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Structural Changes and Dairy Chain Efficiency in Italy

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ABSTRACT

The dairy chain in Italy experienced substantial structural changes during the past years. Since the introduction of milk quotas in 1984, structural changes caused by consistent reduction of dairy farms, growing brand concentration at wholesale level, and diffusion of private labels at retail level may have altered the competitive market conditions, with increasing price asymmetry and inefficiencies in price transmission. We tested this hypothesis using the McCorriston and Sheldon's successive oligopoly model, and we gave evidences of altered price transmission and consumer's surplus distribution along the vertical chain in the examined period.

Keywords. dairy chain; imperfect competition; successive oligopoly; simulation; Italy

JEL (L11), (L13), (L16)

1 Introduction

The EU the dairy sector with 127 million tons of milk produced, and a value of 45 billion euros, represents about 13 percent of the total turnover of the European food and beverage industry. Since 1984 the EU dairy market was regulated by the Common Market Organization (CMO) under the Common Agricultural Policy (CAP), imposing import duties, export refunds, and buffer stock interventions for butter and skimmed milk powder and most important, the regulation of milk supply with quotas assigned to all the EU countries. The CMO was reformed many times: from 2009/10 to 2013/14 the milk quotas were increased by 1% every year to allow a gradual adaptation of the milk supply. At the beginning of 2015, the quotas were dismantled and substituted by a new free market regime. The measures for the restructuring of the dairy sector in Italy are now tied in with dairy policy to support the declining prices. In December 2012, the European Commission issued a report dedicated to the future of the dairy sector and conditions for a smooth phasing out of the milk quota system. The Milk Package, drafted by a special High Level group set up after the 2009 milk market crisis, contains measures aimed at boosting the competitive position of the dairy producers to prepare the sector to the open market competition. To mitigate the negative impacts of expected increased milk supply, the EU Commission encourages milk producers to bargain collectively with processors (Hueth et al, 2003). This new regulation published in March 2012, focused on the producers' organization, the inter-branch organization and delegation of powers to the Commission, to define the terms of the written contracts between milk producers and processors and imposed new rules for the inter-branch organizations (European Commission, 2012)[*].

Small, locally operating milk producers and their producer associations were replaced with more concentrated groups leading to an almost complete integration of these associations into integrated downstream cooperatives and mid-stream MNC (Multinational corporations) at the processing level (see

[*] The literature on producer organizations, such as bargaining cooperatives, is very much dominated by authors from the US where these organizations have traditionally played a larger role (Hueth & Marcoul, 2003, USDA, 2005).

Burrell, 2004; Dries et al., 2008; EU Commission, 2012). However the EU situation suggests that the resulting efficiency of the dairy chain varies from country to country. In Denmark and the Netherlands, 80% of the dairy business is now controlled by a small number of cooperative groups and in Eastern countries the concentration is similar (Dries et al., 2009). The aim of this research is: i) to examine the dairy chain in Italy and the main structural changes that occurred in recent years; ii) to examine market efficiency by studying the vertical price transmission along the dairy chain with the successive oligopoly model; iii) to discuss the results of simulations of price asymmetry for welfare distribution and iv) to discuss the role of agricultural policy for improving the dairy chain competitiveness in the future.

2 Review of the literature

A great deal of literature has been dedicated to the competition in agro-food chains. Food industry consolidation, market integration and advances in econometric technique have sparked renewed interest in farm–retail price linkages. The studies about market margins (Wohlgenant, 2001; Ward, 1982) for fresh vegetables, the vertical price transmission in dairy chain (Kinnucan and Forker, 1987), and space price transmission (Azzam, 1999) tested whether retail cost increases are transmitted faster that cost decreases to wholesale and farm levels and why prices respond differently to increase or decrease in farm or shipping-point prices (see literature reviews by Meyer and von Cramon-Taubadel, 2004; Goodwin, 2006; Vavra et al, 2005). Asymmetry in farm-retail price transmission is hypothesized to exist due to: i) industry concentration at market levels beyond the farm gate as mentioned previously, ii) government intervention in the pricing of farm milk, and iii) differential impacts of shifts in retail demand versus farm supply. Using a simple regression to test the farm-retail prices, Kinnucan et al. (1987) found that 55% to 95% of the variation in retail prices were explained by the lagged milk prices at farm level with asymmetric response. This type of evidence of price asymmetries has policy relevance as it may be inconsistent with market efficiency predicted by standard economic theory of competitive markets (Peltzman, 2000).

From a policy perspective, despite its implications for competitiveness, empirical evidence rejecting the symmetric price transmission hypothesis has been argued to provide a “prima facie” case for government intervention about distorsive consequences for welfare distribution due to asymmetric price transmission (McCorriston et al., 2001; Meyer and von Cramon-Taubadel, 2004). The results of 205 asymmetric pricing studies reviewed by Meyer and von Cramon-Taubadel (2004) suggested that symmetry could be rejected in 48% of the cases. Peltzman's (2000) examined evidence across 77 consumer and 165 producer goods, including 120 food and agricultural products and found the symmetry hypothesis was rejected in about two-thirds of the cases. From these studies, it would appear that the asymmetric price transmission is the rule rather than the exception, and different approaches are needed to examine competitiveness. Time series analysis was used to test vertical market integration and price transmission; another approach used was industrial organization theory (Schmalensee, 1989; Sexton et al, 2004; Serra and Goodwin, 2003; Rosa and Vasciaveo, 2012).

Vertical price transmission has been re-examined as commodity markets have become more concentrated at each level of the dairy chain and more integrated across levels; with the industrial organization approach based on S-C-P and conjectural hypothesis the consequences of price asymmetry have been tested with the successive oligopoly model (Mc Corriston and Shieldon, 1996; Henderson et al, 1993; Royer and Rogers, 2003; Anichiarico and Orioli, 2008; Cavicchioli, 2010; Akimowitz et al., 2013; Bailey et al., 1989; Sexton et al, 2004; Dhar et al, 2000). To estimate the consequences of the oligopoly situation, it is assumed that preferences could be modeled with a quasi-linear utility function in a reduced form (demand and profit function).

In this paper, we focus on price transmission in the Italian dairy chain using the paradigm of industrial organization to examine the structural changes and consequences for conduct and results (Goddard, 1993). It is focused on the structure of the dairy chain at different levels responsible for the conduct to determine significant departures from competitive price setting, affecting the price transmission and welfare distribution (Bresnahan, 1989; Carlton and Perloff, 1997; Hudson et al, 1991; Palaskas, 1995; Cavicchioli, 2010). In this paper, the structure of the dairy chain is examined at three levels: dairy farm level, processing level, and retail level. In the next section, we present evidence of substantial structural change at each level. Next, we examine evidence of price transmission based on a hypothesis of oligopolistic behavior and simulation of price transmission, consumer surplus and welfare distribution. In the last section, we report some conclusions drawn from the analysis and make suggestions concerning the future of the dairy chain in a more competitive market in the absence of the CMO.

3 Scenario and structural changes in the dairy chain

The evidence of scale economies across firms or within an industry over time is frequently detected by using the average cost per unit of a product. In the dairy sector, the evolution of scale economies has been of interest as an explanation of the evolution of firm size and competitive conditions as larger sizes affects entry conditions (Boehlje, 1992; Wijnands et al, 2008). Other indicators of structural changes include the degree of specialization and mechanization, and the extent of use of information technology (milking robots, quality control, herd monitoring devices, data processing). Organizational changes focussed on the horizontal links between dairy producers and vertical coordination of technical and economic functions affecting price setting and market regulation tools (Goddard et al. 1993). These changes can generally be explained in terms of better competitive conditions in line with economies of scale/scope (Chavas 2001; Boussemart et al. 2009).

To a larger extent, the decline in the number of enterprises at the farm level is justified by the progress in labor productivity due to automatic milking and feeding systems causing a decline in average costs per unit of milk produced. **S**ince the introduction of the milk quotas in 1984, the structure of the dairy sector in all EU countries evolved consistently: the number of dairy farms generally declined and the size of dairy herds and production increased (see table 1); the average herd size is now about 60-80 cows per farm (AA:VV, 2013). Among the EU countries, the largest decline in dairy farms occurred in Italy (- 80%), accompanied by an increase of 254% in production; in Denmark the number of farms declined by 78% and the production increased by +165%; in France the number of dairy farms reduced by 73% while the production increased by 160%.; in Germany the progress in production was +158% and in Ireland +135%. The largest dairy farm sizes were found in the UK and the Netherlands; in other Member States, namely Spain, Portugal, Greece, Hungary, Latvia and Slovakia, the number of enterprises increased but the average production declined. At the processing level of the dairy chains, in the Netherlands, Germany and France, some of the biggest dairy groups were involved in international alliances to achieve higher competitive advantages outside the EU markets.

