System Dynamics and Innovation in Food Networks 2013

Proceedings of the 6th International European Forum on System Dynamics and Innovation in Food Networks, organized by the International Center for Food Chain and Network Research, University of Bonn, Germany
February 18-22, 2013, Innsbruck-Igls, Austria
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EAAE(European Association of Agricultural Economists)
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CIGR (Intern. Commission of Agric. and Biosystems Engineering)
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edited by

U. Rickert and G. Schiefer

ISSN 2194-511X

Published by
Universität Bonn-ILB Press, Bonn
(Rheinische Friedrich-Wilhelms-Universität Bonn,
Institut für Lebensmittel- und Ressourcenökonomik)

Order Address:
Department of Food and Resource Economics, University of Bonn
Meckenheimer Allee 174, D-53115 Bonn, Germany
Phone: ++49-228-733500, Fax: ++49-228-733431
e-mail: uf.ilr@uni-bonn.de
Printed by
Universitätsdruckerei der Rheinischen Friedrich-Wilhelms-Universität Bonn

Imperfect Competition in the Italian Dairy Chain: Consequences for the Price Transmission and Welfare Distribution

Franco Rosa and Michela Vasciaveo
Department DISA, University of Udine, Italy,
rosa@uniud.it

Abstract
The milk quotas were introduced in Italy in 1984; from that time onward, the dairy chain has progressed in technology and organization with consequences for the market competition. The Aglink-Cosimo simulations suggest milk production will return to an increasing path, driven by a fairly optimistic demand outlook for the improved macroeconomic 2020 future prospects in the EU-27 economies and milk production will exceed the present level by about 3%. Milk deliveries would be expected to increase in Italy by a slightly higher rate, according with the consumption trend of dairy products. Purpose of this paper is to analyze the consequences of structural adjustments of the dairy chain for the competitive price setting assuming the retailers and processors having the control on the market prices, causing changes on the welfare distribution. The analysis is based on derived demand and price-transmission equations, using a successive oligopoly model. The conjectural hypothesis about the players provides the framework for estimating the degrees of price transmission in a dynamic setting with agents at the industry and retail levels (rather than firm) are acting as two oligopoly players. The conjectures about the oligopoly depending on the structure (number of competitors, size and degree of collusion), across the vertical stages of the dairy chain allow to simulate different degrees of market imperfection reflected on the price transmission and welfare distribution. (Dhar and Cotterill, 2000; McCorriston and Scheldon, 96; Morgan and Rayner, 1988). Six simulations for price transmission and ten simulations for welfare distribution are performed assuming different collusive patterns and results are used to check for the market efficiency hypothesis. [1]

Keywords: *dairy chain, imperfect competition, successive oligopoly, price transmission, welfare*
JEL L13

1 Introduction

With the CAP health check the milk quotas are increased by 1% a year from 2009/10 to 2013/14 campaigns; after this soft landing period, the quota system should be ban at 2015. Measures to drive the restructuring of the dairy sector in Italy are tied in with this opening. They have been defined as one of the rural development priorities and then will benefit from additional modulation measures. In December 2012 the Commission passed to the second step by fixing the conditions for a smooth phasing out of the milk quota system, as requested by the Council as part of the 2008 CAP Health Check. The "Milk Package" is drafted on the basis of the conclusions of a special High Level group set up after the 2009 milk market crisis, this series of measures is aimed at boosting the position of dairy producers and preparing the sector for a more competitive and and sustainable market with less restrictions. The new regulation published on 30 March 2012, the elements on producer organizations, inter-branch organizations and the delegation of powers to the Commission is active since April 2nd, while all other elements became effective 6 months later. The milk package provides for written contracts between milk producers and processors to negotiate contract terms collectively via producer organizations and new specific EU rules for inter-branch organizations, allowing actors in the dairy supply chain to dialogue and carry out certain activities. This paper is devoted to examine the dairy chain situation in Italy characterized by a large number of dairy farm with size constrained by market quotas facing a concentrated

[1] This research was made with the contribution of the Region Friuli Venezia Giulia Law 26/05/2008

processing industry and even a more concentrated distribution. The evidences of changes in the structure with mergers and acquisitions operations contribute to the advance in market concentration: Granarolo the first dairy group is continuing to grow its business, Parmalat merged recently with the Lactalis group becoming one of the largest dairy group in the world; in Denmark and Netherland the 80% of the dairy business is already concentrated in few cooperative groups. Although the concentration is progressing the empirical evidence on the extent of the actual exercise of manufacturer and retailer market power in EU dairy chain is under discussion. Surveys of the recent empirical work by Sexton (2000), Sexton and Lavoie (2001), and Sheldon and Sperling (2003) provide evidence of modest departures from perfect competition; others argued that the downstream imperfect competition was a key explanation for asymmetric price transmission through the marketing chain, (Miller and Hayenga, 2001) and noticed that in most cases, this claim was made with little theoretical underpinning. McCorriston, Morgan and Rayner (1998, 2001) have addressed the issue of incomplete pass-through of commodity prices through various market levels. Dosi et al. (1994) using the background of organizational economics, defined the importance of four factors contributing to strengthen the role of conduct within the chain: complementary assets, enterprise learning, technological opportunities, and selection; however, the complementary assets is the most important one in explaining the distribution of power along the chain. Complementary assets lay upstream or downstream "from product-process development in the value added chain and generate path dependencies affecting the behavior of the agents. Williamson's concept of idiosyncratic assets and their impact on organizational design is broadened by the introduction of irreversibility and dependencies. Enterprise learning is the most important factor to improve their performance: cumulated knowledge and concerns organizational skills rather than individual skills give to the firms placed at different levels of the chain the opportunity to exploit better the complementary assets by coordinating their activities. Moreover, the choice of new agreements along the chain will be dependent on the emerge of complementarities: "firms can be thought of as an integrated cluster of core competencies and supporting complementary assets. The relationships between learning, path dependencies, opportunities, inherited complementary assets, and selection allows to distinguish six forms of corporate coherence: specialist firms, vertically integrated firms, coherent diversifiers, conglomerates, network firms, and hollow corporations. The vertically integrated firms, for instance, are characterized by "slow learning but high path dependencies and specialized assets; older firms are likely to be more vertically integrated than young firms because start-ups are less common in industries where learning is slow" (Dosi et al.,1994). Then the producers operate in the dairy chain as integrated cluster of core competencies and adopting organizational models of complementary assets. Researchers from the London Economics (2003), after investigating the links between retail and farm-gate milk prices in the UK, Denmark, France and Germany, found that in the UK, a unit increase in the retail price of liquid milk was fully transmitted to the farm gate price, whereas a unit increase in farm gate prices resulted in only a 0.56 unit increase of retail price and a unit decrease in farm gate price was transmitted at the retail by only 0.71 %. In Germany, the study also provided two-way price transmission, though rather imperfect, in Denmark, there was no evidence of price transmission in any direction, in France, farm-gate price changes were imperfectly, transmitted to retail prices.

