to be no positive correlation between the average margin and the impact of asymmetry for the aggregated estimates. If market power is the driving force for asymmetry, then we might expect that it leads to higher margins. However, looking at national brands we find that cooperative brands have the highest margins in butter and non-cooperative brands indicate the highest margins in milk. But these groups show very little impact of asymmetric price adjustment in the price simulation. It appears that groups that operate at low average margins try to use asymmetric behavior to expand it. Exceptions from this rule are private labels for butter which indicate the lowest margins and almost no asymmetries. Butter, however, might be a key product in luring consumers into the store. Private labels might be used as loss leaders or might reinforce a halo-like-effect through manipulation of consumers' perception of the store's overall price level.

7 Conclusions

In this paper the cost pass-through between the wholesale and retail market for milk and butter in Germany is analyzed at the individual product (brand) and store level. The non-linear nature of many of these price relationships is best captured by a bivariate three regime thresholds error correction mechanism. We estimate 2633 individual vertical price relationships for milk and butter in Germany including different brands (cooperative national brands, non-cooperative national brands and private labels) and different retail outlets (supermarkets, small and large consumer markets, hypermarkets and discounters).

Private labels are marketed at lower margins and deviations from the long-run cost-price equilibrium (margin) are reduced much faster than for national brands. In particular butter shows an immediate almost one to one response to shocks at the wholesale level. Discounters sell at lower prices compared to other retail formats; however, this holds for national brands rather than private labels. Private labels are priced almost the same in different store types. Though the dynamic cost-price adjustment shows significant asymmetries, the economic impact is offset by strong symmetric contemporaneous reactions and large inner regimes of almost zero response. Interestingly, we find significant asymmetries that might be used to expand margins, but strong brands with high margins show less economically significant asymmetric cost-price adjustments. The results imply that firms with strong market power (e.g. close to monopoly) do not use asymmetric price responses to expand their margin. This result makes sense because in theory it has not been proven yet that monopolists would benefit from asymmetric price response. Firms with less market power might face oligopolistic competition which leads to smaller margins and asymmetric price responses. This observation might support the theory of the kinked demand model. Thus, the starting hypothesis that stronger brands or companies with more market power use asymmetric cost-price adjustments more excessively to generate higher margins has to be reconsidered. Strong brands enforce significant markups (margins) without excessively using asymmetric cost-price adjustments; their cost-price response is sluggish but mostly symmetric.

Asymmetries in three regime threshold models can occur due to different responses in the upper and lower regimes and due to the location of the inner band. In our study we find that the range is most often biased towards positive deviations. This would support the impact of positive asymmetric responses in the outer regimes. However, simulations show that both effects are statistically significant but most often not economically. And the effects of asymmetric cost price responses on the margins are not related to the overall levels of the margin. While the location of the inner regime can reinforce the asymmetric cost-price response, the range of the inner regime always reduces the effect of asymmetries in the outer regimes. A comprehensive interpretation of two threshold error correction models needs to consider the location of the range of the inner regime and needs to look at the level and differences of adjustment parameters between the outer regimes.

Finally, we find significant differences in the marketing margins which can be explained by descriptive factors such as brands, retail outlets, product qualities etc.; The distribution of margins between retailers and dairies cannot be investigated statistically because firms do not publish their negotiated contract prices. However, according to market experts for strong brands margins are split at least by half between in favor of the dairies. The increase in retailer or processors profits might be disadvantageous for farmers or consumers. Because Granger-causality test results indicate wholesale prices to be exogenous, higher margins likely lead to higher retail prices.[32] Thus, consumers pay the price not farmers.

[32] This result is supported by the fact that German wholesale prices for Butter and skim milk powder show a strong relationship to the respective world market prices (see LOY AND STEINHAGEN, 2009).

8 References

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9 Tables and Figures

Table A1: Average retail milk and butter prices for the period from 2005 to 2008

UHT Milk (in €/liter)

	SM	SC	LC	HM	D
Cooperative Dairies	0.81	0.80	0.80	0.74	0.64
Non-cooperative Dairies	0.93	0.87	0.88	0.90	n.a.
Private Labels	0.60	0.59	0.59	0.59	0.58

Fresh Milk (in €/liter)

	SM	SC	LC	HM	D
Cooperative Dairies	0.79	0.83	0.79	0.78	0.73
Non-cooperative Dairies	0.94	0.94	0.88	0.86	0.87
Private Labels	0.61	0.60	0.60	0.60	0.60

Standard Butter (in €/250 g)

	SM	SC	LC	HM	D
Cooperative Dairies	1.27	1.27	1.24	1.22	1.09
Non-cooperative Dairies	1.19	1.31	1.18	1.03	1.03
Private Labels	n.a.	0.88	0.89	0.83	0.82

Additionally Labelled Butter (in €/250g)

	SM	SC	LC	HM	D
Cooperative Dairies	1.38	1.4	1.39	1.36	1.26
Non-cooperative Dairies	1.30	1.32	1.29	1.25	1.26
Private Labels	n.a.	n.a.	n.a.	n.a.	n.a.

Legend: Average prices for observations from 2005 to 2008 are calculated for the respective group.
SM: supermarket, SC: small consumer market, LC: large consumer market, HM: Hypermarket, D: Discounter.

Source: Own calculations based on SIG (2011) with STATACORP. (2011).

Table A2: The number of regimes according to the test by STRICKHOLM AND TERÄSVIRTA (2006)

Milk

Number of Regimes	SM	SC	LC	HM	D	all
1	14%	19%	16%	0%	4%	10%
2	45%	49%	84%	0%	25%	41%
3	41%	32%	0%	100%	70%	49%

Butter

Number of Regimes	SM	SC	LC	HM	D	all
1	24%	24%	0%	0%	0%	6%
2	76%	75%	0%	0%	0%	20%
3	0%	1%	100%	100%	100%	74%

Legend: SM: supermarket, SC: small consumer market, LC: large consumer market, HM: Hypermarket, D: Discounter

Source: Own calculations based on SIG (2011) with STATACORP. (2011).

Table A3: Percentage of cases with significant asymmetries in the adjustment back to the long-run price equilibrium

UHT Milk

	SM	SC	LC	HM	D
Cooperative Dairies	55%	48%	71%	59%	100%
Non-cooperative Dairies	56%	61%	52%	37%	62%
Private Labels	79%	74%	76%	93%	90%

Fresh Milk

	SM	SC	LC	HM	D
Cooperative Dairies	79%	71%	82%	65%	80%
Non-cooperative Dairies	56%	50%	68%	41%	n.a.
Private Labels	54%	80%	57%	100%	89%

Standard Butter

	SM	SC	LC	HM	D
Cooperative Dairies	61%	63%	55%	61%	53%
Non-cooperative Dairies	79%	52%	76%	70%	100%
Private Labels	n.a.	0%	21%	23%	43%

Additionally Labelled Butter

	SM	SC	LC	HM	D
Cooperative Dairies	33%	35%	47%	56%	46%
Non-cooperative Dairies	74%	51%	65%	47%	93%
Private Labels	n.a.	n.a.	n.a.	n.a.	n.a.

Legend: SM: supermarket, SC: small consumer market, LC: large consumer market, HM: Hypermarket, D: Discounter

Source: Own calculations based on SIG (2011) with STATACORP. (2011).