The structural change in Italy progressed in three directions: concentration, specialization and geographic localization in some vocated regions following the trend of other EU countries. Table 1 reports the milk production in Italy at the farm level in 2010: Lombardia is the leading dairy region producing approximately half of the total milk supply. The production asymmetry is evident by observing the two extremes of the dairy farm size distribution: at the lower side (herd size: 1-9 heads), 32% of dairy farms cover only 3% of total milk supply; by adding the herds with 10-19 heads, the cow number increases by 51% but the production and milk supply are less than 8% of the total. At the other side, the 5,3% of the largest producers (herd > 150 heads) covers 35% of the total milk production, by adding the 10% of dairy farms with herd size between 100 - 150 heads the milk supply is higher than 50% of the total. Another evidence of this situation is the value of Gini index equal to 0,65[†] signalling a situation of asymmetry in milk production which is confirmed by the Herfindal index value equal to 1870.

Table 1.
Structural variables of the dairy farm in Italy: situation in 2010

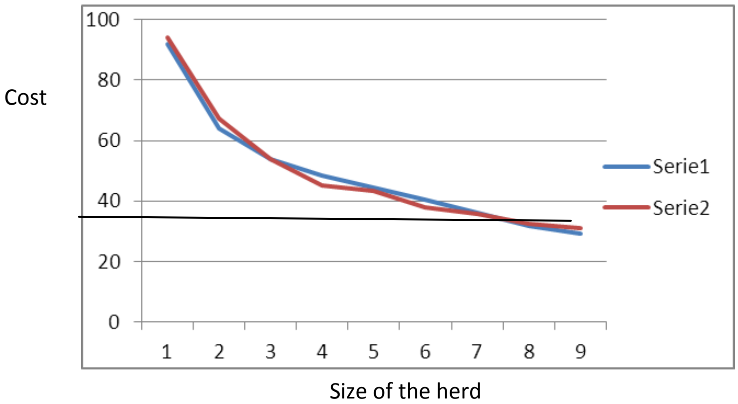
Variables	Size of the herds: number of cows per farm								
	1-9	10-19	20-29	30-39	40-49	50-69	70-99	100-149	>150
% of dairy farms	32,00	18,70	10,90	9,50	6,10	7,20	5,60	4,80	5,30
% of milk produced	2,90	4,90	5,60	7,10	6,00	11,00	11,90	15,90	34,70
nr of cows	6,50	14,60	24,60	34,40	45,00	60,30	83,70	124,10	251,20
yield (t/cow)	4,20	4,91	5,55	5,66	6,16	6,85	6,71	7,16	7,05
milk produced per dairy farm (ton)	27,00	72,00	136,00	195,00	277,00	413,00	562,00	889,00	1772,00
nr cow per Ha	0,80	1,00	0,90	1,30	1,80	1,70	1,60	2,70	3,90
hour labor/cow)	61,10	32,30	23,00	16,40	12,40	10,00	8,40	6,60	4,50

Source – Il mondo del latte, 2011

The table of figure 1 reports the actual and estimated average costs for the herd size; the horizintal line, positioned at the 30 cent/liter shows the break even only for the largest producers. Figure 1 shows the estimated average costs using a log-quadratic regression of the average costs (AC) per unit of milk produced (AC is the sum of fixed and variable costs):

$$\mathrm{Ln}\,(AC) = 5{,}058 - 0{,}166 \quad \ln\,(Q)^2;\; R^2 = 0{,}98\ ^{‡}$$

[†] The value of Gini ranges between 0, (absence of concentration) to 1 (maximum concentration)
[‡] R^2 is the goodness of fit index



Size	Estimated (serie 1)	Actual data (serie 2)	error
1	92,10	93,98	-1,88
2	63,93	67,21	-3,28
3	53,95	53,94	0,01
4	48,24	45,24	3,00
5	44,38	43,20	1,18
6	40,33	37,93	2,40
7	35,92	35,81	0,11
8	31,60	32,32	-0,72
9	29,11	31,00	-1,89

Figure 1. Scale economies in dairy farming

This function suggests the high correlation between average costs and the quantity Q of milk produced building on a constant and Q. Both parameters are statistically significant and the coefficient of determination indicates a high goodness of fit.

4 Geographic distribution of milk production among and within Member States

For many decades, the geographical distribution of milk production was based on a compromise between the advantages of proximity to local (liquid) milk markets and processing dairy plants and those of comparative advantages (Burrell, 2004; Mukhtar and Dawson, 1990; Alvarez and Arias, 2003). The cost advantages of scale economies were achieved with the growing intensification of farm production by increasing the capital investments in machinery, genetics, and feeding. These changes were accelerated in the European Union by the 1992 program for farmers' early-retirement introduced by the Common Agricultural Policy. Young farmers with higher education degree are also better trained in new farm technologies, and supported by modernization and investment programs, contributing to technical and organizational changes. Farm growth is progressing to reach the minimum cost (catch-up effect), however, given the diversity of farm types, the low mobility of the land, and despite an underlying growth trend, farm sizes remain highly variable. The evidence suggests that the higher specialization has affected the optimal size threshold of dairy farms being now over 1000 heads.

The location of dairy farms in some areas was favored by the following factors: agro-climatic conditions, lower land competition, supply of forage and cereals, and higher labor productivity. In the late 1990s, over half of the EU-15 milk supply was produced in ten regions (Eck et al., 1996), situated in the "Atlantic" agro-climatic zone: Asturias and Galicia, Lower Normandy, Brittany, the Netherlands, Lower Saxony, Denmark, Ireland, Western England. Another 30% of milk production was made in the so-called Continental zone: Eastern France, Central and Southern Germany, the Southern tip of Sweden, Northern Italy, and Austria. In Italy four provinces of the Lombardia region accounted for approximately half of the total milk supply processed by some big industrial groups (Lactalis) and local dairy cooperatives. The increase in logistic efficiency based on road networks and cold chains from the dairy parlor to the processing industry inside and outside the producing country reduced the advantage of proximity between production and processing poles. However, the CMO may have delayed the structural adjustment of dairy chains and inhibited the reallocation of production within Member States by imposing the milk quota and supporting the milk price.

5 The structure of the dairy chain in Italy

In the year 2010, the farm structure in Italy consisted of forty-two thousand dairy farms with 1,8 million cows, producing 10,8 million tons of milk, the maximum allowed by the quota assigned to Italy consistently bounding the potential supply; the 1650 milk collectors were divided in two groups: 891 private and 759 cooperative groups. At the processing level, operations included 1524 cheese plants with 578 second level coops, and 69 farm processors. The remaining firms were independent operators. At the retail distribution level, one could count 552 hypermarkets, 9133 supermarkets and 187550 small retail stores (the HO.RE.CA were excluded from this analysis). The structure is outlined in figure 2.

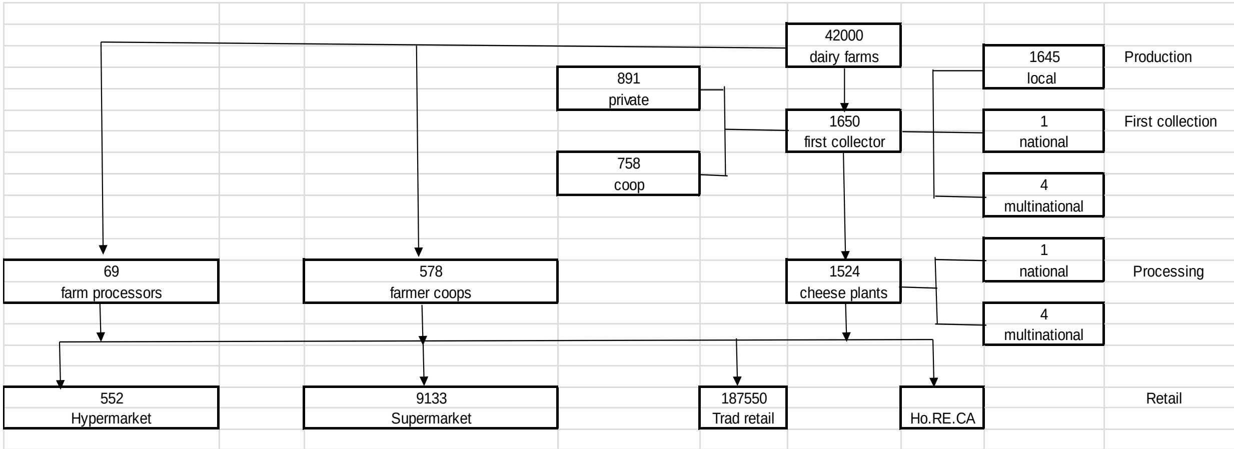


Figure 2. The structure of dairy chain in Italy (number of firms indicated)

Figure 3 outlines the dairy chain value at three levels: the value of the first level is represented by the domestic milk production and imports of 4730 million €; at the second level, the industrial value amounted to 14810 million €; finally at the third level, the retail level (excluding the HO.RE.CA), the value was 24160 million €. Hence, the relative chain values implied are as follows: assuming the farm value equal to 100, the industrial production value is 313 and the distribution value is 511. The question is if these values are consistent with the cost distribution along the dairy chain.