For the scope of this analysis the new industrial organization scheme using the complementary asset theory and conjectural hypothesis is used to frame the oligopoly model and to analyze the consequences for the performance of the dairy chain. (Bresnahan, 1989; Carlton and Perloff, 1997; Hudson et al, 1991). Then, the structure of the dairy chain is examined at the three levels:

1 –farm level: the structure is observed from:

(a) the milk output allocated among herds of different sizes;

(b) the dairy farm specialization indicated by the breakdown of herds according to whether they are located on farms specialized in milk production or on farms with diversified portfolio of production activities;
c) the share of the total milk output produced by the largest dairy farms;
d) the geographical distribution and regional concentration of milk production in Italy
2 – at the processing level, the quantity of milk processed by major processors;
3 – at the retail level, the quantity of milk delivered by major retailers.
The hypothesis is that the degree of concentration and some agreements among players in the dairy chain affect the performance by introducing some forms of collusive conducts and reactions affecting the pass through of prices with implications for the welfare distribution.
The paper is organized as it follows: i) the first part describes the trend and features of the dairy chain in Italy; the second part describes the methodology of price transmission, assuming imperfect pass through of prices; the third part describes the change in consumer's surplus with simulation of some market conditions and the fourth part reports the conclusion under the new dairy policy.

2 Evidence of structural changes in the EU Dairy sector

Over the last decades the European dairy farm sector has changed consistently: since the introduction of the milk quotas in 1983 the number of dairy farms in EU – 9 has declined, while the average size of a dairy farm increased substantially (see table 1). The strongest decline in the number of dairy farms occurred in Italy with -80% and a corresponding production increase estimated to + 254%; in Denmark the number of farms declined by -78% and the production increased by +165%; in France the reduction of dairy farms was -73% and the production increased + 160%.; in Germany the increase in production was +158% and in Ireland +135%. The dairy farm sizes in UK and the Netherlands were already the biggest in the EU-9 when the milk quota were introduced. For the all member states together the number of dairy farms declined by 72% in most countries the dairy cow herd decreased by 40 to 45% over this period. The restructuring of the sector is signaled by the decline of total number of enterprises in the EU during the period between 2003 and 2009; this decline was the biggest in Italy, UK and France and in some Member States also the average milk processed per enterprise decreased and fewer enterprises remained in business (Austria and France). In other Member States, namely Spain, Portugal, Greece, Hungary, Latvia and Slovakia, the number of enterprises increased, but on average the enterprises processed less milk. The specialization in processing involved the EU-12 Member States; however in the Netherlands and in Sweden, where the processing industry was already highly consolidated, the number of enterprises increased between 2003 and 2009 but the average quantity of processed milk per firm decreased. In the Netherlands or Germany, dairy groups are making large scale international alliances to gain competitive power outside the EU.
In the EU economic literature it is broadly discussed the topic of scale economies (decline of average cost per unit of product for herd sizes of 60-80 cows. To a larger extent, this is due to the increase in labor productivity and, to a lesser extent, to fixed capital structures. Thereafter, with further scale expansion, unit costs fall much more slowly. Structural changes leading to fewer, larger herds and to a larger share of sectorial milk output being produced by the larger herds lower the average production cost across the sector, and improve the economic performance of larger dairy farmers. The structural changes in Italy are accompanied by concentration, specialization and localization of milk production in some specific areas similarly to other regions of the EU. In the following table it is illustrated the size of the of the milk production with some indexes clearing the features of the concentration of dairy farms.

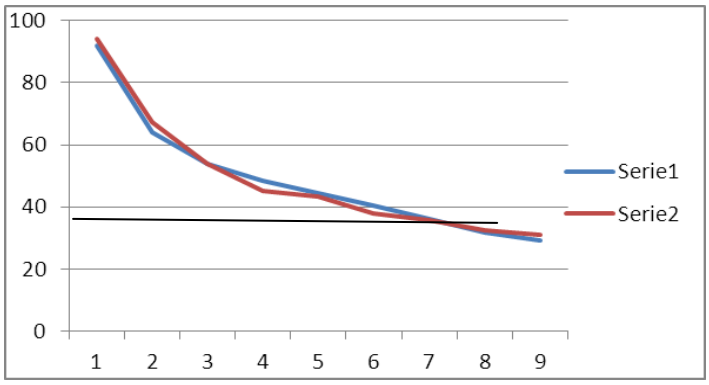
Table 1. Structural variables of the dairy farm in Italy: situation at 2010

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 p 132

The asymmetric distribution of dairy farm can be observed from table 1, by examining the two extremes of distribution: at the lower production level (herd 1-9), the 32% of dairy farm produced only the 3% of total milk production; the merge of the herds size 1-9 and 10-19 heads, represents the 51% of dairy farms but less than the 8% of the total production; at the other side of the distribution, the 5,3% of major herd (> 150 heads) cover the 35% of the total milk production while the 10% of dairy farms with herd greater than 100 heads covered the 50% of total production. The concentration measured with the Gini index is equal to 0,65 (zero means signals perfect distribution and one signals the total production realized in one plant); the Herfindal index value equal to 1870. The scale economies offer the empirical evidence of the relation between average cost and size; by using the log transformation data the following equation has been estimated:

$$1 - CME = 5{,}058\ (0{,}06) - 0{,}166\ (0{,}008)\ Q^{2};^{2}\quad R2 = 0{,}98$$



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

Figure 1. Graph of scale economies

The number in the abscissa indicate the size of the herd (see tab. 1) and in the vertical axis the average cost

3 Geographic distribution of milk production between and within Member States

For many decades, the geographical location of the milk production has been driven by the compromise between the advantages of proximity to local (liquid) milk markets or processing dairy plants and those of comparative advantage. (Burrell, 1990; Mukhtar and Dawson, 1990; Alvarez and Arias, 2003.) With more intensive production systems customary in Europe diffused, economies of scale are continuing to expand beyond 1000 cows contributing to the shift of dairy farms in some specialized areas, with better agro-climatic conditions, lower competition for land, supply of forage and corn, better labor productivity and more convenient costs. Already in the

[2] In parenthesis are reported the SE values for validation of parameters; R^2 is the goodness of fit index

late 1990s, it was noticed that over half of the EU-15 milk was produced in only ten regions (Eck et al., 1996), situated in the agro-climatic zone known as Atlantic (CEAS, 2000) including the Asturias and Galicia, Lower Normandy, Brittany, the Netherlands, Lower Saxony, Denmark, Ireland, Western England. Another 30% of milk production was displaced in the so-called Continental zone (eastern France, central and southern Germany, the southern tip of Sweden, northern Italy, and Austria). These two zones enjoy more advantages for the milk production; in Italy four provinces of the Lombardia region are close to produce the 50% of the total milk supply for the most profitable dairy chains. In recent time, the progresses in the logistic platform with evolution of the road networks and refrigerated chains from the dairy parlor to the processing dairy extended to the EU has greatly reduced the need of proximity between production to consumption or processing poles. The milk quota system has contributed to frozen the production shares, the plant concentration and the efficiency among Member States and has inhibited the relocation of production within Member States.

Table 2. Number of enterprises and quantity of milk processed by dairy firm in some UE countries in 2003 and 2009

	Number of enterprises			Processed milk[1] (1,000 t)			Average processed milk per enterprise (1,000 t)		
	2003	2009	Change 2003-2009	2003	2009	Change 2003-2009	2003	2009	Change 2003-2009
EU-15									
Austria	86	79	-7	2,644	1,660	-984	30.7	21.0	-9.7
Belgium	69	50	-19	2,830	2,945	115	41.0	58.9	17.9
Denmark	26	27	1	4,518	4,716	198	173.8	174.7	0.9
Finland	23	16	-7	2,398			104.3		
France	468	414	-54	10,910	6,858	-4,052	23.3	16.6	-6.7
Germany	201	194	-7	27,431	28,615	1,184	136.5	147.5	11.0
Greece	649	815	166	1,362	1,385	23	2.1	1.7	-0.4
Ireland	63			5,310			84.3		
Italy	1,707	1,439	-268	9,175	8,627	-548	5.4	6.0	0.6
Luxembourg	3			176			58.7		
Netherlands	14	21	7	10,373	11,713	1340	740.9	557,8	-183,1
Portugal	188	178	-10	666			3.5		
Spain	570	616	46	6,605	5,150	-1,455	11.6	8.4	-3.2
Sweden	10	14	4	3,206	3,972	766	320.6	283.7	-36.9
United Kingdom	622	456	-166	14,195			22.8		

4 The structure of the dairy chain in Italy

The dairy farm structure in Italy consisted in 2010 of 42 thousand farms with 1,8 million cows, producing 10,8 million ton, the limit imposed by the quota assigned to Italy; the first collectors were 1650 subdivided almost equally between private and cooperatives. At the processing stage operated 1524 cheese plants, 578 second level coops and 69 farm processors and at the distribution stage operated 552 hypermarkets, 9133 supermarket and 187550 small retail stores, (the HO.RE.CA are excluded from this analysis). The next figure reports the value chain of dairy chain at the three levels: the domestic milk production and import amounted to 4730 million €, the industrial value was 14810 € and the retail excluding the GO.RE.CA was 24160 million €.
By assuming the farm value = 100, the value at the industry is 313 and at the distribution is 511, these results suggest some considerations about margin distribution along the chain.

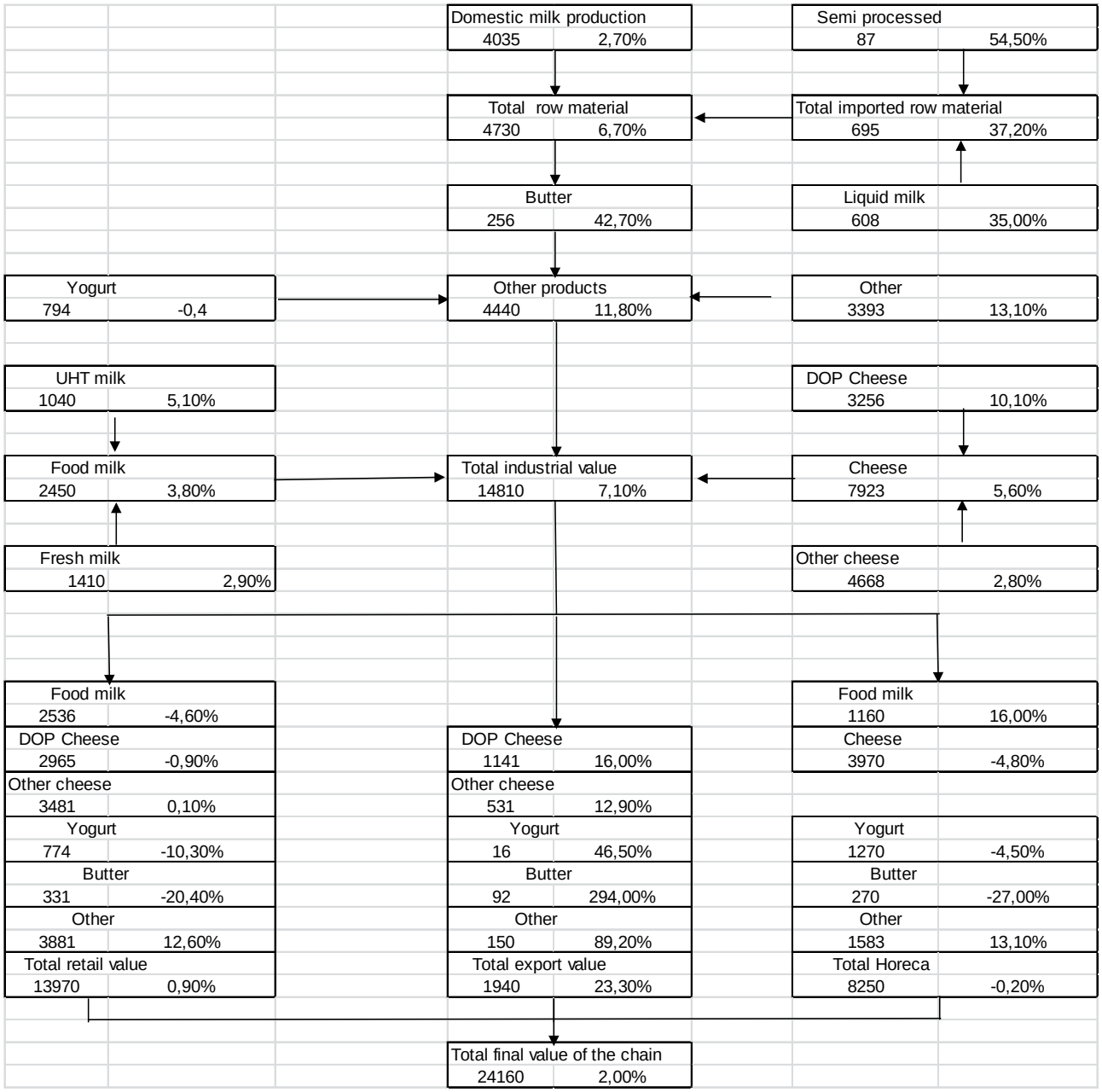


Figure 2. The Dairy value chain in Italy (mio euro)