6 The processing level

This level is examined through the balance of the Italian firms operating in the dairy sector. Using a sample represented by: i) 213 incorporated societies (IS) with a turnover of 7,4 billion €; ii) 197 coops with a turnover of 2,9 billion and a total turnover of 10,3 billion € covering 70.5 % of the total turnover of the dairy sector equal to 14.6 billion € (situation of 2010, data base AIDA). These two groups are examined separately because they use different managerial strategies due to different objectives and strategies of private and coop enterprises.

The IS sample includes firms classified as follows (table 2):

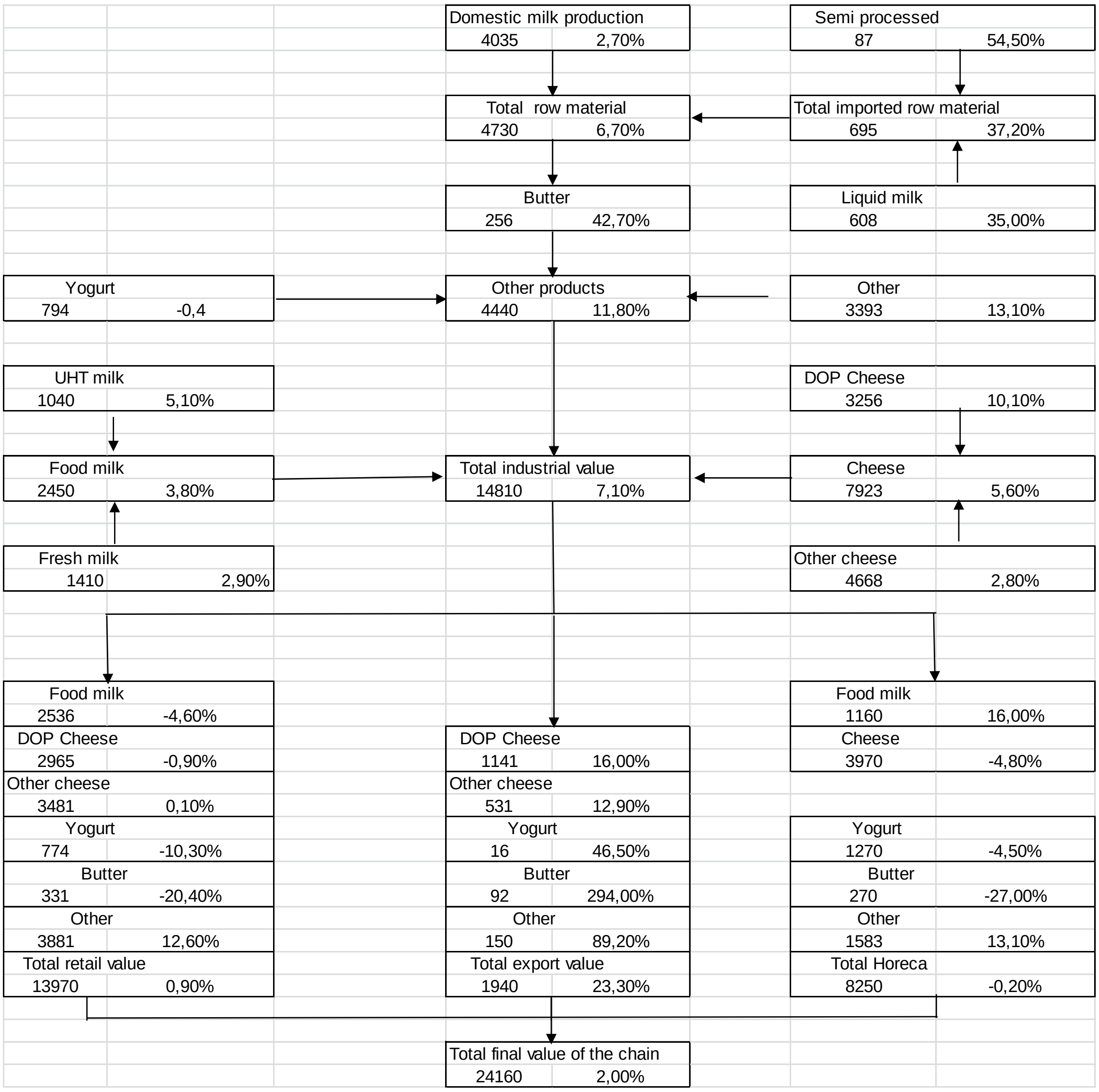
1) Short term production cycle (fresh milk, yogurt, cream, and others);

2) Medium term production cycle: from few weeks to a maximum of nine months;

3) Long term production cycle (Parmesan, Padano and other hard cheeses) with average ripening period lasting more than nine months.

4) Collection centers (concentrated here on the fresh milk supply);

5) 14 big short cycle groups (7% of total sample) with a total turnover of 4,7 billion, representing 63% of the total. The Gini concentration index for this sample is 0,785 signaling a high level of concentration with 10% of the largest groups covering 70% of the total turnover.



Source: Il mondo del latte

Figure 3. The Dairy chain value in Italy (mio euro)

Table 2.
Sample 1 – Incorporated societies monitored at the year 2010

Type	Groups	Average period of deposit (months)	Turnover per firm million euro	Turnover billion euro	Nr companies
1	short production cycle	0-2	1-95	1,7	134
2	medium production cycle	2- 9	1-96	0,8	44
3	long production cycle	> 9	1-30	0,1	10
4	collection centers	0-2	1-38	0,1	11
5	big short cycle	0-2	101-935	4,7	14

This analysis takes into account only the short cycle IS producing milk and some fresh products as yogurt and fresh cheeses representing the largest share of consumers' expenditure. The 134 short cycle IS realized 4.66 billion € covering 63% of the total IS sample turnover; by adding the turnover of the first 8 biggest short cycle IS, the turnover increased to 6,4 billion euros, covering 86.5 % of the total sample turnover and 44 % of the total dairy production value. The eight biggest short cycle IS (table 3) with a turnover greater than 100 million euros covered a total equivalent to 23.5 % of the short cycle IS sample. Granarolo is the biggest first dairy group operating in Italy with a turnover of 923 million euros realized in 2012 by one thousand members producing 750 thousand tons/year of milk collected (situation in 2012); the second group was Parmalat which merged with the Lactalis group, one of the largest dairy groups in the world after recovering from bancrupcy.

Table 3.
Sample 1 - Dairy Firms at the processing stage

Companies (2009)	Roe	Roi	ROS	Turnover 000 €	Cost = T - ROS*T	Lerner (P - C)/P	e	%turn/total
Granarolo	13,8	8	5,8	871791	821227	0,058	17,24	24,00
Parmalat	13,5	13,9	55	819978	368990	0,55	1,82	22,57
Egidio Galbani	1	5,3	6,8	759403	707764	0,068	14,71	20,90
Danone	36,5	22	23,5	490686	375375	0,235	4,26	13,51
Sterilgarda Alimenti	21,3	18	9,4	235400	213272	0,094	10,64	6,48
Alim. Valdinievole	7,8	4,1	2,7	163977	159550	0,027	37,04	4,51
Lat-Bri Latticini Brianza	0,2	2,2	1,6	151307	148886	0,016	62,50	4,16
Centr. del latte di Roma	18,5	15,1	11,1	140287	124715	0,111	9,01	3,86
			Total T =	3632829			C4 =	80,98

ROE = Return on equity; ROI = return on investments; ROS = return on sales

The Coop sample included 197 units with a turnover of 2, 93 billion euros covering 20% of the total turnover realized by the dairy industry.

Table 4.
Sample 2 – Coop Companies year 2009

Type	Groups	Average period of deposit (months)	Turnover per firm million euro	Total turnover billion euro	Nr Coops
1	short cycle	0-2	1-87	0,6	33
2	medium cycle	2- 9	3-60	0,44	37
3	long cycle	> 9	1-51	0,23	31
4	collection centers	0-1	1-41	0,36	90
5	big		133-414	1,3	6

The biggest three short cycle coops were Cooperlat, Milkon and Assegnatari soci di Arborea (table 5) with a turnover of 0,48 billion euros, representing 80% of the total short cycle coop turnover.