5 The processing stage

This stage is examined using the data base AIDA that reports the balance data of the Italian firms: the dairy sector is examined using a sample including 213 incorporated societies (IS) with a turnover of 7,4 billion € and 197 coops with a turnover of 2,9 billion. The total turnover of this sample is 10,3 billion and represents the 69,6% of the total dairy processing turnover in Italy at the beginning of 2010. These two groups are split because of different managerial organizations: IS are quite different from the Coops with relevant consequences for the economic and financial results. The IS sample includes firms classified in three groups based on the duration of the production cycles, collection centers and big short cycle societies:

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); for these products, the average ripening period is longer than nine months.

4) collection centers: intermediate collectors of fresh milk;,
5) 14 big short cycle groups (7% of total sample) with a total turnover of 4,7 billion, the 63% of the total. The Gini concentration index of the total sample (IS + Coop) is 0,785, signaling a high level of concentration with the 10% of the major companies covering the 70% of the total turnover .

Table 3. Sample 1 – IS 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

For the purpose of this research we examine the short cycle IS producing mainly milk (and fresh products as yogurt and fresh cheeses) covering a large share of the consumer's expenditure in milk products. The 134 short cycle IS represent in number the 63% of the total IS sample; by adding the turnover of the big short cycle IS, the turnover increased to 6,4 billion euros, that is the 86% of the sample and the 44,4% of the total dairy production. The eight biggest short cycle IS with a turnover greater than 100 million euros covered a total turnover of 3,633 billion euros, the 57% of the short cycle IS sample and the 24,51% of the total dairy sector. The Lorenz curve suggests that these 10% of companies covered the 70% of the turnover (Il mondo del latte p. 382) and the Gini index value was 0,785. These data let us to hypothesize a presence of an oligopolistic control at this stage of the dairy chain.

Table 4. 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

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

Table 5. Sample 2 – 197 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 short cycle coops are: Cooperlat, Milkon and Assegnatari soci di Arborea covering the 20% of the total coop turnover while the three biggest dairy coop with a turnover of 0,48 billion euros cover the 80% of the total turnover and are short cycle coops.

Taleb 6. Sample 3 – Results of the coop

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

A summary of the data representing the structure of the dairy chain is reported here:
Nr of cheese plants: 1524
Nr of coops: 578
Nr of farm processors: 69
Total turnover of the dairy sector: 14,81 billion €

Sample:
Short cycle IS (incorporated societies) = 134 + 8; turnover =6,4 billion €
First 4:quota of total turnover = 81%
Short cycle Coops = 33, turnover = 0,6 billion €
First 3: quota of total turnover = 80%

6 The retail stage

The retail stage is described with reference to the year 2010. The Ismea-ACNielsen collects only domestic purchases used for the analysis of the distributive sector; the HO.RE.CA (restaurant, catering and industrial use of dairy products) are excluded. The highest quota of the dairy products is sold to hyper/supermarket both representing more than 2/3 of the total purchases of milk, butter, yogurt and cheese in the year 2010. The fresh milk expenditure increased by 3,3% at hypermarkets and declined by 5,3% at supermarkets; the total milk purchases at hypermarket remained almost unchanged and decreased by 7% at supermarket; the milk purchases at superette and discount stores were the 13%, a similar quota was detected for traditional retail. Despite the growth of the discount stores in recent years, the market quota still remained at 5,3% of total milk purchased. The distributive network in Italy consists of 522 hypermarkets and 9133 supermarkets and 4000 retailers; despite the economic slowdown, the modern distribution continues to evolve versus higher level of concentration with regional gaps due to economic and geographic differences. The retail sales are higher in the Northern regions; however, the South regions are recovering fast in last years with the highest rate of growth was for super and hypermarkets (+ 4.7%) sales compared to the national average (2.5%). The development of modern distribution (LD) in Italy, has greatly influenced the consumption habits: the share of purchases at super/hyper of the fresh milk is now more than 82% and the UHT milk is 80% (AC Nielsen and Istat reports). The current economic situation has determined the growth of discount stores that increased their sale quota by 9.4% in 2010. The changing structure of the LD, the higher competition and the need to reduce the costs have pushed forward the concentration that is progressing with internal growth or merger and acquisition operations; the most important is now the Centrale italiana composed by Coop, Sigma, and Despar, (Il mondo del latte, 2011 p. 310). The size of large distribution has grown with backward integration of retail stores with the wholesale distribution that represent an integral part of the modern distribution, especially in the

form of Cash & Carry. Few big brand names dominate the market, most of them are foreign brands that operate as well in other EU countries: the top 5 groups cover the 66.8% of the total turnover of the national C & C and four of these largest 5 players operate in retail department stores and the only one specialized wholesale it is also the leader of the sector. (Tieri and Gamba, 2009). The most important groups operating at retail level are: Carrefour (sales in 2011 more than 82,8 billion (7,2 % of market quota), Metro, 66,7 billion, Auchan, 44,4 billion, Leclerc, 40,6 billlion and Rewe, 40,3 billion. The top 4 top groups operating in retail are: Coop (15.3), Conad (10.6%); Selex (8,1%); Auchan (7,8%); all together they cover the 41,8% of total retail; and the first 8 groups represent the 65% of the total sales.

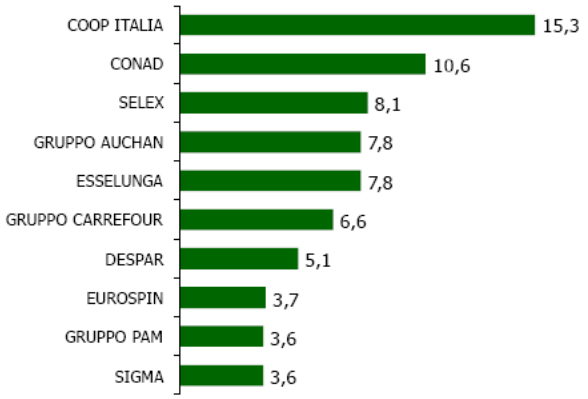


Figure 3. The market quota of the first 10 groups operating in Italy at retail level
Source AC Nielsen 2012

The sale concentration of the first three groups are different in the EU area: 34% in Italy (Coop, Conad, Selex); 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 as Carrefour, Leclerc operate in many EU countries.

The concentration let us to hypothesize some degree of market control facilitated also by the higher fragmentation of the rest of distribution. A further evidence of the chain control is the logistic strategies of the purchasing groups (Centrali d'acquisto) that operate at the industry level and control the storage and distribution of dairy products. The competitive position of the distribution is illustrated with some indexes elaborated on a sample of 32 commercial groups representing the 33,5 of the national turnover.

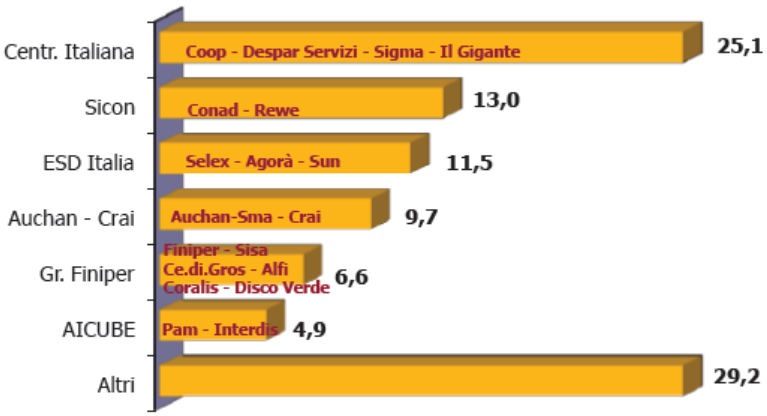


Figure 4. Purchasing groups concentration: % of turnover over the total
Source Nielsen GLC 2012.

These groups are managing the delivery contracts with the Great Suppliers but are excluded from purchases of branded products. For this reason, the weight of the "Centrali" do not exceed the 50% on average, because not all the distribution companies are members of these Groups.
This situation suggests that collusion could create conditions for other types of marketing control in the LD representing more than the 50% of consumers' purchases.
The results of market analysts suggest that the quality of milk is perceived almost standardized from the label reporting the milk composition and consumers are now looking for more convenient products. The price is the main driver of consumer's choice, determining the market share and positioning of larger groups confirming the orientation versus the private label and discount stores. In the next tables are reported the domestic purchases of dairy products, at different market channels with changes of share respect the previous year. As we expected, LD represents the highest quota of expenditure with 75% of fresh milk and 83% of UHT.

Table 7. 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 tab 11.3 p 314 and 11.5 p 317

The price competition among the market channels is suggested by comparing the price of different dairy products assuming the price of hypermarket the reference for the other channels. In table 8, the column "hypermarket" reports the prices of the different dairy products in absolute values while in the other columns the prices are indicated in % difference with hypermarket prices. The supermarkets have prices 4% higher, almost zero is the difference with superette, the lowest prices (-33%) are found for the discount channels, in traditional shops prices are 11,4% higher and in other shops prices are 2,4% higher. For the fresh milk product, the prices are significant lower at hypermarket compared to other channels with the exception for the discount channel.

Table 8. Dairy products: % price differences for market channels *

Product		Price differences % value respect the Iper					
	hypermarket	Supermarket	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
Totale yogurt	3,68	7,07	0,00	-45,65	7,34	-1,09	-1,36
Totale formaggi DOP	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

7 The imperfect competition in the dairy market

As the price of fresh milk passes from 0,30-0,40 €/liter at the production stage to 0,6- 0,8 at processing and from 0,9 to 1,5€/ liter to distribution stage, the question is if whether these values correspond to the prices determined in a situation of market efficiency. The structure of the dairy chain previously discussed suggests to examine the price at different market levels by using a partial equilibrium model to observe if the price setting at different market levels could be affected by the imperfect market conditions.

This observation is important twofold: first to formulate an econometric approach to predict the prices formation and second to estimate the bias in welfare distribution induced by the prices at different market levels. The market power may be analyzed with the multilevel market behavioral models by assuming fixed proportion technology, constant marginal cost and linear demand through the specification of those elements affecting the competition in the equations of price transmission mechanism here reported.

2 $$c*P^p (1 + (EC_p/e_p)) + M = P^c (1 +(EC_c/e_c))$$ then

3 $$P^c – M = (c*P^p (1 + (EC_p/e_p)) / (1 +(EC_c/e_c))$$

4 $$P^c / c*P^p = (1 + (EC_p/e_p)) / (1 +(EC_c/e_c)) + M$$

5 $$d P^c / dP^p = c*(1 + (EC_p/e_p)) / (1 +(EC_c/e_c))$$

These equations suggests that the final price at the consumption of the milk product P^C, and the price of milk at the farm gate P^P, are related by a conversion coefficient c, and are bound by the processing costs M and possible influence of the oligopoly conduct performed by farmer-processor and processor-retailer of agricultural commodities (ratio between the conjectural elasticity EC_P of the dairy farm milk, and supply elasticity of dairy farm milk e_P) and the oligopolistic behavior for the presence of large dairy chains (formalized with the ratio between the conjectural elasticity at retail ECc and the elasticity of final demand e_c). The crucial point of this

analysis is to determine the extent of the market power, represented essentially by the value of the conjectural elasticities EC_C and $EC_{P:}$ the greater the elasticity different from zero, the higher will be the power along the supply chains and the deviation from a regime of perfect competition. While these elasticities, under appropriate restrictions, can be approximated by measures of industrial concentration, and it is possible to obtain reliable estimates of these parameters from the econometric analysis or with Learner index.[3] Other authors have discussed the relations between vertically related, imperfectly competitive market structures, product differentiation, degree of price pass-through, conjectural changes and consumers' welfare variation (Kinnukan and Forker, 1987). By using the conjectural variation in the imperfect competitive industry, it is possible to generate various degree of market imperfections signaled by the price transmission mechanism[4]. Also in this approach the authors demonstrate that only a fraction of the price change is passed through successive stages affecting the margins and the consumer's welfare distribution, that is lower compared to the perfect competition. The literature describes different approaches to the vertical chain for modeling the market power: some studies focus on the wholesale-retail level (Gohin and Guyomard, 2000), others on the farm-processing level (Suzuki and Kaiser, 1997) and others consider jointly the processing ⁄ retailing levels (Chidmi et al., 2005). By modeling a two stage successive oligopoly, the market power can be elaborated at different levels of the vertical chain with n upstream firms processing products used by m downstream firms distributing the final product. Different authors provide a general framework for estimating indexes of market power in a dynamic setting when only industry-level (rather than firm) data are available. (Mc Corriston and Sheldon, 1996). Perloff et al. (2007, Chapter 7) One has to choose the appropriate setting to correctly identify the source of imperfectly competitive behavior modeled as a Cournot competition. Specifically it is assumed: fixed proportion production technology, firms at both stages operate with constant marginal cost; the downstream (retail) enterprise do not exert market power at the intermediate (processing) stage and the consumer demand is linear. (Wu, 1992).