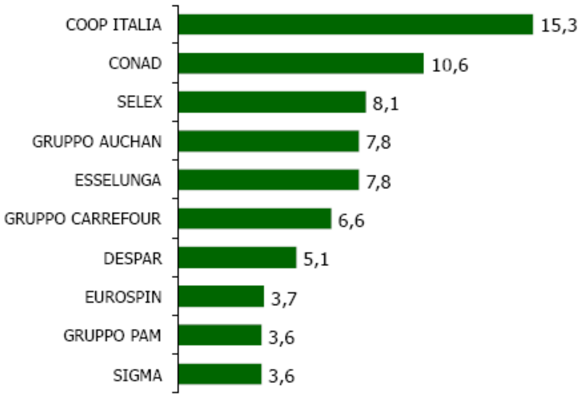
Table 5.
Sample 3 – Financial results of some big coop companies

Coops	Turnover (000 euro)	Operative margin (000 euro)	Oper Marg/Turn (Lerner index)	Costs (000 euro)
MiIkon	170760	88974	0,52	81786
Cooperlat	191676	27622	0,14	164054
Assegn. Assoc. Arborea	120196	72200	0,60	47996

7 The retail level

The information about the retail level is provided by Ismea-ACNielsen that collected only domestic purchases used for the analysis of the distributive sector; the HO.RE.CA (restaurant, catering and industrial use of dairy products) is excluded from this analysis. The largest quota of the dairy product turnover is given by the hyper-/supermarkets covering more than 75% of the total purchases of milk, butter, yogurt and fresh cheeses. The fresh milk expenditure increased by 3,3% at hypermarkets and declined by 5,3% at supermarkets; the total milk purchases at hypermarkets remained almost unchanged and decreased by 7% at supermarkets; the milk purchases at Superette and discount stores represented 13%, a similar quota was covered by the traditional retail. The distributive network in Italy is represented by 522 hypermarkets, 9133 supermarkets and 4000 retailers; the modern distribution is evolving with higher concentration but with some regional differences due to economic and cultural factors. The retail sales value is higher in the Northern regions; however, the Southern regions are growing at a faster rate in recent years and the highest growth rate is for super- and hypermarket (+ 4.7%) sales compared to the national average (+ 2.5%). The development of modern distribution (LD) in Italy has greatly influenced consumers' habits: the quota of purchases at super-/hypermarkets of fresh milk is now more than 82% and of UHT milk 80% (AC Nielsen and Istat reports).

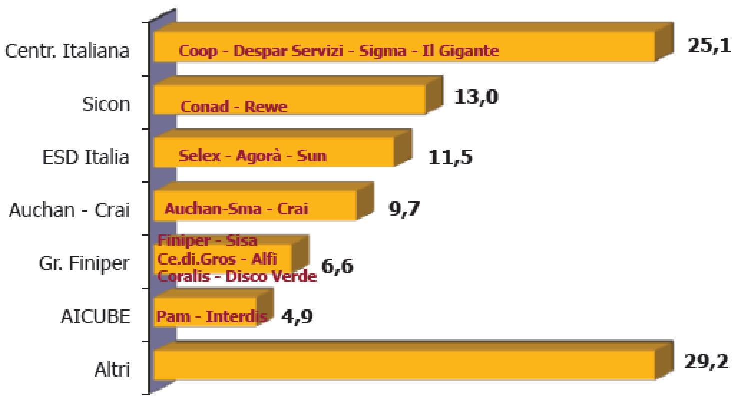
The current economic situation has accelerated the growth of discount stores that have increased their sales quota by 9.4% in 2010. The changing structure of the LD, the higher competition and the need to reduce the costs caused concentration through internal growth performed by mergers and acquisitions. The most important group is the "Centrale italiana" that includes Coop, Sigma, and Despar (Il mondo del latte, 2011). The backward integration operated by retail stores with wholesale distribution is an integral part of modern distribution (C&C = Cash & Carry). Few big brand stores control now the market, most of them are foreign multinational companies (figure 4): the top 5 groups represent 66.8% of the total turnover of the national C&C and four of these largest 5 players operate in retail department stores; one group specialized in wholesale is also the leader (Tieri and Gamba, 2009). The first 4 top retailers control the following market quotas: Coop Italy (15.3%), Conad (10.6%); Selex (8,1%); Auchan (7,8%). The first four groups have a concentration index C4 = 41,8% and the first eight groups a concentration index C8 = 65%.



Source AC Nielsen 2012

Figure 4. The market quota controlled by the first 10 retailer groups operating in Italy

Structures and strategies of milk retailers dramatically changed in the last years, forced to concentrate in an almost saturated dairy market (Rosa, 1997). One of the main drivers of competition is the continuous business growth of the distributors' brands (private label) at the expense of producers' brands. This competition is drawing a scenario in which few big retailers are covering the entire demand in an oligopolistic market situation (Gracia, Albisu, 2001; Suzuky and Kayser, 1995). The concentration situation in the EU retail market given by the C3 ratio (turnover of the biggest three groups) is: 54% in France (Carrefour, Leclerc and Casino); 53% in Spain (Carrefour, Mercadona and Eroded), 61% in Germany (Edeka, Rewe and Aldi), 61% in UK (Tesco, Asda and Sainsbury's). Some of these groups such as Carrefour and Leclerc operate in different EU countries. In Italy, the concentration is 34% with three groups, Coop, Conad, and Selex while the remaining 66% of the market are highly fragmented. A further evidence of the market control of these groups is the logistic strategies of the purchasing groups named "Centrali d'acquisto" that operate at the industry level by controlling the storage and distribution of milk. The competitive position of the distribution is illustrated (figure 5) with some indexes elaborated on a sample of the 32 biggest commercial groups representing 33,5% of the national turnover.



Source Nielsen GLC 2012.

Figure 5. Purchasing groups concentration: % of turnover over the total

These groups are controlling the delivery contracts with the great suppliers but are excluded from purchases of branded products. Not all distribution companies are members of these groups and this explains the business quota of “Centrali” that controls 50% of the market.

At the retail level, the estimates of fresh milk consumption suggests a persisting negative trend; some marketing analysts suggested that milk sales at retail level are not influenced by the milk label as it is considered a convenience product and consumers are in general interested in the price which is the main driver of consumers’ purchases at hyper-/supermarkets. This situation has determined the market share and positioning of largest groups, confirming the preferences for the private label and discount stores. Table 6 reports the domestic purchases of dairy products, at different market channels showing changes in the share compared to the previous year. As expected, LD represents the highest quota of expenditure with 75% of fresh milk and 83% of UHT.

The competition among different market channels is suggested by comparing the prices of dairy products with the equivalent prices set at the hypermarket which is used as benchmark for the dairy market. In table 7, the column “hypermarket” reports the prices of the different dairy products in absolute values (€/liter), while the other columns report the percentage of price differences with respect to hypermarket prices. The results are: the supermarkets prices are on average 4% higher, the superette prices are almost equal, the discount prices are 33% lower, the traditional shops prices are 11,4% higher and the other shops prices are 2,4% higher.

Table 6.

Italy - Total purchase of dairy products for market channel in 2010. Values are expressed in Euro

Product	Ipermarket		Supermarket		Superette		Discount		Traditional shopping		Other shopping		Total Italy	
	2010	% 10/09	2010	% 10/09	2010	% 10/09	2010	% 10/09	2010	% 10/09	2010	% 10/09	2010	% 10/09
Fresh milk	338,1	3,3	609,4	-5,3	114,8	9,9	45,2	0,4	145,3	-3,5	11,1	0,9	1263,9	-1,4
UHT	424,4	-1	580,9	-8,3	67	19,3	91,4	3,5	38,7	6,9	8,6	-8,7	1211	-3,3
Total milk	762,5	0,9	1190,3	-6.8	181,7	13,2	136,6	2,4	184	-1,5	19,7	-3,5	2474,8	-2,3
Butter	88,5	4,7	119,2	0,2	12,1	-4,3	17,3	14,7	6,8	0,7	2,1	12,6	246	2,6
Total yogurt	582,3	-1,1	719	-6,6	52,6	0,3	84,9	-1,9	38,7	6,9	8,9	12,8	1486,4	-3,6
Total DOP cheese	585,6	7,8	751,6	2	106,5	0,21	161,6	4,4	214,1	2	138,1	2,4	1957,5	4,1
Total industr. Cheese	464,8	4,9	618,7	-3,2	85,4	5	115,4	4,4	110,1	-4,3	71,5	5,8	1465,9	0,7
other cheese	670,8	-8	982,7	-0,6	150,4	1,9	177,5	-9,4	235	0,3	119,3	-6,8	2335,5	0,6
Total cheese	1721,2	4,7	2353	-1,8	342,3	7,1	454,5	-0,6	559,2	-2	328,9	1,4	5758,9	0,8

Product	% share of purchases of dairy products for type of market channel													
	Ipermarket		Supermarket		Superette		Discount		Traditional shopping		Other shopping		Total Italy	
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
Fresh milk	25,5	26,8	50,2	48,2	8,1	9,1	3,5	3,6	11,7	11,5	0,9	0,9	100	100
UHT	34,2	35	50,6	48	4,5	5,5	7,1	7,5	2,9	3,2	0,8	0,7	100	100
Total milk	29,8	30,8	50,4	48,1	6,3	7,3	5,3	5,5	7,4	7,4	0,8	0,8	100	100
Butter	35,2	36	49,6	48,5	5,3	4,9	6,3	7	2,8	2,7	0,8	0,9	100	100
Totale yogurt	38,2	39,2	49,9	48,4	3,4	3,5	5,6	5,7	2,3	2,6	0,5	0,6	100	100
Total DOP Cheese	28,9	29,9	39,2	38,4	5,4	5,4	8,2	8,3	11,2	10,9	7,2	7,1	100	100
Total industr. Cheese	30,4	31,7	43,9	42,2	5,6	5,8	7,6	7,9	7,9	7,5	4,6	4,9	100	100
Total cheese	28,8	29,9	41,9	40,9	5,6	5,9	8	7,9	10	9,7	5,7	5,7	100	100

Source: Il mondo del latte 2011

8 The Imperfect competition of the dairy chain

Next we examine price changes at different market levels to analyze the extent of price transmission vertically in the dairy chain. For the time period studied, the average prices were estimated: 0,30-0,40 €/liter at the production level, 0,6- 0,8 €/liter at processing level and 1,06 on average ranging from 0,9 (UHT milk) to 1,39 (UHT high digestible) €/liter at the distribution level (Istat, Nielsen and producer association data, Pieri, 2013, p 361). The wider margin at the distribution level is justified by the brand and product differentiation of the largest groups and it is important for two reasons: for elaborating a quantitative approach for examining the price transmission and for estimating the consequences for welfare distribution induced by the market competition. The implications of an oligopoly for price transmission have been examined in past literature by considering the relations between vertically related and imperfectly competitive market structures, product differentiation, degree of price pass-through, conjectural hypotheses and consumers' welfare variation (Kinnukan and Forker, 1987).

Table 7.
Dairy products: % price differences for market channels *

Product	% Price differences with respect to Hypermarket values (Istat)*						
	Hyper-mkt	Super-mkt	Superette	Discount	Trad shop	Other shop	Italy
	abs value	% value	% value	% value	% value	% value	% value
Fresh milk	1,19	9,24	15,97	-25,21	22,69	12,61	6,72
UHT	0,87	3,45	-11,49	-40,23	5,75	-3,45	-3,45
Total milk	0,99	8,08	7,07	-39,39	31,31	7,07	2,02
Butter	6,18	6,96	8,41	-35,76	14,40	3,72	0,00
Total yogurt	3,68	7,07	0,00	-45,65	7,34	-1,09	-1,36
Total DOP cheese	10,99	-0,18	-0,18	-24,48	3,00	-3,18	-2,55
Total industrial cheese	8.08	4,58	1,73	-35,02	12,00	8,91	-0,99
Hard cheese	11,51	0,61	-2,52	-21,37	2,78	-4,78	-2,26
Fresh cheese	6,87	3,93	5,53	-36,54	18,49	5,68	0,44
Tender cheese	8,89	3,94	11,25	-32,28	15,64	1,57	-1,01
Semihard cheese	8,92	-0,45	0,78	-29,04	0,78	-1,68	-3,59
Total other cheeses	8,75	1,49	-34,29	-29,94	6,17	2,17	-2,06
Total cheese	8,56	2,34	0,58	-31,31	7,94	4,09	-1,64
Average	5,98	3,93	0,22	-32,79	11,41	2,43	-0,75

*price at hypermarket are reported in absolute value. Source: Il mondo del latte, 2011

With the conjectural hypothesis presented below, it is possible to simulate various degrees of market competitive conditions embedded into the price transmission[§]. As the market conditions become less competitive only a fraction of the price change is passed through successive market levels affecting the margins and the consumers' welfare distribution that will be lower compared with the perfect competitive situation. The literature describes different approaches to the vertical chain used for modeling the market power: some studies focused on the wholesale-retail level (Gohin and Guyomard, 2000), others on the farm-processing level (Suzuki and Kaiser, 1997), others consider jointly the processing ⁄ retailing levels (Chidmi et al., 2005). By modeling a two stage successive oligopoly, the market power at different levels of the vertical chain is elaborated with a number (n) of upstream firms processing the products used by (m) downstream firms distributing the product in the final form. Different authors have provided a general framework to estimate indexes of market power in a dynamic setting when only industry-level (rather than firms) data are available (Mc Corriston and Sheldon, 1996; Perloff et al., 1989,1992). In that case, an appropriate description of the market will identify the source of imperfect competition framed into the Cournot model. The conditions assumed to use this model are: fixed proportion production technology, firms at the stages of the chain operate with constant marginal cost; the downstream (retail) enterprise do not have market power at the intermediate (processing) stage and the consumer demand is linear (Wu, 1992).

9 Price transmission: the conjectural model

We consider a partial competitive equilibrium model for the fresh milk chain in Italy represented by dairy farms, industry (processing) plants and distribution (retail) stores with a competitive numeraire one. Farm level: the structure of farming activities and the behavior of the producers are modeled by assuming the profit maximizing behavior. The many dairy farms and the fragmentation of milk supply at farm level refuse the hypothesis of collusive behavior at this level. Farmers gathered in their representative Unions (Coldiretti, Confagricoltura, CIA, Italatte) can only bargain a price close to the marginal production value. At the processing level the agents are targeted to achieve better margins at the expenses of farmers, at the retail level come collusive conducts can be assumed. The final demand for milk is modeled following a utility maximizing behavior, assuming the consumers are perfectly informed about milk quality. At processing and retailing levels it is presumed that some imperfect competition could exist (Deodhar et al, 1998.

[§] Although criticized on the theoretical ground for its dynamic inconsistency, the conjectural variation approach has been particularly appealing empirically, where conjectures are often interpreted as the result of an un-modelled dynamic and imperfectly competitive game (Bresnahan, 1989)

The model will provide more insight about the vertical transmission of shocks, both at the final level and at the farm level (i.e. agricultural policy reform and price changes, see Moro et al., 2006; Soregaroli et al., 2011). The successive oligopoly model is adopted (Mc Corriston and Shieldon, 1996; Anichiarico, 2008) with preferences modeled with a quasi-linear utility function and a quadratic sub-utility, assumed symmetric in all product varieties and identical across individuals:

$$U(q) = q_0 + a\ \Sigma_{i = 1\ldots n}\, qi - b/2\ \Sigma_{i = 1\ldots n}\, qi^2 - g/2\ \Sigma_{i = 1\ldots n}\ \Sigma_{j \neq i}\, q_i\, q_j \qquad (1)$$

q_i is the quantity of product variety for i = 1..n and q_0 is the quantity of the numeraire good**, all parameters are assumed to be positive. The condition b > g > 0 implies that consumers pay attention to the variety, ensuring that the utility function will satisfy the strictly concavity condition. The parameter g measures the degree of substitution between varieties so that goods are substitutes, independent or complements according to whether g > = < 0. A larger g means closer substitutes; if b = g the goods are perfect substitutes and equation (1) is the quadratic utility for a homogenous product. By restricting the n products to one the focus is on the fresh milk used in this analysis. Then the consumers' behavior can be formalized using a separable quadratic, concave utility function, linear in the numeraire having the following functional form:

$$U(Q_2) = aQ_2 – b/2{*}Q_2^2 \qquad (2)$$

Q2 is the supply of liquid milk at the retail level; a and b are the parameters of the utility function and the subscript 2 indicates the retail level. The optimal consumer's condition for a consumer is achieved with the equality between marginal utility and price P_2:

$$a – bq_{2i} = P_2 \qquad (3)$$

The equation (3) is the inverse, linear demand function with b the slope of demand with negative sign and a representing the constant term. If the retailers have pricing power, they will set the price to maximize the profits based on this demand:

$$\Pi_{2i} = (P_2 – C_{2i} - \alpha P_1)\ q_{2i} \qquad (4)$$

where P_2 is the price of milk at the retail level (level 2), P_1 is the price of milk at the previous (processing) market level, C_{2i} is the constant marginal cost of production for the retailer; q_{2i} is the quantity of product demanded at retail, α is the conversion ratio, between the quantity of processed milk to obtain one unit (1 liter) of milk at the retail level. Ignoring the subscript i, the profit maximization condition is obtained by differentiating the equation (4) with respect to the variable q_2:

$$d\ \Pi_2 / dq_2 = (P_2 – C_2 - \alpha P_1) + (dP_2 / dq_2)\ q_2 = 0 \qquad (5)$$

In case of monopoly, the equation (5) could be solved by substituting the demand curve slope into the last term. Where an oligopoly exists, with n2 identical firms (Azzam, 1999) we have:

$$P2 = (\alpha P_1 - q_2) / (dq_2 / dP_2) + dq_2 / dn_2 * dn_2 / dP_2 \qquad (6)$$

Aggregating the above condition, we obtain:

$$(P_2 – C_2 - \alpha P_1) – Q_2 D_2 = 0 \qquad (7)$$

The term D_2 in this oligopolistic contest is assumed to stand for: i) the slope of the demand function (negative dP_2/dq_2 = - b): by increasing the competition, the elasticity will also increase causing a decrease in the margin between the net retail price and demand that tends to zero (eq 6); ii) the interaction among the n_2 retail firms

** The use of a quasi-linear utility function leads to a partial equilibrium analysis, in that the income effect on the demand for differentiated goods is completely neglected. At the same time, the numeraire good can be seen as a composite good, formed by the rest of the goods produced in the economy, capturing all the variations in income level. See Annichiarico and Orioli, (2008) for details.

i.e. the variation term V_2 represents the conjectural hypothesis about the rival reaction to the supply decision of the leading firm [††], then the term D2 is given by this equation:

$$D_2 = b/n_2 (1 + (n_2 - 1)^* V_2) \tag{8}$$

with b taken as its absolute value.