8 Price transmission and the conjectural model

The partial competitive equilibrium model of the dairy sector is framed into the domestic contest (Italy) with the vertical chain 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 assuming the profit maximizing behavior. The number of dairy farms and the fragmentation of the farm supply do not allow to assume a collusive behavior among producers. Farmers with the intervention of their representative associations (Coldiretti, Confagricoltura, CIA, Italatte) could only bargain a price close to the marginal production value of the most efficient producers.

b) processing level: at this stage the behavior of agents involved in processing is profit maximizing. All these vertical relationships are modeled as a single stage; the interest is in modeling the impact on agricultural producers (upstream) and final consumers (downstream), assuming that all the vertical relations within this stage will only affect benefits distribution. Possible evidence of collusive behavior will be demonstrated along the analysis.

c) the retail level follows the approach of the processing level and collusion could also be more evident for the marketing strategies and product differentiation. The final demand for milk

[3] For example, the dairy sector in Italy has been modeled with a partial equilibrium model (Moro, Sckokai and Soregaroli, 2006) which includes the effects of market power.

[4] Although criticised 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 unmodelled dynamic and imperfectly competitive game (Bresnahan, 1989)

product is modeled at this stage as a utility maximizing behavior and consumers do not have any market power. Since in the processing and retailing stages of the dairy chain there are evidences of imperfect competition the model accounts for market power: thus the price transmission mechanism will provide more insight for the vertical transmission of shocks, both at the final level (i.e. the BSE crisis) and at the farm level (i.e.agricultural policy reform) (see Moro and others, 2006). Thus we assume a successive oligopoly paradigm, following the approach suggested by Mc Corriston and Shieldon, (1996). Ottaviano et al. (see Anichiarico, 2008) suggest that the preferences could be modeled by a quasi-linear utility function with a quadratic sub-utility that is assumed to be symmetric in all product varieties and identical across individuals defined as it follows:

6 $$U(q) = q_0 + a\Sigma_{i=1...n}\, qi - b/2\ \Sigma_{i=1...n}\, qi^2 \ - \ g/2\ \Sigma_{i=1...n}\ \Sigma_{j \neq i}\, q_i\, q_j$$

q_i is the quantity of product variety i = 1..N and q_0 is the quantity of the numeraire good. [5]
All parameters are assumed to be positive. In particular the condition b > g > 0, imply that consumers pay attention to the variety and these assumptions ensure that U is strictly concave. The parameter g measures the degree of substitution between varieties so that goods are substitutes, independent or complements according to whether g >, = , < 0. The larger is g, the closer substitutes goods are; if b = g the goods are perfect substitutes and equation (1) becomes a standard quadratic utility defined over a homogenous product. By reducing the n product to one, namely the fresh milk, the consumer behavior can be modeled with a separable quadratic and concave Utility function, linear in the numeraire having the following functional form:

7 $$U(Q_2) = aQ_2 - b/2*Q_2^{\,2}$$

Q_2 is the supply of liquid milk at the consumption stage; a and b are the parameters of the Utility function and the subscript 2 indicate the final stage of the dairy chain. The consumer's optimization is based on the equality between marginal utility $dU/(Q_2)$ and price P_2:

8 $$a - bQ_2 \ = \ P_2$$

that is the inverse demand function. The profit of the firm ith operating at the final stage is:

9 $$\Pi_{2i} = (P_2 - C_{2i} \ - \alpha P_1)\ q_{2i}$$

P_2 is the price of milk at the final stage, P_1 is the price of milk at the processing level, C_{2i} is the marginal constant cost[6]; q_{2i} is the quantity produced by the representative firm I, □□ is the ratio that represent the quantity of the industry product used to produce one unit (1 liter) of fresh milk to consumption. Ignoring the subscript i, the profit maximizing condition for the representative firm is:

10 $$d\,\Pi_2 / dq_2 = \ (P_2 - C_2 \ - \alpha P_1) + q_2\ (\ dP_2/\ dq_2) \ = 0$$

Assuming n_2 symmetric firms at stage 2 and aggregating the above condition we obtain:

[5] 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, which captures all the variations in income level. See Vives (1999) and Ottaviano et al. (2002) for details.
[6] At given condition marginal cost is assumed to be equivalent to average cost

11 $$(P_2 - C_{2i} - \alpha P_1) - Q_2 D_2 = 0$$

D_2 incorporates the slope of demand function (negative dP_2/ dq_{2i}) and the strategic interaction among the n_2 firms with conjectural variation term for a representative firm having the form:

12 $$D_2 = b/n_2 (1 + (n_2 - 1)) V_2$$

The conjectural variation term V_2 is what the representative firm expects about the rival reaction to his own change in supply at retail level[7]. In the repeated game played by a firm, the outcome will depend on the type of conduct ranging from competitive to collusive behavior depending on the interaction among firms. Then three situations are possible:
i) collusive conduct: 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 formation will follow the monopolistic model;
ii) perfect competition: (Bertrand), 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 behavior: the rivals do not react to the change in supply of the representative firm then the value of Vi will be: Vi = 0.

With substitution of the value of Q_2 in the inverse demand 7 into 10 we obtain:

13 $$P_2 = (b /(b + D_2)) (\alpha P_1 + C_2 + a/b D_2)$$

By substituting the value P2 from equation (7) into equation (10) and expressing the value of Q2 in terms of Q1 the derived inverse demand function for milk at industry is:

14 $$P_1 = (a - C_2) / \alpha - ((b + D_2) / \alpha^2) Q_1$$

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

15 $$\Pi_1 = (P_1 - C_1 - \delta P_0) q_1$$

P_0 is the milk price at the farmers level used by industry processor , C_1 is the marginal cost of production and δ that indicates the amount of farmer's milk used to produce one unit of processed milk. The profit maximizing condition for representative industry processor is

16 $$d \Pi_1 / d q_1 = (P_1 - C_1 - \delta P_0) + q_1 (d P_1 / d q_1) = 0$$

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

17 $$(P_1 - C_1 - \delta P_0) - Q_1 D_1 = 0$$

[7] There are several types of oligopoly. When all firms are of (roughly) equal size, the oligopoly is said to be symmetric; when this is not the case, 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.