In the repeated game played by this firm, any outcome is possible, depending on the type of collusion among participants, from pure competitive to collusive behavior and three situations are hypothesized as possible:

i) Collusion: the behavior of the firms is similar to a monopoly, the value of Vi (i =1 for processing and 2 for retail) will approximate to 1, and the price setting will follow the monopoly model;

ii) Perfect competition (Bertrand model): the value of Vi will be Vi = $-1/(n_i - 1)$, the firms are price takers with no effect on market price;

iii) Cournot Nash model: the rivals do not react to the change in supply of the representative firm then the value of Vi tends to 0. With $V_2 = 1$, (collusive conduct), D2 = |b|, with $V_2 = -1/(n_i - 1)$, (perfect competition), D2 = 0; 3), with $V_2 = 0$, D2 = b/n2.

With the substitution of Q_2 in the inverse demand equation 3, the equation 6 becomes:

$$P_2 = (b /(b + D_2)) (\alpha P_1 + C_2 + a/b\ D_2) \tag{9}$$

By integrating the value P2 from equation (3) into equation (6) and expressing the value of Q2 in terms of Q1, one obtains the derived inverse demand function for milk at the processing level 1:

$$P_1 = (a - C_2) / \alpha - ((b + D_2) / \alpha^2)\, Q_1 \tag{10}$$

The profit of the representative dairy firm at the processing level is:

$$\Pi_1 = (P_1 - C_1 - \delta P_0)\, q_1 \tag{11}$$

P_0 is the price of milk at the farmer's level used by industry processors, C_1 is the marginal cost of production and δ is the conversion index given by the ratio between the quantity of farmer's milk used to produce one unit of processed milk. The condition of maximum profit for the representative industry processor is obtained from equation (10) :

$$d\,\Pi_1 / d\,q_1 = (P_1 - C_1 - \delta\, P_0) + q_1 (d\,P_1 / d\,q_1) = 0 \tag{12}$$

By aggregating the above conditions over n_1 symmetric one it is obtained:

$$(P_1 - C_1 - \delta\, P_0) - Q_1 D_1 = 0 \tag{13}$$

The term D_1 incorporates the slope of the derived demand of milk at the processing level while the interaction among firms at processing level 1 is represented by the conjectural variation parameter V_1. Hence D_1 is:

$$D1 = (b + D_2) / n_1 \alpha^2\ (1 + (n_1 - 1)\, V_1) \tag{14}$$

The calculation of V_1 is similar to V_2: by substituting the value Q1 from equation (12) in the derived inversed demand equation 13 it is obtained:

$$P_1 = ((a - C_2) * \alpha\, D_1 + (b + D_2)* (\delta P_0 + C_1)) / (\alpha^2 D_1 + b + D_2) \tag{15}$$

[††] The conjectural variation depends on several types of oligopoly: if all firms are of (roughly) equal size, the oligopoly is said to be symmetric, in other cases the oligopoly is asymmetric. One typical asymmetric oligopoly is the dominant firm. The analysis of oligopoly behavior normally assumes a symmetric oligopoly, often a duopoly. Whether the oligopoly is differentiated or undifferentiated, the critical problem is to determine the way in which the firms act in the face of their realized interdependence.

From equations (8) and (14), one obtains the equation of price transmission from distribution to farm level:

$$dP_2/dP_0 = dP_2/dP_1 * dP_1/dP_0 \quad (16)$$

The two partial derivatives are obtained from equations 8 and 12 as:

$$dP_2/dP_1 = \alpha * b/(b + D_2) \quad (16.1)$$
$$dP_1/dP_0 = (b + D_2)\,\delta / (\alpha^2 D_1 + b + D_2) \quad (16.2)$$

The distribution-farm transmission equation is:

$$dP_2/dP_0 = (\alpha * b * \delta) / (\alpha^2 D_1 + b + D_2) \quad (17)$$

With the substitution of D1 and D_2 one obtains the final version of the price transmission equation:

$$dP_2/dP_0 = (\alpha * \delta * n_1 * n_2) / (((n_2 + 1) + (n_2 - 1) V_2) * ((n_1 + 1) + (n_1 - 1) V_1))) \quad (18)$$

The equation 18 is the differential of price transmission along the chain from farm level (P0) to retail level (P2): in this version, the factors affecting the price pass-through are both structural and conjectural:
i) structure: the number (and size) of firms operating at the final level (n2) and processing level (n1);
ii) the conversion ratios α (processing-retail) and δ (farm - processing); these factors are not influential in this case since $\alpha = \delta = 1$.[‡‡]
iii) the conjecture about the collusive behavior among firms at the retail (V_2) and processing (V_1) levels; It can be argued that with these assumptions the price transmission will depend only on the number of firms operating at the levels of the chain and conjectures about the collusions among them are represented by: V_1 for processors and V_2 for retailers.

Assuming $\alpha = \delta = 1$, the extent of price transmission ranges in theory from a minimum value of 0,25 to a maximum value of 1, depending on the degree of collusions Vi (i = 1,2): for Vi with i approximating to 1 participants exhibit collusive behavior, and the degree of price transmission will be at the lowest value 0,25. By increasing the competition, Vi tends to 0 and the value of price transmission will approximate 1; in this case the firm behavior will be the one predicted by the Cournot Nash model. Then the price transmission fluctuates in the range between a minimum of 0,25 to 1, depending on the number of firms: by increasing the number of firms, the value of V1 and V2 will decrease as a result of higher competition and the price transmission approaches to 1 (Deodhaar and Fletcher, 1998). The price elasticity is $dP_2/dP_0 * P_0/P_2$, in case of perfect competition $dP_2/dP_0 = 1$ and the ratio P_0/P_2 corresponds to competitive prices, in the opposite case $0{,}25 * P_0/P_2$ will reveal oligopolistic collusion with asymmetric price transmission.

10 Results

The values of the fresh milk conversion coefficients α from farm to processor and δ from processor to retailer are assumed to be 1 because the fresh milk is converted along the two levels of the dairy chain without significant losses in volume. Table 8 reports the situation of the dairy chain in Italy using the information discussed in the previous paragraphs. The Gini index at retail level is calculated on a sample of 410 firms of which 213 are IS and 197 cooperatives.

Simulation

Market results are simulated assuming three concentration levels calculated with respect to the total market sales respectively: 1) 40-50%; 2) 60-70%; 3) 71-80%; these values, reported in table 9, are maintained for the three levels of the dairy chain. Further, the oligopolistic market conditions are assumed by setting the values of V_1 and V_2 to represent the conjectures of the representative firm against rivals at the level 1 and 2 of the dairy chain. Further, we set the type of agreement among firms using the values of V_1 and V_2 ranging from: a) strong collusion among firms, as in a monospolistic market condition: Vi = 1 for i = 1,2; b) Bertrand behavior: the firms are price takers, meaning that their collusive behavior

[‡‡] The decline of α and δ will affect the price transmission, the extreme situation is when α or δ approach to 0, in this case there will not be a price transmission because there is no milk flowing from one level to another.

will not have consequences for the market price determination; in this case Vi = -1/(ni -1); and c) the Cournot Nash behavior: the rival firms will not react to the output change of the leading firm; the value of Vi = 0. Then the simulated outcomes are compared with specific competitive and structural conditions.

Table 8.
Dairy chain in Italy at 2010

Voice	Value	Description
coefficient α	1	Conversion milk index processing/retail
coefficient δ	1	Conversion milk index farm/processing
Co (Cost at farm level)	0,35	Minimum average cost at farm level
C_1 (Cost at processing level)	0,6	Minimum average cost at processing level
C_2 (Cost at retail level)	0,8	Minimum average cost at retail level
Po (Price at farm level)	0,4	Price at farming level (average 2010); mo = 0,05
P_1 (Price at processing level)	0,7	Price at processing level; m1 = 0,10
P_2 (Price at retail level)	1,25	Price at retail level fresh milk; m2 = 0,45
	Farm	
nr dairy farms	42000	Total number of dairy farms
Symmetry	2226	Symmetric farms (largest 5,1%)
Lerner index (Po - Co) / Po	0,3	Lerner index at farm stage = 0,14
Herfindal index	1870	Squared quota of milk produced by different size dairy farms
Gini index	0,65	Concentration dairy farm
C4	26%	Milk produced by the 4% of largest dairy farms
	Industry	
nr of firms = n1	2171	Including cheese plants farm coops and farm processing plants
P_1- C_1 / P_1	0,14	Lerner index at processing stage = 0,143
Gini index	0,785	Concentration of production
C4	81%	
	Retail	
nr of firms = n2	9685	Number of symmetric firms at retail stage (Hyper and supermarkets)
P_2- C_2 / P_2	0,36	Lerner index at retail =0,36
C4	41,4	Concentration index first 4 firms

Table 9.
Number of firms for given levels of concentration in the Italian dairy chain

	sector		
Number of enterprises	farm production	industry turnover	retail turnover
concentration value: 40-50% turn number	50%	44,60%	41,80%
(abs value)	4083	2	4
% value	10%	20%	50%
concentration value: 60-70% number:	60%	67,70	61,7
(abs value)	6347	3	7
% value			
concentration value: 71-80% number:	80%	81%	72%
(abs value)	11724	4	10
% value	29%	40%	100%

Table 10 reports six simulations about the oligopoly conditions and consequences for price transmissions. In the first successive oligopoly simulation it is assumed that both players collude together, assuming the condition V2 =V1 = 1, causing the lowest value of price transmission.

Table 10.
Simulation of price transmission with different conjectural hypotheses and concentration levels in dairy chains

Concentration	□	□	n1	n2	V2	V1	dP2/dPo	Po
simulation 1								
40-50%	1	1	4	3	1	1	0,38	0,385
60-70%	1	1	8	5	1	1	0,31	0,360
71-80%	1	1	142	7	1	1	0,29	0,351
simulation 2								
40-50%	1	1	4	3	1	0	0,60	0,445
60-70%	1	1	8	5	1	0	0,56	0,436
71-80%	1	1	142	7	1	0	0,58	0,441
simulation 3								
40-50%	1	1	4	3	1	-0,33	0,75	0,471
60-70%	1	1	8	5	1	-0,14	0,63	0,450
71-80%	1	1	142	7	1	-0,01	0,58	0,442
simulation 4								
40-50%	1	1	4	3	0	1	0,75	0,471
60-70%	1	1	8	5	0	1	0,63	0,450
71-80%	1	1	142	7	0	1	0,58	0,442
simulation 5								
40-50%	1	1	4	3	-0,50	1		
60-70%	1	1	8	5	-0,25	1	0,83	0,482
71-80%	1	1	142	7	-0,17	1	0,70	0,463
simulation 6								
40-50%	1	1	4	3	0,07	0,07	1,00	0,500
60-70%	1	1	8	5	0,07	0,07	0,98	0,498
71-80%	1	1	142	7	0,07	0,07	1,00	0,500

The collusion decreases as the market concentration increases: these values range between 0,38 for lower concentration and 0,29 for higher concentration. For the second simulation we assumed a stronger control at the retail level (close to monopoly) and competition at processing level, then $V_2 = 1$ and $V_1 = 0$; this market asymmetry increases the pass-through that ranges between 0,60 for lower concentration and 0,58 with higher concentration. In the third simulation it is assumed $V_2 = 1$ and Bertrand behavior at processing level ($V_1 = -1/(n1-1)$. The pass-through values range from 0,75 corresponding to lower concentration to 0,58 for higher concentration, the same value obtained in the previous market situation. The fourth simulation assumes a monopoly condition at processing level ($V_1 = 1$) and no power at retail ($V_2 = 0$). The pass-through values correspond to the previous market condition. The fifth simulation assumes $V_1 = 1$ and $V_2 = -1/\ (n2-1)$. With Bertrand behavior; the pass-through is ranging between 0,83 with 60-70% of concentration to 0,70 with 71-80% concentration. Finally, the sixth simulation assumes both players to behave almost competitively and the result is the best value of price transmission.

The simulations confirm the behavioral hypothesis of successive oligopoly with price transmission improving passing from the strongest collusion between processors and distributors to conditions of perfect competition. These results can be used for a price setting strategy along the chain using the following price margins: difference between 0,35, the minimum cost and 0,5, the market price, then m = 0,15. By using the coefficients of price transmission the prices at the farm level vary between the minimum of 0,35 with simulation 1, assuming V1 = V2 = 1 and concentration set to 71-80% and the maximum 0,5 obtained with simulation 6 and concentration causing no consequences for prices. The average price in Italy is approximately 0,40 cent/liter then the most approximate market structure, suggested by simulation 1 with concentration 40-50%; simulation 2 shows the prices are close to 0,44; in simulation 3, 4, and 5, the prices are affected by the concentration and suggest that the high level of collusion at processing or retail have the same effect; simulation 6 shows the highest price transmission. The conclusion is that simulation 1 and 6 show the lowest and highest price transmissions while comparing with other market conduct simulations, the price differences are not so big.

11 Oligopoly and consumer's welfare gain

The consequences of the successive oligopoly model are also evaluated in terms of welfare distribution for consumers. The price control will alter the welfare distribution that is shown through the area of consumer's surplus; using the linear demand function (equation 7) the consumers' welfare gain is measured with the consumers' surplus (CS) variation represented by the area under the retail milk demand and its changes according to milk price variations. The price change ΔP from P22 to P21 will determine an increase in quantity from Q22 to Q21 corresponding to ΔQ.

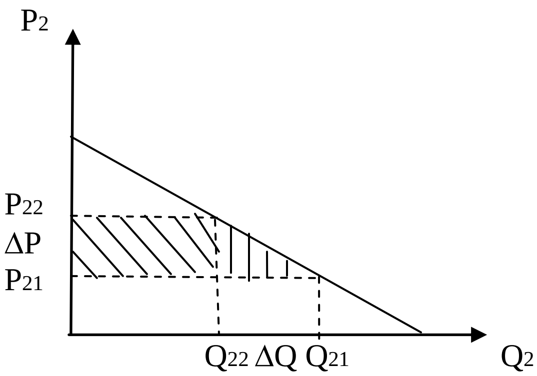


Figure 6. Demand at retail and change in consumer's surplus to price change at farm level

The CS change will depend on the price change:

$$\Delta CS = \Delta P * Q_{22} + \Delta P{*}\Delta Q/2 = \Delta P * (Q_{22} + \Delta Q/2) \tag{19}$$

By substituting ΔP in ΔP_0 from equation 21 and ΔQ with the demand elasticity for milk at retail level η_d the following result will be obtained:

$$\Delta CS = Q_{22} (1 + \eta_d / 2 P_{22} \Omega) \Omega \tag{20}$$

Where Ω will measure the change in price transmission due to a change in dairy farm price ΔP_0:

$$\Omega = dP2/dP0{*} \Delta P_0 = (\alpha{*} \delta {*} n_1{*} n_2) / ((n_2 +1) + (n_2 -1) V_2) * ((n_1 +1) + (n_1 -1) V_1) * \Delta P_0. \tag{21}$$

To compute the changes in consumers' surplus corresponding to a change in farmers' prices the values of the following parameters are required:

i) (δ) quantity of milk at farm converted to one unit of milk at processing level;
ii) (δ) quantity of milk at processing level converted to one unit of milk at retail level;
iii) Po value of price at the farm level;
iv) ΔP_0 absolute change in milk price at farm level;
v) n1, n2 number of firms respectively at processing and retail levels;
vi) V1, V2 conjectural variations at processing and retail levels;
vii) ηd milk demand elasticity at retail level;
viii) the reaction equation dP2/dPo to a change inΔP_0;
ix) P22, Q22**,** price and quantity of milk consumed at retail level [§§].

All these parameter values are drawn from various statistical sources and used to calculate the consumers' surplus in absolute and % changes under different market regimes. For checking the sensitivity of the estimates with respect to changes in parameters ten simulations are performed, the first one is the baseline that is the

[§§] In 2010 the total consumption of milk at retail level was 2,87 mio tons of which 1,59 mio UHT and 1,28 mio fresh. Then the price at retail is the average between fresh and UHT milk equal to 1,2 €/l.

reference for the other simulations; each simulation is performed at two concentration levels. The changes in parameter values for each simulation are reported in red (table 11). The results are summarized as follows:

With near to monopoly conditions ($V_2 = V_1 = 1$) the highest market control by processors and retailers, the following CS effects are detected with simulation 1, 2, and 3: the change in demand elasticity had a limited impact over the consumers' surplus at both concentration levels: passing from 1 to 2 (abs values) the change in CS was only 0,15%; simulations 4, 5, and 6 show that the magnitude of CS changes were considerably higher using the price differences at the farm gate: passing from 0,2 (0,35 c/l to 0,33 c/l) to 0,4 (0,35 c/l to 0,31 c/l) the CS increased from the baseline respectively 2 and 4 times without differences at the two concentration levels. The consequences of different conducts on CS change are considered with simulation 7 to 10:

- simulation 7 assumes control at retail and absence of control at processing level; the CS value is 1,6 times the beginning value with concentration at 40-50% and 1,8 times with concentration at 60-70%;
- simulation 8 assumes control at retail and Cournot Nash situation at processing level: the CS increases 2 times with respect to the beginning value and concentration has no effect;
- simulation 9 assumes control at processing and no control at retail: the effect is an increase of CS of 1,5 times and 1,67 times at the two concentration levels;
- simulation 10 assumes no market power at processing and retail: this has resulted in the best CS with 2,4 and 2,97 times higher in comparison to the beginning value at the two-concentration levels. These results demonstrate that as the degree of market control increases, the consumers' surplus decreases for a given level of price reduction.