The term D_1 incorporates the slope of the derived demand of milk at the industry level, and strategic interaction among firms at stage 1 that is the conjectural variations parameters V_1 . Hence D_1 is:

18 $$D_1 = (b + D_2) / n_1 \alpha^2 * (1 + (N_1 - 1) V_1)$$

The calculation of V1 is similar to V2; with substitution of the value of Q1 from equation (16) into derived inversed demand equation 13 we obtain:

19 $$P_1 = ((a - C_2)/ \alpha D_1) + ((b + D_2)* (\delta P_0 + C_1) / (\alpha^2 D_1 + b + D_2)$$

From equation (12) and (18) is elaborated the price transmission equation distribution/farm:

20 $$dP_2/dP_0 = dP_2/dP_{1*}dP_1/dP0$$

The two partial derivatives are obtained from equations 12 and 16 are:

20.1 $dP_2/dP_{1 =} \alpha*b/(b + D_2)$

20.2 $dP_1/dP_{0 =} (b + D_2) \delta *(\alpha^2 D_1 + b + D_2)$

Finally the transmission equation is:

21 $$dP_2/dP_0 = (b* \alpha* \delta) /(\alpha^2 D_1 + b +D_2$$

And with substitution of D_1 and D_2 the final transmission equation is:

22 $$dP_2/dP_0 = (\alpha* \delta * n_{1*} n_2) / ((n_2 +1) + (n_2 -1) V_2) * ((n_1 +1) + (n_1 -1) V_1)$$

This equation suggests that the price transmission from farm (Po) to processing (P1) and retail levels (P2) of the dairy chain is a function of the number of firms at the final (retail) and processing stages; the degree of market imperfection causing imperfect price pass through is consequent to the collusive behavior of firms at these two stages. By assuming $\alpha = \delta$ = 1 meaning that one unit of milk at the dairy farm corresponds to one unit of processed milk and one unit of processed milk corresponds to one unit of final milk. [8] we can say that, the price transmission will depend only by the number of firms operating at different levels and conjectures about their collusion: V1 for processors and V2 for retailers. The degree of price transmission ranges in theory from a minimum 0,25 to a maximum 1, corresponding to the two extremes of the behavioral models. With collusion, the Vi's (i = 1,2) tends to 1 and degree of price transmission will collapse to 0,25, with competition Vi tends to 0, the value of price transmission will approach to 1 and firms would behave as predicted by Cournot Nash model. Then the price transmission will fluctuate in the range between 0,25 to 1 depending on the number of firms and their degree of collusion; with the increase in the number of firms, the value of V1 and V2 tend to decrease showing higher competition. (Deodhaar and Fletcher, 1998)

Source CRPA and Il Mondo del latte (ref file igls-dairy chain value Italy-1 page 2)

[8] 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. In our case it is assumed $\alpha = \delta = 1$ since the quantity of fresh milk remains the same through the chain.

9 Results

The previous analysis provides the information to evaluate the price transmissions across the dairy chain. The values of the fresh milk conversion coefficients □ from farm to processor and □ from processor to retailer are assumed to be 1 because fresh milk passes from farm to retail without significant losses in volume. The next table reports the main features of the dairy chain

Table 9. 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)	0,5	Price at farming level (average 2010)
P_1 (Price at processing level)	0,65	Price at processing level
P_2 (Price at retail level)	1,25	Price at retail level fresh milk
	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
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	2171	Including cheese plants farm coops and farm processing plants
P_1- C_1 / P_1	0,08	Lerner index at processing stage calculated on the first 4 with mediana
Gini index	0,78	Concentration of production
C4	81%	
	Retail	
n2	9685	Number of symmetric firms at retail stage (Hyper and supermarkets)
P_2- C_2 / P_2	0,36	Lerner index at retail
C4	41,4	Concentration index first 4 firms

The Gini index at retail level is calculated on a sample of 410 firms in 2010 of which 213 are IS and 197 cooperatives (Il mondo del latte, 2011, p. 381)

The analysis was performed by assuming three concentration levels calculated with respect to the total market sales respectively: 1) 40-50%; 2) 60-70%; 3) 71-80%; these values were maintained for the three levels of the dairy chain. These values are reported in the following table.

Table 10. Number of firms for given levels of concentration in the Italian dairy chain

Number of enterprises	sector		
	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%

The oligopolistic competition is simulated by assuming the values of V1 and V2, representing the conjectures of the representative firm against its rivals at the level 1 and 2 of the dairy chain. The oligopoly condition will depend on the type of agreement among firms ranging from: a) strong collusion among firms, with a monopolistic market condition: Vi = 1 for i = 1,2; b) Bertrand behavior: the firms are price takers, their collusive behavior will not have consequences for the market price determination; in this case Vi = -1/(ni -1); c) the Cournot Nash behavior: the rival firms will not react to the output change of the leading firm; the value of Vi = 0. The following table reports six simulation of oligopoly conditions and consequences for the changes in price transmissions.

In the first successive oligopoly simulation it is assumed that both players strongly collude together then V2 =V1 = 1 causing the lowest price transmission that decreases with the increase of market concentration: the values range between 0,38 for lower concentration to 0,29 for higher concentration. The change in concentration do not cause major changes in pass through values since the increase in market concentration is counterbalanced by the higher number of firms especially at the processing level that increase the internal reactions.

For the second simulation it is assumed that at retail level there is a monopoly condition at retail and competition at processing level, then V2 = 1 and V1 = 0; this market asymmetry causes an increase in pass through values that range between 0,60 for lower concentration to 0,58 with higher concentration. With the third simulation it is assumed a monopoly at retail, V2 = 1 and a Bertrand behavior at processing level (V1 = -1/(n_1-1). The pass through value range from 0,75 for lower concentration to 0,58 for higher concentration. With the fourth simulation, it is assumed a monopoly condition at processing level and no power at retail. The pass through values correspond to the previous condition. With the fifth simulation it is assumed V1 acting as a monopolist and V2 with Bertrand behavior; the pass through is passing from 0,83 with 60-70% of concentration to 0,70 with 71-80% concentration.

Finally the sixth simulation assumes both to behave as in almost competitive conditions causing the highest value of price transmission.

The simulation results confirm the behavioral hypothesis of successive oligopoly that the price transmission improves by passing from perfect collusion between processors and distributors to the perfect competition. The results of the price pass through can be used to make the price setting along the chain using the margin that is the 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 are estimated and vary in the range between the minimum 0,35 with simulation

1, assuming V1 = V2 = 1 and concentration is set to 71-80% and the maximum 0,5 obtained with simulation 6 with concentration equal to 40-50% and 71-80%. The average price in Italy is close to 0,40 cent/liter then the most approximate market structure is the one indicated by simulation 1 and concentration 40-50%; simulation 2 shows the prices around 0,44, with simulation 3, 4 and 5 the prices behaves similarly and simulation 6 shows the highest price transmission. The conclusion is that simulation 1 and 6 show the lowest and highest prices while with the other market conduct the price differences are not so relevant.