12 Conclusions

The review of the literature suggests that market power could cause asymmetric price transmissions, although other possible causes for imperfect price pass-through are the price volatility independent from market adjustment, menu costs, formula pricing or government interventions. With these premises, this research has been dedicated to study the efficiency market conditions of the dairy chain in Italy using a successive oligopoly model framed into structural conditions of the dairy chain to demonstrate the possible distorsive effects of structure and conduct at different chain levels, affecting the price transmission and welfare distribution. For this research a restricted version of Mc Corriston and Sheldon model dedicated only to the fresh milk product was used. The analysis of the dairy chain revealed different structural conditions at the three levels. This analysis demonstrated that the degree of price transmission along the vertical chain and the consumers' surplus distribution were both affected by the conducts of participants.

While the demand elasticity caused modest impact on CS changes, the market power and the price changes at farm level were the most important determinants of the welfare distribution. These results suggested some policy recommendations: farm prices are still important in determining the CS change, but farmers have a limited power in bargaining their prices with processors, and even less with distributors. Hence some forms of price compensation policy is needed to protect the dairy farmers' from market asymmetries. In absence of any intervention, the structure of the dairy farm will consistently change: by observing the cost slope, it can be said that in the next years many dairy producers will quit the sector; in general the dairy chain will continue to concentrate, specialize and localize in some regions of Italy, namely Lombardia. With the scale economy (see fig. 1), it is possible to predict the magnitude of this change: for a price below 30 cent/liter only the 20% of dairy farmers with a heard with size bigger than 200 heads will survive in this competitive market contest.[***] The milk package of the CMO is a solution to progress in vertical integration and set up rules to avoid the unequal margin distribution caused by the growing market asymmetry.

[***] These results are in line with those predicted by CRPA

Table 11.

Simulation of changes in consumers' surplus with two levels of concentration (in red the changes in parameters)

Parameter	Concentration = 40-50%									
	sim. 1	sim. 2	sim. 3	sim. 4	sim. 5	sim. 6	sim. 7	sim. 8	sim. 9	sim. 10
a	1	1	1	1	1	1	1	1	1	1
d	1	1	1	1	1	1	1	1	1	1
Po	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
n1	4	4	4	4	4	4	4	4	4	4
n2	3	3	3	3	3	3	3	3	3	3
hd	-2	-1,5	-1	-1	-1	-1	-1	-1	-1	-1
V1	1	1	1	1	1	1	0	-0,33333	1	0
V2	1	1	1	1	1	1	1	1	0	0
DPo	0,01	0,01	0,01	0,02	0,03	0,04	0,01	0,01	0,01	0,01
Ω	0,0025	0,0025	0,0025	0,005	0,0075	0,01	0,004	0,005	0,00375	0,006
Q22	2,87	2,87	2,87	2,87	2,87	2,87	2,87	2,87	2,87	2,87
P22	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20
DCS	0,01	0,01	0,01	0,01	0,02	0,03	0,01	0,01	0,01	0,02
DCS index	100,00	99,93	99,85	200,00	300,45	401,20	159,90	200,00	149,89	240,14
Parameter	Concentration = 60-70%									
a	1	1	1	1	1	1	1	1	1	1
d	1	1	1	1	1	1	1	1	1	1
Po	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
n1	8	8	8	8	8	8	8	8	8	8
n2	5	5	5	5	5	5	5	5	5	5
hd	-2	-1,5	-1	-1	-1	-1	-1	-1	-1	-1
V1	1	1	1	1	1	1	0	-0,14286	1	0
V2	1	1	1	1	1	1	1	1	0	0
DPo	0,01	0,01	0,01	0,02	0,03	0,04	0,01	0,01	0,01	0,01
Ω	0,0025	0,0025	0,0025	0,0050	0,0075	0,0100	0,0044	0,0050	0,0042	0,0074
Q22	2,87	2,87	2,87	2,87	2,87	2,87	2,87	2,87	2,87	2,87
P22	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20	1,20
DCS	0,01	0,01	0,01	0,01	0,02	0,03	0,01	0,01	0,01	0,02
DCS index	100,00	99,93	99,85	200,00	300,45	401,20	177,72	200,00	166,58	296,72

This approach can be usefully extended: first, it might reasonably be argued that the model has been restrictive for its assumption of a simple fixed proportions technology. For example, McCorriston et al. (1996) suggested allowing for both imperfect competition downstream, and variable proportions technology in the downstream sector. Interestingly, though, their analysis has shown that the marginal impact on pass-through of upstream price changes of increasing the elasticity of substitution in a variable-proportions technology has significantly declined as the downstream sector becomes less competitive. Second, the downstream technology has been assumed of having constant marginal costs, yet industries defined as imperfectly competitive may also have technologies that exhibited increasing returns that in the downstream sector offset the effects of imperfect competition downstream on pass-through.

Policy implications: as a consequence of the expitration of milk quotas it is predicted that the EU milk production will increase by 5.0% and prices will decline by 10% during the period 15-16; this is a relatively small decline explained by the existence of intervention price (Requillard et al.,2008). Structural changes accelerate to gain scale economies and increasing yield are the two main tools to face the competition. Since demand for dairy products in the EU is inelastic and the price declines are limited, the increases in EU dairy production forces significant increases in the EU exports with the use of export refunds (at least for butter). Our simulations suggest a significant shift of surplus from producers to consumers; for producers the losses due to a price decline are more consistent than the positive quantity effects. In general, the policy scenarios that were simulated will make the EU dairy sector more vulnerable to world price fluctuations and volatility and will increase the domestic market inefficiency. While price support is no longer possible, other market mechanisms as quality support incentives, technical innovation and alternative use of milk in other industrial uses can be an option. Another optional market tool is the granting of financial support (aid) for private storage for butter, SMP and cheese with Protected Designation of Origin (PDO)/Protected Geographical Indication (PDI). These aids can help operators to take products temporarily off the market, as an alternative to "public intervention". Other complementary measures could be suggested against market disturbance, animal diseases and loss of consumer confidence.

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Appendix 1

For the spatial price transmission it is used this concave spatial individual demand function: q = $(\alpha^2 - (m + s*R)^2 / \alpha*\beta$ where α and β are constant parameters, m is the price set up at retail level, s is the unit transport cost and R is the radius of the retail area (Azzam, 1999). With some transformations one obtains the following aggregate demand function as a function of the retail price m and the customers' area measured with the radius R:

$$Q (m, R) = 2D* \alpha*\beta * (\alpha^2 R - (1/3\ s)*(m1 + s*R)^3)$$

To simplify it is assumed that the parameters $\alpha = \beta$ = D = s = 1, then the demand equation becomes:

$$Q (m, R) = 2 (R - (1/3) * (m1 + R)^3)$$

The first derivative condition with respect to m1 is given by: $dQ/dm1 = 2\ (m1 + R)^2)\ (\phi - (1 + \phi) < 0$; and the second derivative $d^2Q/dm1^2 = -2\ ((m1 + R) *(1 + \phi + 2\ \phi 2) < 0$, the aggregate spatial demand will satisfy the downward sloping and concave conditions. This means that for a fixed market radius the slope of aggregate spatial demand decreases as the quantity of retail products rises. Then the implicit price equation for a non repricing strategy becomes:

$$m = w_1 + k\Delta w - (R - 1/3*(m + R)^3 / (\phi - (1 + \phi)*(m + R)^2)$$

with repricing, the equation is

$$m_1 = w_1 + \Delta w - (R - 1/3*(m_1 + R)^3 / (\phi - (1 + \phi)*(m_1 + R)^2)$$

$$m_2 = w_1 + \Delta w - (R - 1/3*(m_2 + R)^3 / (\phi - (1 + \phi)*(m_2 + R)^2)$$

Profit maximizing value for m, m_1 and m2 for alternative ϕ values can be obtained from equations m and m1 by using the values $\phi = 0$ (Loschian retailer) and $\phi = -1/2$ for Hotelling-Smithies retailer; the radius value is assumed to be 1. The asymmetry is measured at retail – price transmission with a change in profit maximizing values in response to equal increments and decrements of θ.