Table 11. -Simulation of price transmission with different conjectural hypotheses and concentration levels in dairy chain

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

10 Oligopoly and welfare gain of the consumer

The effects of oligopoly conducts are also evaluated in terms of welfare change for consumers. Using the linear demand function (equation 7) the consumer's welfare gain is measured with the consumers' surplus (CS) variation that is the area under the retail milk demand that will change according with the milk price variation. The price change ΔP from P_{22} to P_{21} will determine an increase in quantity from Q_{22} to Q_{21} corresponding to ΔQ.

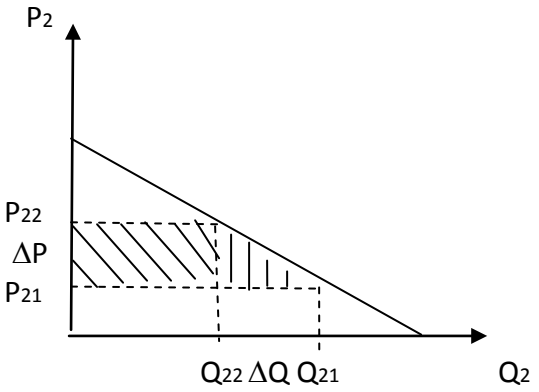


Figure 5. Demand at retail and change in consumer's surplus to price change at farm level

The change in CS depends on the price change:

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

By substituting ΔP in ΔP_0 from equation 21 and ΔQ with the demand elasticity for milk at retail level η_d it is derived the following equation:

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

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

19 $$\Omega = dP2/dP_0 * \Delta P_0 = (\alpha * \delta * n_1 * n_2) / ((n_2 +1) + (n_2 -1) V_2) * ((n_1 +1) + (n_1 -1) V_1) * \Delta P_0.$$

To compute the changes in consumer's surplus corresponding to a change in farmer's 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) (α) 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) η_d milk demand elasticity at retail level;
viii) reaction equation dP2/dPo to a change in ΔP_0;
ix) P_{22}, Q_{22}, price and quantity of milk consumed at retail level [9].

All these parameter values are drawn from different statistical sources and used to compute the consumer's surplus in absolute and % changes under different market regimes. (see table 13).

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

To check the sensitivity of the estimates with respect to change in parameters we have performed ten simulations, the first one is the baseline and is used as the reference for the others; each simulation is performed at two concentration levels. The changes in parameter value for each simulation are reported in red. The results are summarized as it follows:

1) With near to monopoly conditions (V2 = V1 = 1) the highest market control by processors and retailers, the following CS effects are detected with see simulation 1,2,3:

- the change in demand elasticity had a limited impact over the consumer's surplus at both concentration levels: passing from 1 to 2 (abs values) the change in CS was only 0,15%;
- simulations 4,5,6 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 effects of different conducts on CS change are considered with simulation 7..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 respect the beginning value and concentration has no effect;
  simulation 9 assumes control at processing and no control at retail: the effect are the 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 given the best CS respectively 2,4 and 2,97 higher respect the beginning at the two concentration level and equivalent □Po.
  These results demonstrate that as the degree of market control increases, the consumer's surplus decreases for a given level of price reduction.

Table12. Simulation of changes in consumer's surplus with two level of concentration (in red the changes of 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
α	1	1	1	1	1	1	1	1	1	1
δ	1	1	1	1	1	1	1	1	1	1
P0	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
ηd	-2	-1,5	-1	-1	-1	-1	-1	-1	-1	-1
V1	1	1	1	1	1	1	0	-0,3333	1	0
V2	1	1	1	1	1	1	1	1	0	0
ΔP0	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
ΔCS	0,01	0,01	0,01	0,01	0,02	0,03	0,01	0,01	0,01	0,02
ΔCS 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%									
α	1	1	1	1	1	1	1	1	1	1
δ	1	1	1	1	1	1	1	1	1	1
P0	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
ηd	-2	-1,5	-1	-1	-1	-1	-1	-1	-1	-1
V1	1	1	1	1	1	1	0	-0,1429	1	0
V2	1	1	1	1	1	1	1	1	0	0
ΔP0	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
ΔCS	0,01	0,01	0,01	0,01	0,02	0,03	0,01	0,01	0,01	0,02
ΔCS index	100,00	99,93	99,85	200,00	300,45	401,20	177,72	200,00	166,58	296,72

11 Conclusion

This research analyzed the dairy chain in Italy using a successive oligopoly model to explain the consequences of the dairy chain structure for the conduct and price transmission signaled by the value of pass-through across the chain, and welfare distribution. For this research it was used a modified version of Mc Corriston and Sheldon model applied to the dairy chain using the prices of the fresh milk product. The market competition and price transmission was affected by the behavior of operators at different chain levels depending on the number of competitors at processing and retail levels and their degree of collusion. For the analysis of the welfare distribution more market information were needed: the consumer demand and elasticity, and the magnitude of price differences at the farm level; these information were not estimated but obtained from many sources. The analysis demonstrated that the degree of price transmission along the vertical chain and the consumer's surplus distribution were both affected by market conditions. While demand elasticity had a modest effect on CS changes, the market power and the price changes at farm level were the most important determinants of welfare distribution. The suggestions for the policy analysis are: being the farm prices important in determining the CS change, and farmers having a limited bargaining power to control the prices, due to the great heterogeneity of dairy farms, the price support still remain an important political tools, to reduce the losses in welfare. In the absence of any intervention a consistent number of producers will leave the sector and the dairy chain will continue to concentrate, specialize and localize in some specialized areas of the territory with a greater impact on soil and other negative externalities. With the scale economy it is possible to predict this change: for a price below 30 cent/liter only the 20% for dairy farms with more than 100 heads will survive to the liberalization of the dairy

sector in absence of any intervention [10] At this point it is useful to consider how the formal model outlined above might usefully be 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. (1998) have developed a model that allow 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 decreased as the downstream sector becomes less competitive. Second, the downstream technology has been assumed to be one where there are constant marginal costs, yet industries defined 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 (McCorriston et al. (2001). Third, the successive oligopoly has been incorporated into the model underlying the numerical simulation based upon the assumption of linear inverse agricultural supply function, resulting in less than perfect pass-through of changes in the agricultural commodity price.

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

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